



SINGAPORE INSTITUTE OF MANAGEMENT

Diploma in Management Studies ECO2101 Microeconomics

Study Guide

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Study Guide

Module Name

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Module Book

MICROECONOMICS

INTRODUCTION

Content

This module introduces the participants to the problem of scarcity and to choice and decision-making by rational individuals, firms and the government in the context of this scarcity problem. The decisions by these economic units will, in turn, impact on the allocation of scarce resources in the society. In the exposition, the participants will be introduced to ideas relating to the demand function, the supply function, the cost function, the indifference curve, utility function and other relevant economic concepts. Of particular importance are the concepts of economic efficiency and welfare maximization.

The participants will also be exposed to a variety of market structures and to how firm(s) navigate the different market environments with a view to realizing their economic interest. In the process, the participants will be introduced to simple matrix games and the prisoner's dilemma problem. The impact of externalities on market efficiency and the different ways to resolve these problems will also be analyzed.

Module Aims

The aims of this module are to:

1. Provide participants with a fundamental understanding of core economic principles such as trade-off, opportunity cost, diminishing marginal returns, resource constraint, and net benefit maximization.
2. Assist participants to appreciate the economic rationale behind individuals' and firms' decision-making.
3. Assist participants to appreciate the economic thinking behind public policies.

Learning Outcomes

On completion of this module, a participant will be able to:

1. Show a detailed knowledge and understanding of:

- i) Economic problem of scarcity and the concept of opportunity cost;
- ii) Factors influencing demand and supply of goods and services;
- iii) Budget constraint, indifference curves, and utility maximization;
- iv) Price elasticity of demand, price elasticity of supply, income elasticity, and cross elasticity;
- v) Cost functions and production functions of firms;
- vi) Characteristics and welfare implications of the four market structures – perfect competition, monopoly, monopolistic competition and oligopoly; and
- vii) Positive and negative externalities.

2. Demonstrate module specific skills with respect to:

- i) Using the production possibility frontier model to illustrate the concept of opportunity cost;
- ii) Making use of utility concepts and indifference curves to explain how consumers maximise utility and how the law of demand is derived;
- iii) Explaining how the law of diminishing marginal returns and the law of returns to scale affect the shape of a firm's short run and long run cost functions respectively;
- iv) Differentiating between a firm's short run costs and long run costs of production;
- v) Explaining how firms in the four different market structures determine price and output decisions in order to maximize profits;
- vi) Solving the prisoner's dilemma game and other game situations; and
- vii) Explaining the government's solutions to deal with both positive and negative externalities.

3. Show cognitive skills pertaining to:

- i) Analyzing how a change in the determinants of demand and supply affect the equilibrium price and equilibrium quantity in a market;
- ii) Applying the different elasticity concepts to business decisions; and
- iii) Analyzing how firms in the four different market structures would compete given the different market characteristics.

4. Demonstrate transferable skills in:

- i) Analytical reasoning;
- ii) Economic thinking in the context of decision-making and public policies;

- iii) Problem formulation and decision making; and
- iv) Working with others.

Delivery of Module and Lesson Plan			
Session	Topic	Session Learning Outcomes	Prescribed Text, Readings &/or Activities
1.	Introduction to Economics	1. Define economics and distinguish between microeconomics and macroeconomics 2. Define resources and understand marginal analysis 3. Define the production possibility frontier and calculate opportunity cost 4. Distinguish between production possibility and preferences and understand the essential meaning of an efficient allocation of the available resources 5. Illustrate the impact of economic growth on the production possibility frontier	Microeconomics Module Book Session 1
2	Demand and Supply	1. Define Demand 2. Distinguish between a change in demand and a change in quantity demanded 3. Explain the factors that influence demand 4. Define Supply 5. Distinguish between a change in supply and a change in quantity supplied 6. Explain the factors that influence supply	Microeconomics Module Book Session 2
3	Market Equilibrium & Efficiency	1. Explain how demand and supply determine the market equilibrium price and quantity 2. Use this supply-demand framework to make predictions about how the equilibrium price and quantity of a product will be affected as demand and/or supply conditions change. 3. Explain the connection between demand and marginal benefit and define consumer surplus 4. Explain the connection between supply and marginal cost and define producer surplus	Microeconomics Module Book Session 3

Delivery of Module and Lesson Plan			
Session	Topic	Session Learning Outcomes	Prescribed Text, Readings &/or Activities
		5. Explain the conditions under which the market mechanism will lead to an efficient allocation of resources	
4	Elasticity	1. Define, calculate, and explain the factors that influence the price elasticity of demand 2. Explain the relationship between price elasticity of demand and total revenue 3. Define, calculate and explain the factors that influence the cross (price) elasticity of demand and the income elasticity of demand 4. Define, calculate, and explain the factors that influence the elasticity of supply	Microeconomics Module Book Session 4
5	Utility and Demand	1. Explain what limits a household's consumption choices 2. Describe preferences using the concept of utility and distinguish between total utility and marginal utility 3. Explain the marginal utility theory of consumer choice 4. Use marginal utility theory to predict the effects of changing prices and incomes	Microeconomics Module Book Session 5
6.	Possibilities, Preferences & Choices	1. Describe the budget line of a household with a given outlay 2. Show how it changes when prices and/or income change 3. Understand the concept of an indifference curve 4. Construct a preference map using indifference curves 5. Explain the optimal consumption choice	Microeconomics Module Book Session 6

Delivery of Module and Lesson Plan			
Session	Topic	Session Learning Outcomes	Prescribed Text, Readings &/or Activities
7.	Output & Costs	1. Explain the objective and profit of a firm 2. Distinguish between short run and long run analysis 3. Explain the relationship between output and labour employed in the short run 4. Explain the relationship between output and cost in the short run and derive the short-run cost curves 5. Explain the relationship between output and cost in the long run and derive the long-run average cost curve	Microeconomics Module Book Session 7
8.	Perfect Competition	1. Define perfect competition 2. Explain how firms make their supply decisions and why they sometimes shut down temporarily and lay off workers 3. Explain how the price and output level in an industry are determined and why firms enter or leave the industry 4. Predict the effects of a change in demand 5. Explain why perfect competition will tend to lead to efficient outcomes	Microeconomics Module Book Session 8
9.	Monopoly	1. Explain how a monopoly arises and distinguish between a single-price monopolist and a price-discriminating monopolist 2. Explain how a single-price monopoly determines its output and price 3. Compare the performance and efficiency of a single-price monopoly with a perfect competitive market structure 4. Explain how price discrimination increases profit	Microeconomics Module Book Session 9
10.	Monopolistic Competition	1. Define and identify an industry characterized by monopolistic competition	Microeconomics Module Book Session 10

Delivery of Module and Lesson Plan			
Session	Topic	Session Learning Outcomes	Prescribed Text, Readings &/or Activities
		2. Explain how output and price are determined in a monopolistically competitive industry 3. Compare between monopolistic competition and perfect competition 4. Explain why advertising costs are high in a monopolistically competitive industry	
11.	Oligopoly	1. Define and identify oligopoly 2. Explain the Kinked Demand Curve Model 3. Use game theory to explain how price and output are determined in oligopoly 4. Define a prisoner's dilemma game 5. Use game theory to explain other strategic decisions	Microeconomics Module Book Session 11
12.	Externalities & the Environment	1. Explain how externalities arise 2. Explain why negative externalities lead to inefficient output levels (overproduction) and how property rights, emission charges, marketable permits, and taxes can be used to achieve a more efficient outcome 3. Explain why positive externalities lead to inefficient output levels (underproduction) and how public provision, subsidies, vouchers, and patents can improve economic efficiency	Microeconomics Module Book Session 12

Teaching and Learning Methods
Lectures are used to emphasize the key economic principles that explain the logic underlying the important economic tools. Current local and international examples will also be provided to highlight the proper use of these tools in analysis.

Activities are used to discuss the concepts taught during the lectures. Participants are to work out the answers to the questions in the activities. Participants are also encouraged to make use of relevant websites and the Internet when doing their research for the assignments. Participants are expected to learn independently through additional self-paced reading and directed study beyond the taught classes.	
Indicative Readings	
Textbooks required	Tan Khay Boon, Microeconomics, SIM Global Education, 2015
Supplementary Reading	Parkin, M. (2012). <i>Microeconomics with MyEconLab: Global Edition</i> , 10th Edition, NJ: Pearson. ISBN-13 978-0-27-37-5398-8
Online Journals	Use of online databases like EconLit and references to: <i>Microeconomics</i>
Assessment/coursework All assessments must comply with the SIM Rules and Regulations. To satisfy module requirements, students must: 1) Satisfactorily complete and present on due dates their completed assignment. A penalty of 20% of the total marks will be imposed for late submission. A submission later than 1 calendar day past deadline will receive a zero mark. 2) Complete all assignments and the final examination in a satisfactory manner. 3) Reference all their work and observe SIM's policy on plagiarism. Students found guilty of plagiarism will be dealt with severely. 4) Adopt either the Harvard or APA (American Psychological Association) Referencing Styles. 5) Spend at least 100 hours (including class attendance and assignments) on the module in order to fare reasonably. Specific for this module are the following requirements:	
Weighting between components A and B - A: 60% B: 40%	
Element Description	% of Assessment
Component A (Controlled Conditions)	
Examination (120 minutes)	60%
Component B (CA: Continuous Assessment)	
CA 1	40%
CA 2	

Total	100%

MICROECONOMICS

SESSION 1

INTRODUCTION TO ECONOMICS

At the end of the session, students should be able to:

1. Define economics and distinguish between microeconomics and macroeconomics
2. Define resources and understand marginal analysis
3. Define the production possibility frontier and calculate opportunity cost
4. Distinguish between production possibility and preferences and understand the essential meaning of an efficient allocation of the available resources
5. Illustrate the impact of economic growth on the production possibility frontier

1. Introduction

In this session, we begin with a definition of economics and the classification of economics. Next we discuss resources, scarcity and choices and explain the concept of benefit-cost analysis and marginal analysis. Then we introduce the framework of production possibility frontier and use the framework to illustrate the concept of opportunity cost and efficiency. Finally, we apply the concept of production possibility frontier to explain economic growth.

2. Fundamental Economics Concepts

Economics is a social science focuses on how a society manages its limited resources to produce output and how to distribute output to the people in the society.

2.1 Classification of Economics

Economics is broadly classified into two groups: Microeconomics and Macroeconomics

Microeconomics is the study of economics in an individual sense. It involves the study of the behaviour of an individual consumer in making choices, the behaviour of an individual firm in making decision on price and quantity of output, the behaviour of an individual market in determining the price and quantity of a product. It also involves analysing the behaviour of the government in making decisions and the behaviour of the society in responding to an issue. The focus on microeconomics is on consumers and firms decision making processes and how they interact in a specific market, sometimes with influence from the government and the impact on the society.

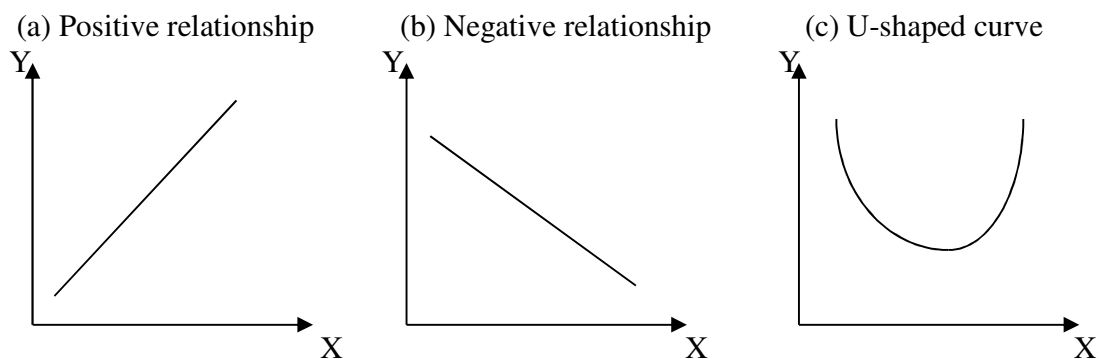
Macroeconomics is the study of economics in an aggregate sense. It involves the analysis of all consumers together in aggregate consumption, the analysis of all firms together in aggregate production and the analysis of the prices and quantities all products in all markets. In other words, it is the study of the performance of a country as a whole. The focuses on macroeconomics are on the general price of goods and services in a country, the employment in a country, the economic growth and the distribution of income in a country. It also concerns with the actions of government in implementing policies that will affect the growth and distribution of income in the economy, as well as the interaction between an economy and the rest of the world in international trade and finance.

2.2 Assumption of Economics

In real life economic analysis are often very complicated and many issues tend to affect each other. To simplify the analysis of an economic incident, economic agents often single out one major issue to explore in relation with the incident, assuming the other issues which may also affect the incident remain equal or constant.

The assumption of other things equal is known as the "ceteris paribus" assumption. The advantage of making this assumption is that when two issues are singled out, they can be expressed in a diagram form or an equation form that will make the analysis easier to be conducted and understood. The common relationships between two issues X and Y are shown in the following diagrams:

Figure 1.1: Common Relationship In Economics



In Figure 1.1, Panel (a) portrays a positive relationship between the two issues where Y increases as X increases. One such relationship is supply discussed in Session 2. Panel (b) shows a negative relationship between the two issues where Y decreases as X increases. This is represented by demand in Session 2. Panel (c) reflects a relationship where Y decreases and then increases as X increases. This is analyzed in cost curves in Session 7.

2.3 Economic Analysis and Economic Statements

There are two types of economic analysis, known as positive analysis and normative analysis. The statements that arise out of the analysis are known as positive statement and normative statement respectively.

Positive analysis involves analyzing the facts of an incident and make a statement in the form of "What is". Thus a positive statement can be tested to verify the facts. For example, a statement "The price of car in this year has increased by 5% compared to last year" is a positive statement since it is possible to verify whether the price of car has increased or not.

Normative analysis involves analyzing the situation of an incident and make a statement in the form of "What ought to be". The analysis involves value judgement based on the value of the party that makes the analysis. It is not possible to verify since different people have different value judgement. For example, the statement "The price of car is too high" is a normative statement since it may be too high from a consumer point of view but may not be too high from a seller point of view. There is no way to verify whether the statement is valid or invalid.

In economic analysis, it is important to make positive statement instead of normative statement.

2.4. Resources

Human have desire for goods and services; known as their wants. Goods are tangible, such as food, while services are intangible, such as transportation. They both contribute to human wants. To produce the goods and services to satisfy the wants of the people, resources or factors of production are needed. Thus wants are the unlimited desires that people have for goods and services.

There are four main types of resources in a typical economy. They are:

- (a) Land: Land refers to the physical ground that plants and animals are living and buildings can be built on it. It also refers to the natural resources such as oil, mineral deposits and other possessions such as river, lake and sea that are created by nature.
- (b) Labour: Labour refers to the human effort in producing output, represented by the number of workers in the labour force.
- (c) Capital: Physical capital refers to man-made machines that use to facilitate the production of goods and services. It includes all the simple and complex tools, offices and building and infrastructures such as airport. The productivity of capital is dependent on the level of technology. Technological improvement leads to more sophisticated physical capital being produced.

There is another type of capital known as human capital. It refers to the knowledge and skills of the workers that enhance the efficiency of labour resource in the production process. Human capital is often embedded with the labour resource to produce goods and services and it can be enhanced through training and education.

(d) Entrepreneurship: Entrepreneurship refers to the human effort to organize land, labour and capital to produce useful goods and services. The individual that provides this ability is known as an entrepreneur. An entrepreneur acquires the land and raw materials, employ the labours, obtain the machines, apply the technology and coordinate among all the resources to produce goods or services to sell to consumers. Without the entrepreneurs, many land and labour resources may be left idle and capital goods may not be produced.

2.5 Scarcity, Choice and Opportunity Cost

Scarcity means the society has less to offer than people wish to have. Regardless of the size of an economy, its resources endowed are always limited. However, human wants are unlimited in that people always desire for more goods and services. The resources endowed in any economy are insufficient to produce all the goods and services to satisfy all the wants. Thus resources are scarce and this create the problem of scarcity.

Due to scarcity in resources, people have to make choices. This means whenever an individual makes a choice, the individual will have something but must give up something else. There is sacrifice and hence cost is incurred whenever a choice is made. The value of the next best alternative that we give up represents a cost of our choice. This cost is known as the opportunity cost.

When an individual makes a choice, he or she will select the option that provides the highest benefit relative to the cost. The value of the second-best option is the opportunity cost of the choice selected by the individual. For example, a consumer has \$10 to spend and he is considering a shirt or a book. His preference is firstly the book, follow by the shirt. Hence he spend his \$10 on the book. The opportunity cost of buying the book is the shirt, which is the next best alternative of using the \$10.

When an individual is making a choice, there may be more than one alternative that need to give up. The opportunity cost of this choice is only the value of the next best alternative that needs to give up, not the value of all alternatives forgone. In the earlier example, suppose the consumer has three products to consider for the \$10, a shirt, a book and a burger. His preference is the book, follow by the shirt and finally the burger. He will buy the book since it is his most preferred product, and the opportunity cost is still the shirt, not the shirt plus the burger.

Note that opportunity cost need not always expressed in monetary value. For example the opportunity cost of spending one hour in studying is the next best use of that one hour, which could be exercising.

3 Rational Choice and Marginal Analysis

Choices are guided by incentives and there are two types of incentives, positive incentive and negative incentive. Positive incentive refers to choice that provide benefits to the individuals and will induce the individual to select the option. On the other hand, choice with negative incentive will result in costs incurred by the individual and will prompt the individual to avoid the option. This gives rise to the benefit-cost analysis in decision making process.

3.1 Rational Choices and Benefit-Cost Analysis

The objective of an individual is to maximize his or her own welfare. Since individuals need to make the choices, they will need to make rational choices to maximize their own welfare. Every choice provides some benefits to the individual but incur some costs to the individual too. Thus welfare can be measured by benefit less cost, or net benefit.

For example, when an individual decides to spend \$10 to buy a shirt, an individual has the benefit of wearing the short but have to give up the \$10 which can be used for other goods or services. This the individual needs to weigh up the costs and benefits of any activity. If the benefits exceed the cost, the individual will select the activity. If the benefit is less than the cost, the individual will avoid the activity. If there are many activities with benefit exceeds cost, the individual will choose the activity which has the greatest benefit relative to its cost, including opportunity cost.

3.2 Marginal Analysis

Once an activity is decided, the individual also needs to determine to what extent the activity should be involved. For example, how many units of a product should a consumer consume or how many units of a product should a supplier produce? The rational choices involve weighing up marginal costs and marginal benefits.

Marginal benefit is the additional benefit of doing a little bit more (or one more unit) of an activity. Usually when the quantity of an activity increases, the marginal benefits tend to decrease. Marginal cost is the additional cost of doing a little bit more (or one more unit) of an activity. Usually when the quantity of an activity increases, the marginal cost tend to increase. Constant marginal benefit or marginal cost may be assumed for simplicity in some situations.

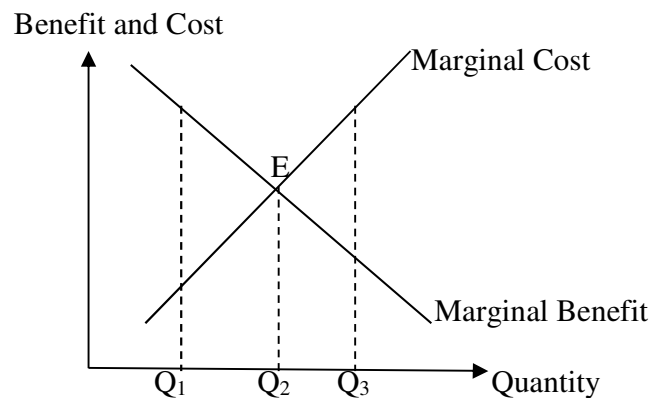
If the marginal benefits of an activity exceeds its marginal cost, a rational person will want to pursue more of the activity. However, if the marginal cost of an activity exceeds its marginal benefit, a rational person will want to reduce the quantity of the activity

In other words, as long as the marginal benefit exceeds the marginal cost, a rational agent should increase the level of activity. Conversely, if the marginal benefit is less than the

marginal cost, the agent will be better off if he reduce the level of activity. The optimum level of any activity is at the level when marginal benefit equals marginal cost.

Consider an individual deciding on the quantity of an activity. The marginal benefit and the marginal cost of the activities are represented diagrammatically in Figure 1.2. The marginal benefit curve is downward sloping while the marginal cost curve is upward sloping. Starting from a small quantity such as Q_1 , the marginal benefit is larger than the marginal cost and it is beneficial to increase the quantity. But in a large quantity such as Q_3 , the marginal cost exceeds the marginal benefit and it is beneficial for the individual to reduce the quantity. The optimal quantity is when the marginal benefits equals the marginal cost, which is Q_2 .

Figure 1.2: Marginal Analysis and Optimum Quantity



4 Economics Systems

In view of the scarcity in resources, an economy will have to solve three fundamental problems:

- (a) What to produce

Since resources in an economy are limited, it is important to decide on the way to use the resources. For example, should a piece of land be used to produce rice or to build a factory, or should the worker work in the farmland or in the factory?

- (b) How best to product

After deciding what product to produce, the economy also needs to decide on how to produce the product as there could be more than one method to produce the product. For example, should more labour be used in the production with few physical capital or should the production involve more physical capital with few workers?

(c) For whom to produce

The limited resources produce a limited amount of goods and services. It is likely that there are more consumers than the amount that is produced. So the economy will need to decide on how to distribute the limited goods and services to its consumers.

There are different methods to deal with scarcity, depending on the economic systems implemented by the economy. There are three basic economic systems, the command economy, the free market economy and the mixed economy.

4.1 The Command Economy

In a command economy, all economic decisions are made by the government. It is usually associated with a socialist or communist economic system, where land and capital are state owned. The state allocates the resources of the economy, plans the output of each industry and firm and distributes the output between consumers.

The command economy has the advantage of relying in the decisions of a few politicians that may be in the interests of society as a whole. It could direct the nation's resources in accordance with specific national goals. High growth rate could be achieved if the government directed large amount of resources into investment.

4.2 The Free Market Economy

In a free market economy, there is no government intervention at all. All decisions are taken by individuals and firms, which are assumed to act in their own self-interest. This is usually associated with a pure capitalist system where land and capital are privately owned. Individuals are free to make their own choices. Firms seek to maximize profits, consumers seek to maximize value from purchases and workers maximize wages in jobs.

Free market economy relies on the price mechanism to allocate resources. Prices respond to shortages and surplus. Shortages cause prices to rise, thus attract more resources to produce the products with higher price. Surplus cause prices to fall, thus lesser resources will be allocated in the products with lower price. Prices will continue to change until all shortages or surpluses are eliminated.

The advantages of a free market economy are its functions automatically. There is no need for government to coordinate economic decisions. Competition in the market keeps prices down and acts as an incentive to firms to become more efficient. When resources are more efficiently used, more output can be produced and consumed and hence the economy will achieve a higher level of welfare.

4.3 The Mixed Economy

In a mixed economy, the government may be actively involved in producing certain goods and services while the private sector take over the production of other goods and services. In addition, the government may impose taxes, provide subsidies or implement legislation to control the relative price of goods and resources, to redistribute income and to affect the production and consumption patterns of certain goods and services.

In this course, we implicitly assume the economy is operating under the free market economy where the allocation of resources is done by the market system based on the collective efforts by all consumers and producers.

5. Production Possibility Frontier

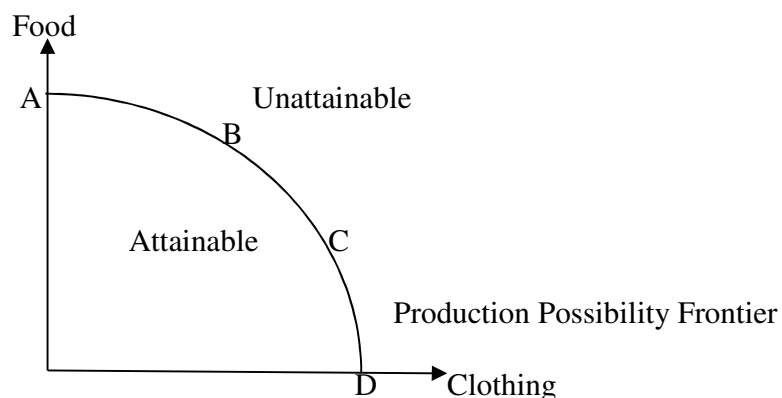
The production possibility frontier (PPF) shows the maximum combinations of two products which an economy can produce, given a fixed amount of resources and a given level of technology.

5.1 Construction of the Production Possibility Frontier

Consider an economy endowed with a fixed amount of land and a given amount of labour based on its population. Assume that the economy uses all its resources to produce two products, food and clothing, at a given level of technology. We hold the quantities of other goods and services constant, under the *ceteris paribus* assumption.

Since resources and technology are fixed, to produce one more unit of food, more resources will be consumed in the food production and there will be lesser resources available for the clothing production and vice versa. Hence the increasing production of food must be accompanied by a decrease in the production of clothing and the production possibility curve must be downward sloping. A typical production possibility frontier is thus a downward sloping curve with a concave shape, as shown in Figure 1.3.

Figure 1.3 : Production Possibility Frontier



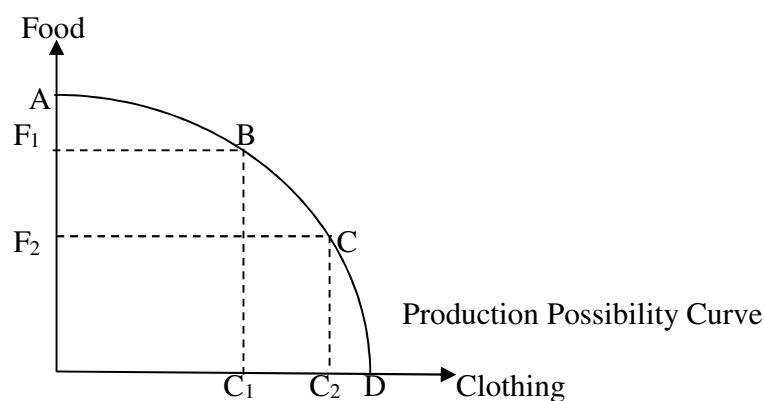
If all resources are used to produce food, the economy will be at point A where it has the maximum amount of food and no clothing. On the other hand, if all resources are used to produce clothing, the economy will be at point D where it has the maximum amount of clothing and no food. Between these two extremes, the economy may allocate more resources to produce food and less resources to produce clothing, such as point B. It may also reach point C when there are more resources for clothing relative to food. It can also produce at any combination below the production possibility frontier. However, it is unable to reach a combination above the production possibility frontier. Hence the production possibility frontier is a boundary between those combinations of goods that the economy can produce (attainable) and those that cannot (unattainable).

5.2 Production Possibility Frontier and Opportunity Cost

The production possibility frontier is concave in shape because resources in an economy are not identical. Some land will be suitable to produce food while others are suitable to produce shirt. Likewise some workers are more suitable to produce food while others are more suitable in producing clothing.

Starting from Point A where all resources are used in producing food, there will be no clothing being produced. To produce some clothing, the economy will release resources that are more suitable to produce clothing and less suitable to produce food first. Thus initially it gives up only a small amount of food to produce a given quantity of clothing as the economy moves down the production possibility frontier. From A to B, the slope is gentle and increases by a small magnitude.

Figure 1.4 : Concave Production Possibility Frontier



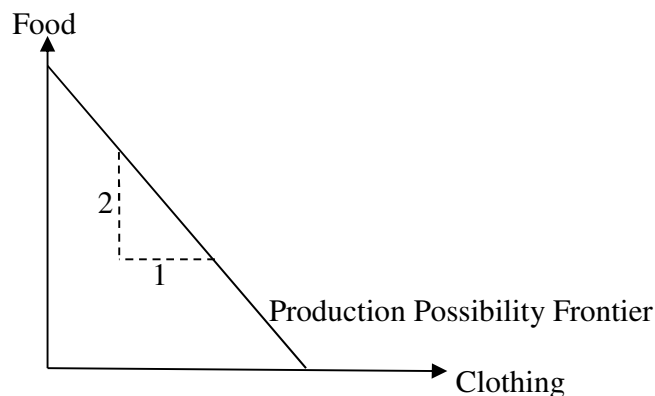
If the economy requires more and more clothing, it will need to transfer more and more resources from the food production to the clothing production. When all resources that are better in producing clothing had been transferred, the economy will now have to transfer resources which are more suitable to produce food and reallocate them to produce clothing. It will then have to give up more and more food to have the same additional amount of

clothing. Thus from B to C and eventually to D, the slope increases by a larger and larger magnitude as the economy moves down the production possibility frontier.

The slope of the production possibility frontier reflects the opportunity cost incurred in producing one more unit of the product in the X axis. The opportunity cost is given by the amount of output in the Y axis that needs to be given up in order to produce one more unit of the output in the X axis. A concave curve is consistent with the concept of increasing opportunity cost.

If all resources are identical, there will be constant opportunity cost in production and the production possibility frontier will be a straight line. For example, assume that land and labour resources are identical such that the same amount of resources can either produce 1 unit of clothing or 2 units of food regardless of the amount of food and clothing being produced. In this case the opportunity cost of clothing is always 2 units of food which is a constant. The production possibility frontier is a straight line with slope = -2, as shown in Figure 1.5.

Figure 1.5 : Straight Line Production Possibility Frontier



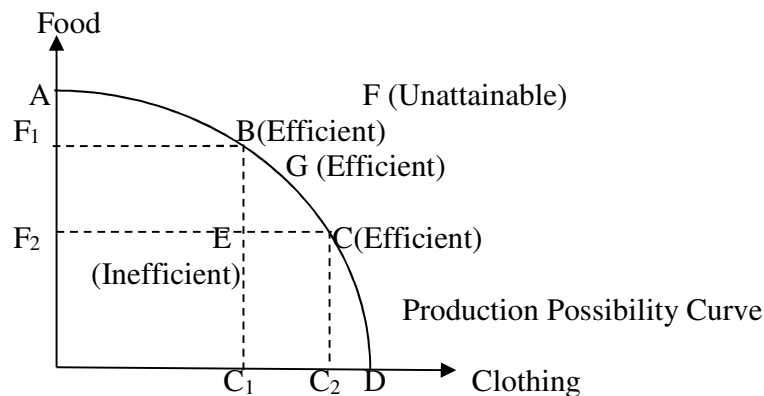
5.3 Production Possibility Frontier and Productive Efficiency

In Section 5.2, we mention that a production possibility frontier has two sections, attainable and unattainable. However, we can further divide the frontier into three regions, the region below the frontier, the region on the frontier and the region above the frontier. While the concave shape of the production possibility frontier exhibits the concept of increasing opportunity cost, it also exhibits the concept of production efficiency. A production is considered as efficient if more of one product can be produced only by producing less of the other product.

The region below the frontier shows the inefficient combinations of the two products. For example combination indicated by point E in Figure 1.6 with F_2 amount of food and C_1 amount of clothing is an inefficient production combination. This is because it is possible to move from E to B where food production can increase to F_1 with the same amount of clothing production at C_1 . It is also possible to move from E to C where the clothing

production can increase from C_1 to F_2 without reducing food production at F_2 . It is also possible to move from C to G where both food and clothing productions can increase. A combination below the production possibility frontier occurs when there are unused resources in the economy or when resources are underutilized.

Figure 1.6 : Production Possibility Frontier and Efficiency



In contrast, points on the production possibility curve such as A, B, G, D and D show the efficient combination of production. From A to B, it is only possible to increase the production of clothing by reducing the production of food. From C to B, it is only possible to increase the food production by reducing clothing production. Thus all the combinations on the production possibility frontier are efficient. This also represents the situation when all resources in the economy are fully and efficiently utilized

All the combinations outside the production possibility curve are unattainable. For example, a combination given by point F is unattainable given the current amount of resources and level of technology. Point F will only be attainable when the production possibility frontier shifts out to encompass point F.

5.4 Productive Efficiency and Allocative Efficiency

Although all combinations on the production possibility frontier fulfils the productive efficiency criteria, not all satisfy the allocative efficiency criteria. For resources to be allocated efficiently, it must produce the combinations of output that people desires in the economy.

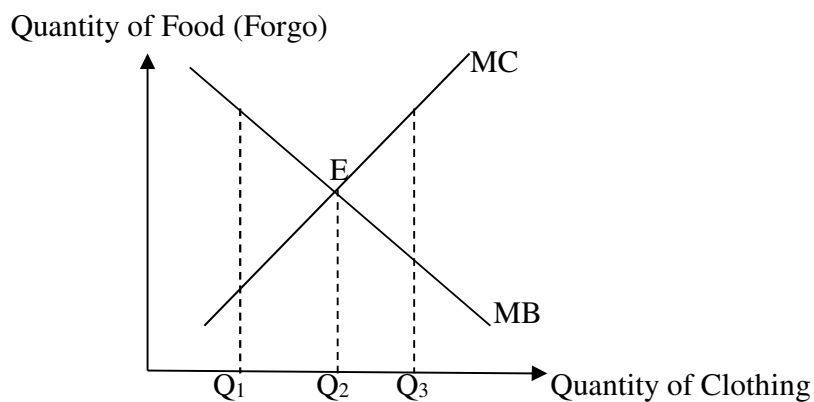
For example, if an economy desires more clothing relative to food, then a combination B which has more food and less clothing is productive efficient but not allocative efficient. This is because too much of resources are allocated to food and too few to clothing. Likewise a combination C is not allocatively efficient to cater to an economy which prefers more food to clothing. Determination of allocative efficiency requires information on the marginal cost (opportunity cost) and the marginal benefit (preferences) in the economy.

The marginal cost (MC) of a product is defined as additional cost when producing one more unit of the product. If we define the additional cost of producing one more unit of clothing as the amount of food that the economy needs to give up, the slope of the production possibility frontier will be the MC curve of clothing production. Since the slope increases with more clothing being produced, the marginal cost curve is an upward sloping curve. Note that every point on the MC curve represents productive efficiency.

Preferences refers to the likes and dislikes of the people. A strong preference of a product is associated with a large marginal benefit arises from consuming the product. The marginal benefit (MB) of a product is the additional benefit received when consuming one more unit of a product. It is measured by the individual's willingness to pay for an additional unit of the product.

Human nature is such that an individual will have a strong preference on a product if it is scarce and have a weaker preference if the product is in greater abundance. This is known as the principle of decreasing marginal benefit where an individual's willingness to pay for a product decreases as its quantity increases. If we define the willing to pay for clothing as the amount of food an individual is willing to forgo, we can plot the MB curve and MB curve is downward sloping. Combing MC curve and MB curve, we have the diagram as shown in Figure 1.7

Figure 1.7: Allocative Efficiency



In Figure 1.7, at Q_1 of clothing the marginal cost is low but the marginal benefit is high in the economy. Thus people will prefer to have more resources allocated to the clothing production. In contrast, at Q_3 of clothing the marginal cost is high but the marginal benefit is low in the economy. Thus people will prefer to have less resources allocated to the clothing production. Only at quantity of Q_2 of clothing there is efficient allocation of resources for both products. Thus only at point E there is allocative efficiency.

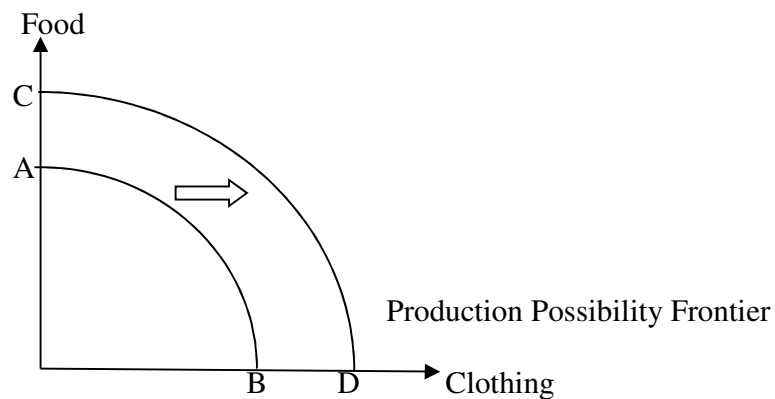
6 Analysis of the Production Possibility Frontier

The production possibility frontier is constructed based on the assumption of a fixed amount of resources at the given level of technology. If there is a change in the quantity and/or the quality of the resources or a change in the level of technology, the production possibility frontier will shift. This is known as an economic growth.

6.1 Shifting of Production Possibility Frontier

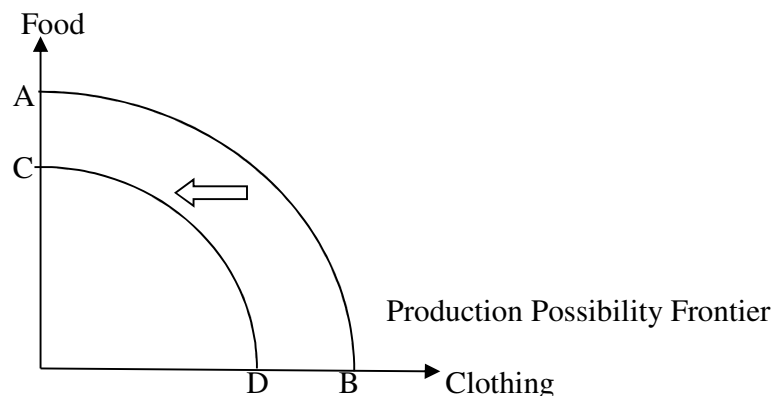
Consider an economy using existing resources to produce food and clothing. The production possibility frontier is given by the curve AB in Figure 1.8. If the economy receives foreign workers who are able to produce both food and clothing, with more resources the economy will be able to produce more food and clothing. Thus the production possibility frontier shifts outwards from AB to CD, as shown in Figure 1.8.

Figure 1.8 : Outward Shifting of Production Possibility Frontier



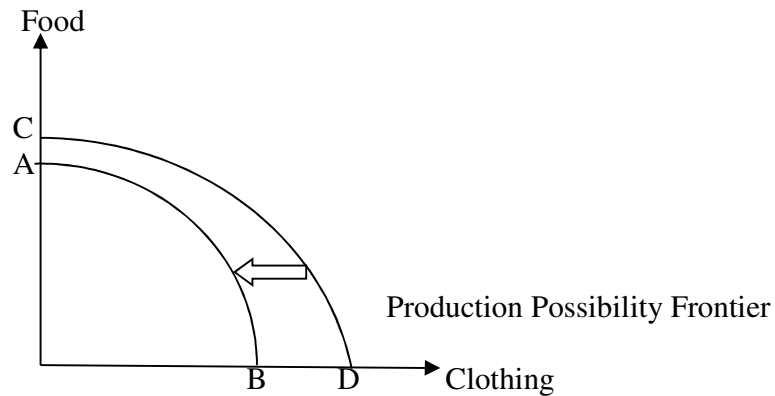
On the other hand, if there is a natural disaster such as earthquake that destroy many plantation land and factories in the economy, it will reduce the production capability of both food and clothing. The production possibility curve will shift inwards from AB to CD, as shown in Figure 1.9.

Figure 1.9 : Inward Shifting of Production Possibility Frontier



The shifting of the production possibility frontier need not always be neutral that affect both products equally. It can be a bias shift that affect one product more than the other. For example, if the foreign labour is more skillful in producing clothing than food, the shift of the production possibility frontier will show a larger increase in clothing production than food. This is shown in Figure 1.10

Figure 1.10 : Bias Shifting of Production Possibility Frontier

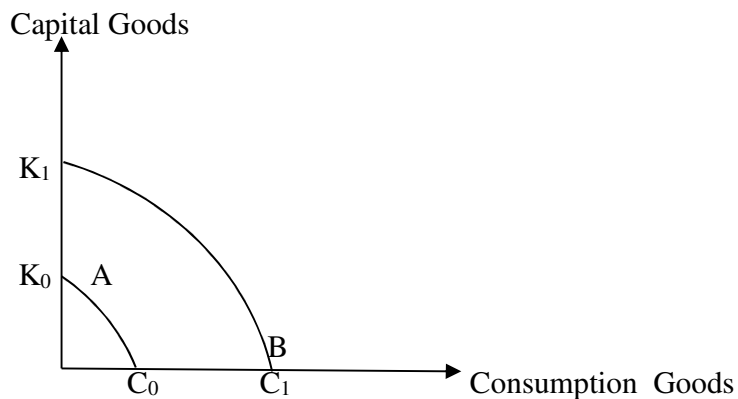


6.2 Production Possibility Frontier and Economic Growth

The process of production possibility frontier shifts out reflects economic growth. To achieve economic growth, it is necessary to have more and better resources and also better technology. This requires investment, especially in capital goods.

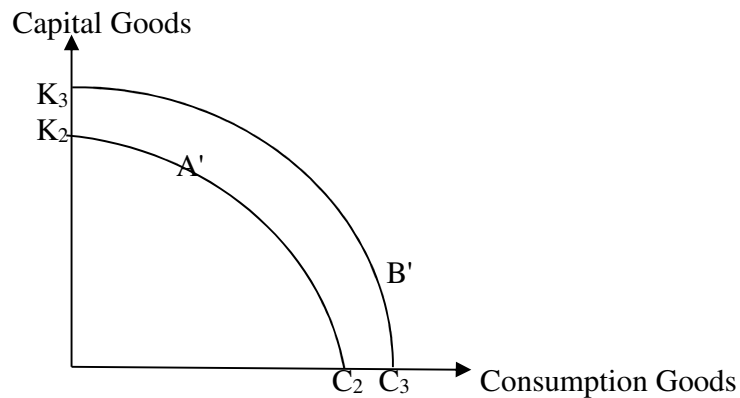
Consider two economies, Country A and Country B in 1980, both producing two types of products, consumer goods and capital goods. Country B is a much larger economy than Country A with more resources and better technology. Hence its production possibility frontier (K_1C_1) is above that of Country A (K_0C_0) and there is a big gap between them. This is shown in Figure 1.11

Figure 1.11 : Country A and Country B Production in 1980



Overtime Country A will have more additional resources and hence its production possibility shifts out by a larger magnitude. In contrast Country B has a smaller increase in capital goods and its production possibility frontier shifts out by a smaller amount. Hence 45 years later in 2025, although Country A production possibility frontier is still below that of Country B, the gap between them has narrowed. This is shown in Figure 1.12.

Figure 1.12 : Country A and Country B Production in 2025



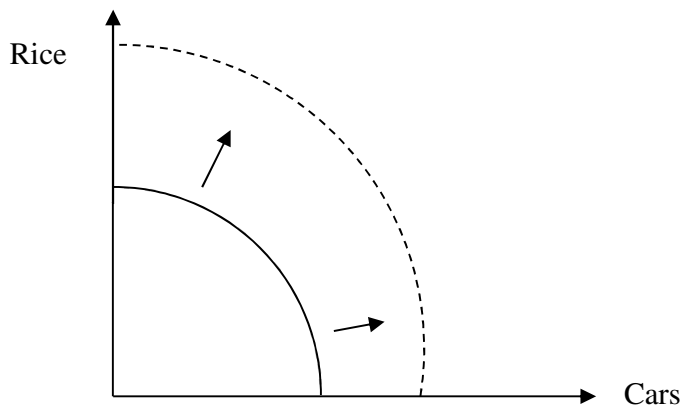
6.3 Illustration Questions

Consider Country Tee producing two types of goods: rice and cars; using three types of resources: land, labour and machines. Assume land and labour are used to produce rice, while labour and machines are used to produce cars. Analyse the effects on the production possibility frontier of Country Tee when the following incidents occur independently.

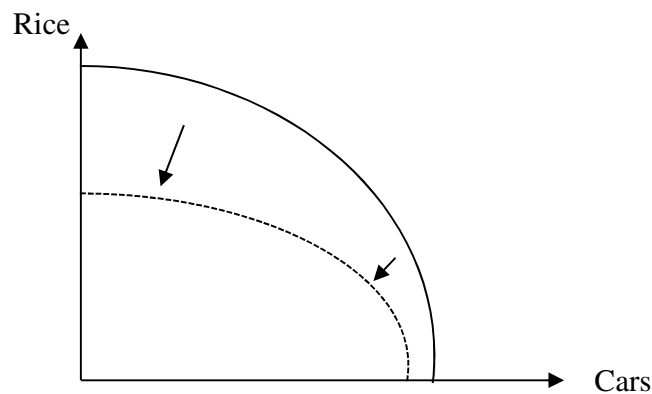
- (a) The government allows more workers to migrate to Country Tee.
- (b) A major earthquake destroys land and kills half the labour force in Country Tee.

Suggested Answers

- (a) Since labour is used in the production of both cars and rice, the influx of workers will increase the production of both goods. Assume the influx affects production equally, this will result in a parallel shift of the PPF outward.



(b) The natural disaster destroys land and this should cause rice production to drop. However, the loss of half of the labour force impacts both rice and car production (assuming equal effects here). Thus the boundary of the PPF should shift inward more for rice than that for cars.



7. Discussion Questions

Question 1

When an economy produces at its allocatively efficient production point,
_____.

- (A) a society can increase the production of all goods.
- (B) resources are not limited.
- (C) scarcity does not become a problem.
- (D) a society can increase the production of one good only by decreasing the production of some other good that is valued more highly.

Question 2

Which of these is **NOT** a factor of production?

- (A) Land.
- (B) Labour.
- (C) Capital.
- (D) Money.

Question 3

Given the production possibility frontier of 2 output X and Y, when there are more workers who are only able to produce Y, then

- (A) the production possibility frontier shifts to indicate a larger maximum of output Y.
- (B) the production possibility frontier shifts to indicate a larger maximum of output X.
- (C) the production possibility frontier shifts to indicate a larger maximum of both output X and Y.
- (D) there is a movement along the production possibility frontier indicating more Y and less X.

Question 4

Which of the following statements are correct?

- I. The "highest-valued alternative given up to get something" is the opportunity cost.
 - II. Wealthy economies don't experience opportunity costs.
 - III. Scarcity creates opportunity costs.
-
- (A) I only
 - (B) I and II
 - (C) I and III
 - (D) I, II, and III

Question 5

When an economist talks of scarcity, the economist is referring to the _____.

- (A) ability of society to employ all of its resources.
- (B) ability of society to consume all that it produces.
- (C) inability of society to satisfy all human wants because of limited resources.
- (D) ability of society to continually make technological breakthroughs and increase production.

Question 6

For the following statement, state if it is true or false and justify your answer.

“For a production point to be productively efficient, it must first be allocatively efficient.”

Question 7

PINEapple is a company that only produces two products: aPhones and PineBOOKS. The marginal cost of producing each of these products increases as more of it is produced.

- (a) An analyst says that aPhones are the ultimate best product in the market today. Is this a normative or positive statement?
- (b) Draw the Production Possibilities Frontier (PPF) of PINEapple. Put aPhones on the y-axis.
- (c) Reproduce your diagram in (b). Assume that PINEapple has an influx of new workers who have defected from rival company BigMI. Draw PINEapple's new PPF.
- (d) Reproduce your diagram in (b). Assume that PINEapple discovers that its supplier for aPhones parts suffered a fire at its factory, resulting in it only being able to deliver half its usual supply of aPhone parts. Draw PINEapple's new PPF.

MICROECONOMICS

SESSION 2

DEMAND AND SUPPLY

At the end of the session, students should be able to:

1. Define Demand
 2. Distinguish between a change in demand and a change in quantity demanded
 3. Explain the factors that influence demand
 4. Define Supply
 5. Distinguish between a change in supply and a change in quantity supplied
 6. Explain the factors that influence supply
-

1. Introduction

Demand and Supply are the basic building blocks in Microeconomics as they form the market which allocate resources and outputs. In this session, we begin with a definition of demand and a distinction between a change in quantity demanded and a change in demand. Next, we discuss the factors that affect demand. Then, we define supply and distinguish between a change in quantity supplied and a change in supply. Finally, we analyze the factors that affect supply.

2. Demand Analysis

If a consumer demands for a product, the consumer must want the product, can afford to buy the product and have made a plan to acquire the product. Demand is the relationship between price of a product and the quantity of the product which consumers are willing and able to buy. For example, the demand for apple refers to the quantity which of apples which consumers want to buy at different prices of apples.

There are many factors that can affect a consumer's buying decision but the most important factor is the price of the product. We single out price and analyze the relationship between price and the quantity which consumers want to buy in the demand analysis. The other factors that also affect buying decision are assumed to remain unchanged. This is consistent with the ceteris paribus assumption.

2.1 The Law of Demand

At each price, the quantity which consumers are willing and able to buy is called the quantity demanded of the product. Over a range of price, we can establish a range of

quantity demanded for the product and this forms the demand for the product. It is generally observed that when the price of a product increases, its quantity demanded decreases. Conversely, when the price of the product decreases, its quantity demanded increases. There is an inverse relationship between price and quantity demanded and this is known as the law of demand.

The law of demand states that the quantity of a product demanded in a given time period varies inversely with its price, other things constant. The law of demand is based on two reasons: Substitution effect and Income effect. Both effects contribute to the behaviour of consumers buy more of a product when the price decreases.

Every product more or less has some substitutes although some products may have closer substitutes than the others. In general when the price of a product increases, consumers will source for its substitutes and buy less of this product. Thus the quantity demanded of this product decreases follow by an increase in its price. This is known as the substitution effect.

Consumers must have a certain amount of money to be able to buy the products. This amount of money, expressed in dollars, is the money income of the consumer. But the purchasing power of this amount of money is dependent on the price of the product and this is the real income of the consumers. When the price of a product decreases, the purchasing power of consumer's income, or the real income increases. The consumer can afford to buy more with the same amount of money. If a consumer desires to buy more due to higher purchasing power of his money income, this is known as the income effect.

2.2 Demand Schedule and Demand curve

Demand schedule is a table showing the quantity demanded of a product at different price. A typical demand schedule for a product, say bread, is shown in Table 2.1

Table 2.1: Demand Schedule for Bread

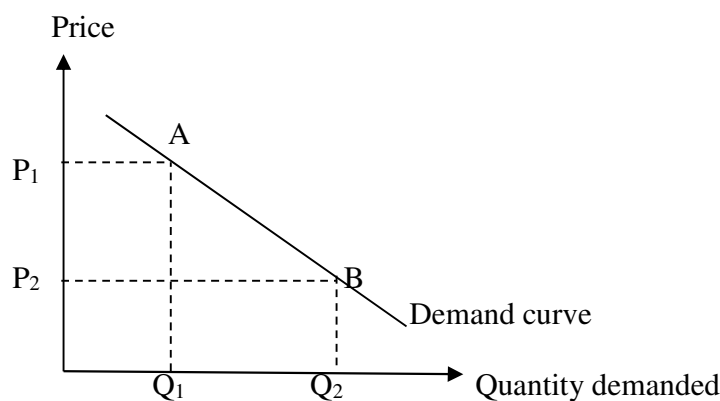
Price of bread	Quantity of Bread Demanded
\$0.80	140
\$1.00	130
\$1.20	120
\$1.40	110
\$1.60	100
\$1.80	90

The demand curve is a diagram representing the demand schedule. It is drawn with Price on the Y-axis and quantity demanded on the X-axis. The demand curve is always downward sloping due to the law of demand.

Note that demand refers to the entire price range while quantity demanded refers to only at a particular price. When price of a product decreases, consumers buy more and this is known as an increase in the quantity demanded. When price of a product increases, consumers buy less and this is known as a decrease in quantity demanded. Changes in price are reflected as movements along the same demand curve and this is known as a change in quantity demanded.

A typical demand curve is shown in Figure 2.1. An individual point on the demand curve, such as point A or point B in Figure 2.1 shows the quantity demanded at a particular price. Any movement along a demand curve reflects a change in quantity demanded.

Figure 2.1: Demand Curve



When a product becomes cheaper, consumers buy more. This is known as an increase in quantity demanded. It is reflected as a movement down the demand curve. Thus when price decreases from P_1 to P_2 , the quantity demanded increases from Q_1 to Q_2 , reflected as a movement from point A to point B in Figure 2.1. When a product becomes more expensive, consumers buy less. This is known as a decrease in quantity demanded and is reflected as a movement up the demand curve from point B to point A.

2.3 Demand and Marginal Benefit

There are two ways to interpret a demand curve. One way is the horizontal interpretation where given the price, the demand curve shows the quantity of the product demanded by the consumer. The other way is the vertical way where given the quantity, the demand curve shows the maximum price that consumers are willing to pay for the product. The maximum price reflects the willingness to pay and hence the demand curve is also known as the willingness to pay curve.

The willingness to pay for a product is consistent with the benefit derived by the consumers from consuming the product. If consumers are able to derive large amount of benefit from the product, they will be willing to pay a high price for the product. On the other hand, if the product provides little benefit to the consumers, the willingness to pay will be

corresponding lower. The amount of benefits change according to the quantity available. It is generally observed that a small quantity of a product tends to provide large additional benefits to the consumers, while a large quantity of a product tends to provide less additional benefits to the consumers. Thus the demand curve is also known as the marginal benefit curve and it is downward sloping.

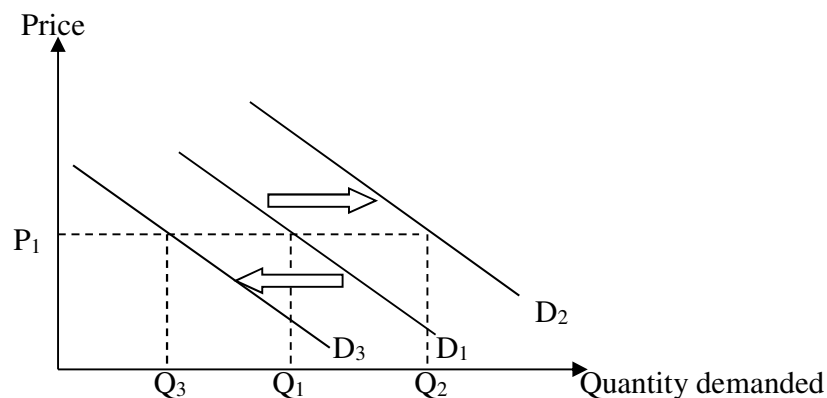
3 Changes in Demand

The demand for a product is not a specific quantity but the entire relation between price and quantity demanded. A change in demand is reflected by a shift in the entire curve. A given demand curve isolates the relation between the price of a good and the quantity demanded when other factors that could affect demand remain unchanged. Once these factors change, the demand curve will be shifted.

3.1 Shifting of Demand Curve

When there is a positive factor change that results in an increase in demand, the demand curve shifts to the right from D_1 to D_2 , as shown in Figure 2.2. This means at the same price, the consumers will want to buy a larger quantity of the product.

Figure 2.2: Change in Demand



When there is a negative factor change that results in a decrease in demand, the demand curve shifts to the left. This means at the same price, the consumers will want to buy a smaller quantity of the product. This is shown in the shifting of demand curve from D_1 to D_3 in Figure 2.2.

3.2 Factors that Affect Demand

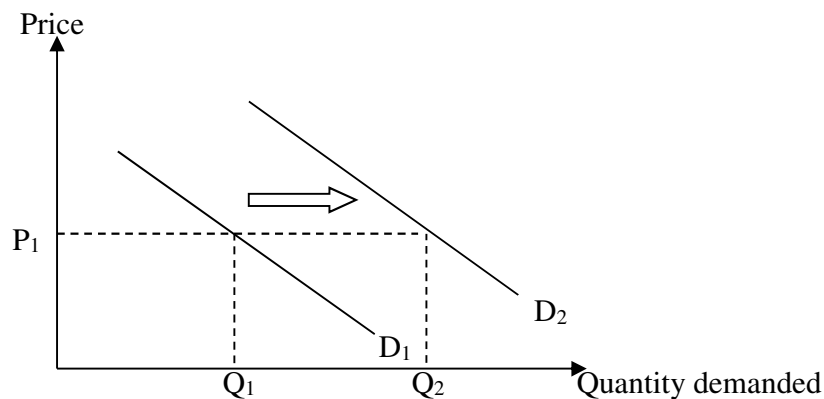
Price is the most important factor but not the only factor that determines buying decision. The willingness and ability of consumers to buy a product is also influenced by many other factors. Some of the common factors or determinants that affect demand are as follow:

(a) Income of Consumers

Consumer's ability to buy a product is determined by his or her income. However, when income increases, a consumer's response will depend on whether the product is a normal good or an inferior good.

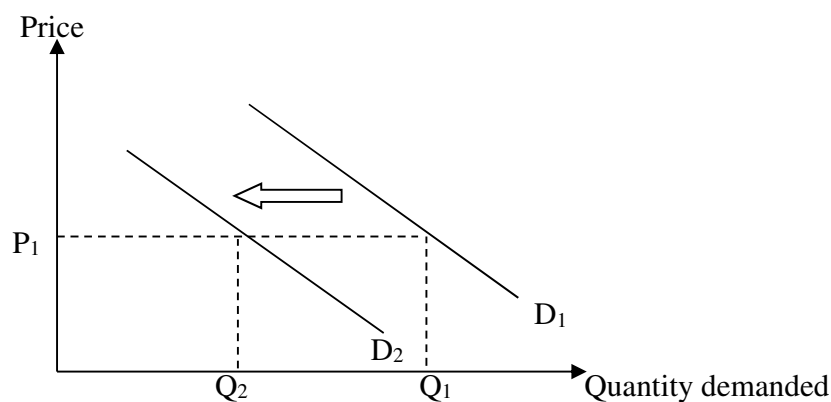
For normal goods, when consumer income increases, they are willing and able to buy more units at each price and to pay more per unit at each quantity, thus the demand curve shifts to the right. This is shown in Figure 2.3.

Figure 2.3: Effect of Income Increases for Normal Good



For inferior goods, their demand decreases as income increases. Consumers tend to buy less of these goods when they are richer because they will switch to the higher category or better of the product. The demand curve shifts to the left when income rises.

Figure 2.4: Effect of Income Increases for Inferior Good



(b) Prices of Related Goods in Consumption

When the price of a good change, it may influence the demand of another good which is related in consumption. Two products can be related in consumption either in the form of complements or substitutes.

Two goods are substitutes in consumption if an increase in the price of one leads to an increase in the demand for the other. Consider buns and cakes which are substitutes in consumption. If the price of buns increases, consumers that initially purchase buns will now switch to buy cakes. Thus even though price of cake is unchanged, consumers want to buy more cakes and hence the entire demand curve shifts right. The demand for Good cakes thus increases.

Two goods are complements in consumption if an increase in the price of one leads to a decrease in the demand for the other. Consider car and petrol which are complements in consumption. If the price of car decreases, consumers will buy more cars. Thus there is an increase in the quantity of car demanded. But since cars and petrol must be used together, when consumers buy more cars they must also buy more petrol, even though price of petrol is unchanged. Thus the entire demand curve for petrol shifts to the right. The demand for petrol increases.

In general, for goods that are substitutes in consumption, an increase in the price of one product will increase the demand for the other product. For goods that are complements in consumption, a decrease in the price of one product will increase the demand for the other product.

(c) Consumer Expectation of Future Price

A change in consumer expectations of the price a product in the future can affect the current demand for the product.

If consumers expect the price of a good to increase in the future, they may increase their demand for the product now, before prices go up. Thus the demand for the product increase, the demand curve shifts right.

On the other hand, an expectations of a lower price in the future will encourage some consumers to postpone their purchases, thereby reducing the current demand. Thus the demand curve shifts left.

(d) Consumer Expectation of Future Income

A change in consumer expectations of future income can also affect demand.

If consumers expect the future income to be higher, they may increase their demand for the product now and finance the purchase by borrowing. Thus the demand for the product increase, the demand curve shifts right.

On the other hand, if consumers expect to earn a lower income in the future, they will tend to save more and postpone their purchases, thereby reducing the current demand. Thus the demand curve shifts left.

(e) Consumers Population

If the number of consumers in the market changes, such as population increases, the demand for a product may increase. When there are more consumers for a product, a larger quantity will be demanded even though price is unchanged. Thus the entire demand curve shifts to the right.

(f) Consumer Preferences or Tastes

Preferences or tastes are individual likes and dislikes as a consumer. Any change in preference towards a product will increase the demand that product.

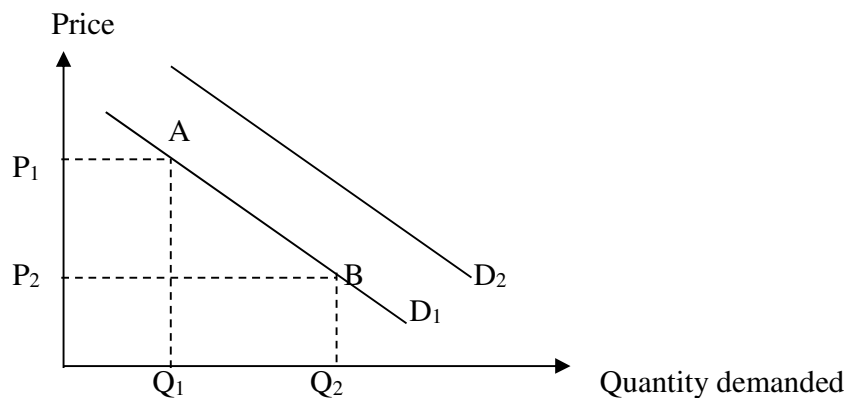
If consumers have a stronger preference for a product, they will buy more even though the price is the same as before. The entire demand curve shifts to the right and the demand increases. Conversely, a decrease in consumer preference will reduce the demand for the product, thereby shifting the demand curve to the left.

3.3 Change in Quantity Demanded Versus Change in Demand

It is important to distinguish between a change in quantity demanded and a change in demand. A change in quantity demanded refers to a movement on a demand curve and it is triggered by a change in price. In contrast, a change in demand refers to a shift of the entire demand curve due to a change in the factors that affect demand. Hence the statement "demand increases when price decreases" is technically incorrect. The correct sentence should be "quantity demanded increases when price decreases".

In Figure 2.5, a change in quantity demanded is shown in the movement from point A to point B on the demand curve D_1 when price decreases, where the quantity demanded changes from Q_1 to Q_2 . It can also be a movement from Point B to point A when price increases, where quantity demanded changes from Q_2 to Q_1 . In contrast, a change in demand is shown by the shifting of the demand curve from D_1 to D_2 when there is a favour change in the factors that affect demand, or a shift from D_2 to D_1 when there is an adverse change in the factors that affect demand. The price of the product must remain unchanged and only the non-price factors of demand change.

Figure 2.5: Change in Demand and Change in Quantity Demanded



4 Supply Analysis

Supply is the relationship between price and the quantity of a product that producers are willing and able to supply. It indicates how much of the good producers are both willing and able to offer for sale per period at each possible price, other things constant.

There are many factors that can affect a supplier's production decision but the most important factor is the price of the product. We single out price and analyze the relationship between price and the quantity which producers want to supply in the supply analysis. The other factors that also affect production decision are assumed to remain unchanged. This is consistent with the *ceteris paribus* assumption.

4.1 Law of supply

There is a positive relationship between quantity supplied and price. When price increases quantity supplied also increases. The reason is that to supply more of a product, more resources are needed. Initially when resources are plentiful, it is relatively easier to obtain the resource at a low cost. Eventually when resources become scarce, it becomes more costly to acquire resources. Thus a higher price is needed to induce producers to acquire more resources to produce more. Another way to view the supply curve is to consider if the cost of producing one unit of a product remains unchanged, then a higher price will result in higher profit and the producers will have incentive to produce more output.

The law of supply states that the quantity supplied is usually directly related to its price, other things constant.

The lower the price, the smaller the quantity supplied. The higher the price, the greater the quantity supplied.

4.2 Supply Schedule and Supply Curve

The amount that producers would like to supply at various prices is shown in a supply schedule. A typical supply schedule for a product, say bread, is shown in Table 1.2

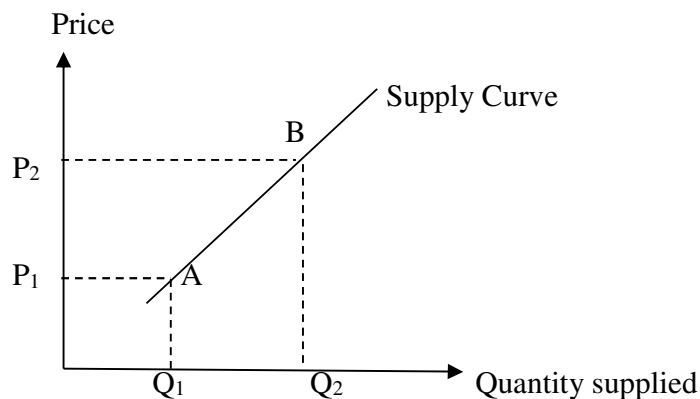
Table 1.2 Supply Schedule of Bread

Price of bread	Quantity Supplied of Bread
\$0.80	100
\$1.00	110
\$1.20	120
\$1.40	130
\$1.60	140
\$1.80	150

When we express the supply schedule in a diagram with price on the Y-axis and quantity supplied in the X-axis, we obtain the supply curve. The supply curve shows the relation between the price of a good and the quantity supplied, other things constant.

From the law of supply, the supply curve is upward sloping. A higher price induces suppliers to supply more of a product. This is reflected as a movement along the supply curve. A typical supply curve is shown in Figure 2.6.

Figure 2.6: Supply Curve



If the price is higher, producers will respond by supplying more of the product. This is known as an increase in quantity supplied. It is shown as an upward movement along the same supply curve. In Figure 2.6, when price increases from P_1 to P_2 , the quantity supplied increases from Q_1 to Q_2 . If the price is lower, producers will produce less of the product. This is known as a decrease in the quantity supplied and reflected as a downward movement down the same supply curve.

4.3 Supply and Marginal Cost

The supply curve can be analyzed horizontally as the largest quantity that the producer are willing to supply at the given price. It can also be analyzed vertically as the minimum price that the producer must receive to supply a given quantity. In this sense the supply curve is also known as the minimum-supply-price curve. Below a certain price, it is possible that the producer may not produce the product at all.

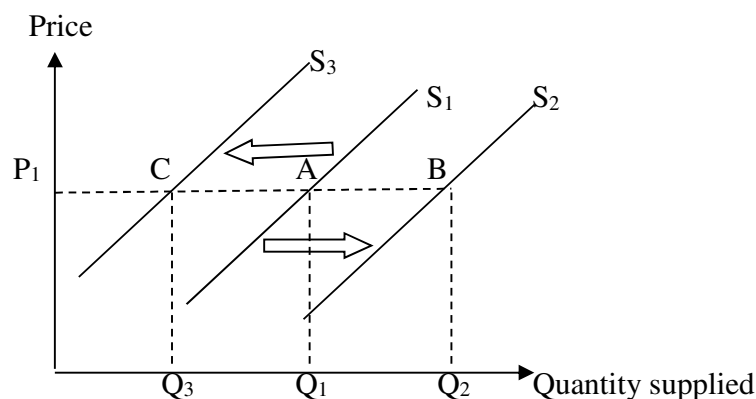
Since the producer needs to acquire resources in order to produce the output, the minimum price that the producer must receive in order to produce a given level of output must at least allows the producer to cover the cost of producing the product. To produce one more unit of the product, the cost incurred is the marginal cost. Hence the minimum price that the producer must receive is the marginal cost of production. As the production quantity increases, the marginal cost tends to increase and hence the price must also increases. Thus the supply curve is also known as the marginal cost curve and it is upward sloping.

5 Change in Supply

Supply decision is not solely determined by price alone. Even if the price of a product is unchanged, there might be other determinants or factors that cause the producer to supply a different quantity of the product at the same price.

If any of the factor of supply were to change, the entire supply curve will shift. A favourable change will shift the supply to the right, resulting in a larger quantity supplied at the same price. This is known as an increase in supply. It is shown in the shifting of the supply curve to the right from S_1 to S_2 in Figure 2.7.

Figure 2.7: Change in Supply



In contrast, a non-favourable change will shift the supply to the left, resulting in a smaller quantity supplied at the same price. This is known as a decrease in supply. It is shown in the shifting of the supply curve to the left from S_1 to S_3 in Figure 2.7.

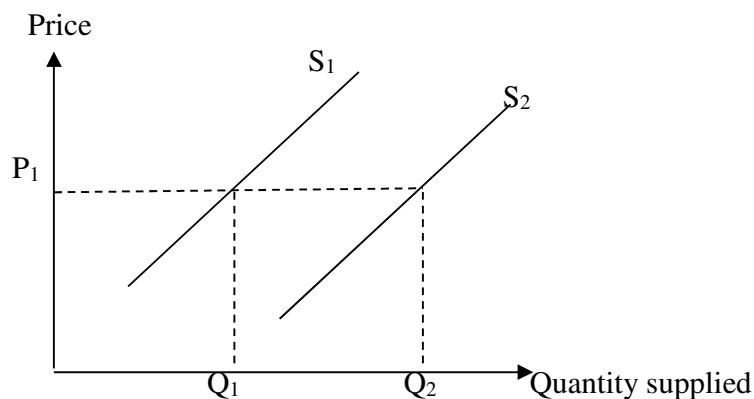
5.2 Determinants of supply

The factors that affect the supply curve are as follows:

(1) Technology

Technology represents the knowhow to combine resources most efficiently in producing a product. If there is an improvement in the technology, more output can be produced with the same resources. Thus the producer will have greater ability to produce more output even at the same price. This is reflected by a shift to the right of a supply curve from S_1 to S_2 in Figure 2.8.

Figure 2.8: Increase in Supply



(2) Prices of Related Goods in Production

Related goods in production can be substitutes in production or complements in production. For example, a piece of land may be able to grow either vegetables or fruits and initially the farmer is growing both. A fall in the price of vegetables will make the production of fruits more attractive and the farmer may allocate more land to grow fruits and less to grow vegetables, even though the price of fruits is unchanged. Thus the supply of fruits increases because the price of vegetables decreases.

Two goods that must be produced together are complements in production. For example, to produce leather, beef must also be produced at the same time. Hence if there is an increase in the price of leather, the supply of beef also increases.

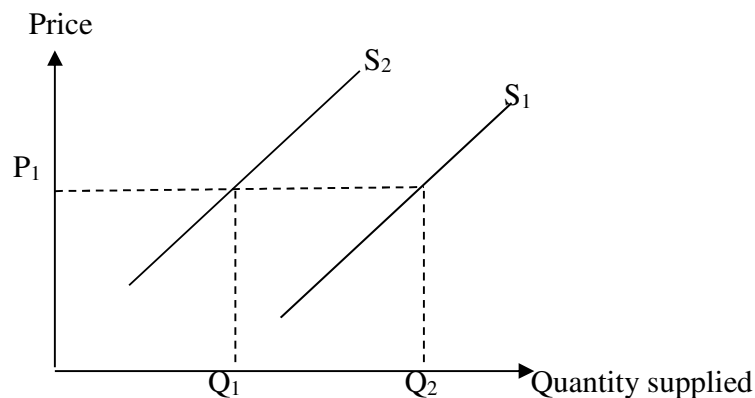
In general, for goods that are substitutes in production, a decrease in the price of one product will increase the supply of the other product. For goods that are complements in production, an increase in the price of one product will increase the supply of the other product.

(3) Prices of inputs or resources

Resources or inputs are needed to produce output and suppliers need to incur costs to acquire the relevant resources. If the resources, such as land, labour and capital become cheaper, the cost of production decreases and the suppliers will be more willing and able to produce more of the output, even though the price remains unchanged. Thus the entire supply curve shifts to the right and the supply increases.

However, if the rental of land increases, the wages of worker increases, the machine price increases or the raw materials become more expensive, the producer will acquire lesser resources and produce a smaller quantity of the product at the given price. This is reflected by a leftward shift of the supply curve from S_1 to S_2 in Figure 2.9.

Figure 2.9: Increase in Supply



(4) Expectation of Future Price by Producers

If the producer expect the price of a product, especially a durable product, such as houses to increase in the future, the producer may prefer to reduce their current supply and await the higher price. Thus at the same price, less will be supplied now and the supply curve shifts left.

Conversely, if the producers expect the price of the product to fall in the future, the producer may prefer to supply more now before the price decrease. Thus the supply curve shifts right.

(5) Number of Producers

If the number of producer increases, more output will be supplied at the same price. The entire supply curve shifts to the right and the supply increases.

If the number decreases, the supply curve will shift to the left and supply decreases.

(6) Government Policy

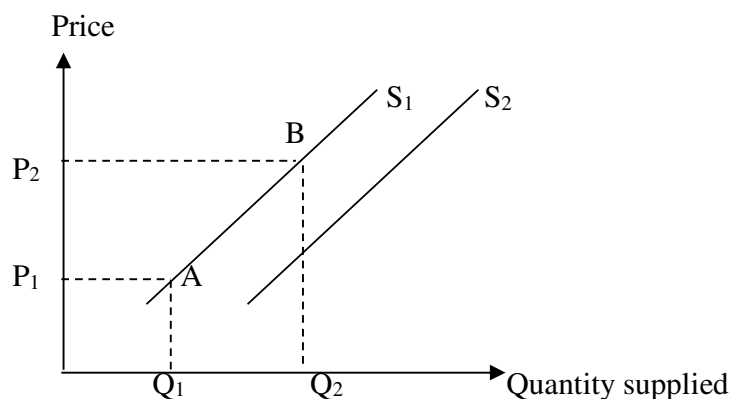
Government policy on taxes and subsidies can affect the supply of a product. If the government imposes taxes on the supplier, the cost will increase and the supply will decrease. The supply curve will shift left. If the government provides subsidies to the suppliers, the cost will decrease and the supply will increase. The supply curve will shift right.

5.3 Change in Quantity Supplied Versus Change in Supply

It is also important to distinguish between a change in quantity supplied and a change in supply. A change in quantity supplied refers to a movement on a supply curve and it is triggered by a change in price only. In contrast, a change in supply refers to a shift of the entire supply curve, due to a change in the factors that affect supply. Hence the statement "supply increases when price increases" is technically incorrect. The correct sentence should be "quantity supplied increases when price increases".

In Figure 2.10, a change in quantity supplied is shown in the movement from point A to point B when price increases along the supply curve S_1 . The quantity supplied changes from Q_1 to Q_2 . It can also be a movement from Point B to point A when price decreases, where quantity supplied changes from Q_2 to Q_1 . In contrast, a change in supply is shown by the shifting of the supply curve from S_1 to S_2 when there is a favourable change in the factors that affect supply, or a shift from S_2 to S_1 when there is an adverse change in the factors that affect supply. The price of the product must remain unchanged and only the non-price factors of supply change.

Figure 2.10: Change in Supply versus Change in Quantity Supplied



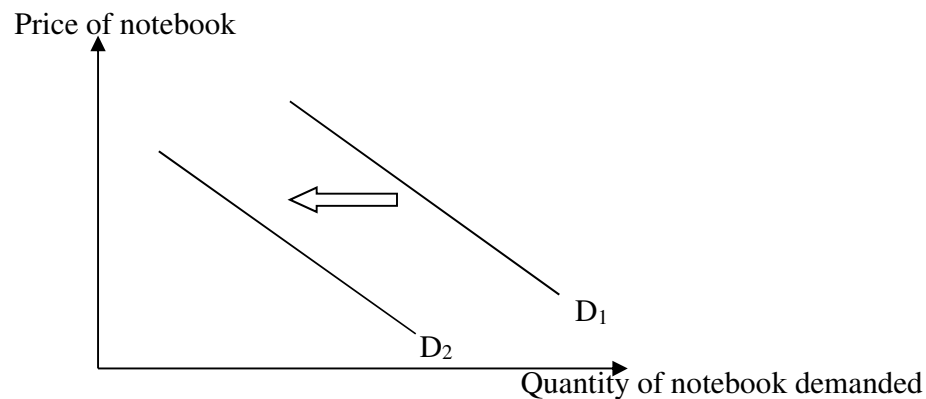
6. Illustration Questions

What effect should each of the following have upon the demand or supply for notebook? Explain your reasoning in each case and draw the relevant demand or supply curve.

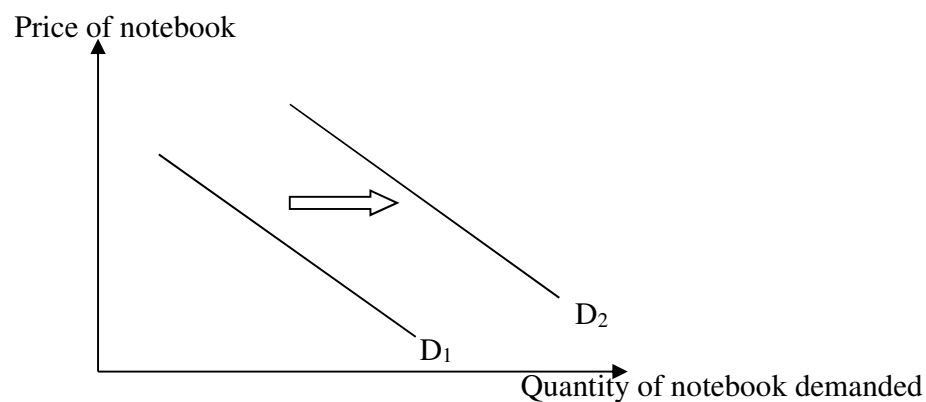
- (a) The development of low-priced tablet that compete with Notebook.
- (b) A substantial increase in the number of computer games
- (c) A substantial decrease in the price of resources in the notebook industry
- (d) Consumer expectations of substantial price increases in notebook

Suggested Answers:

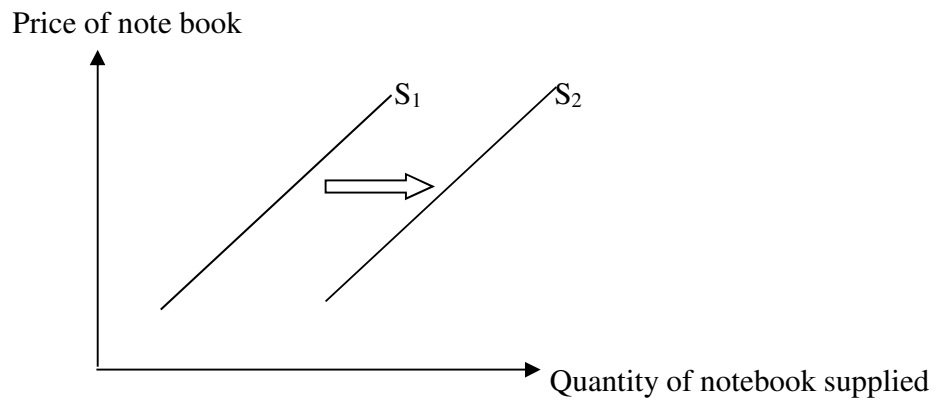
- (a) The availability of low-priced tablet will cause a decrease in demand for notebook, assuming that tablet is a substitute for notebook.



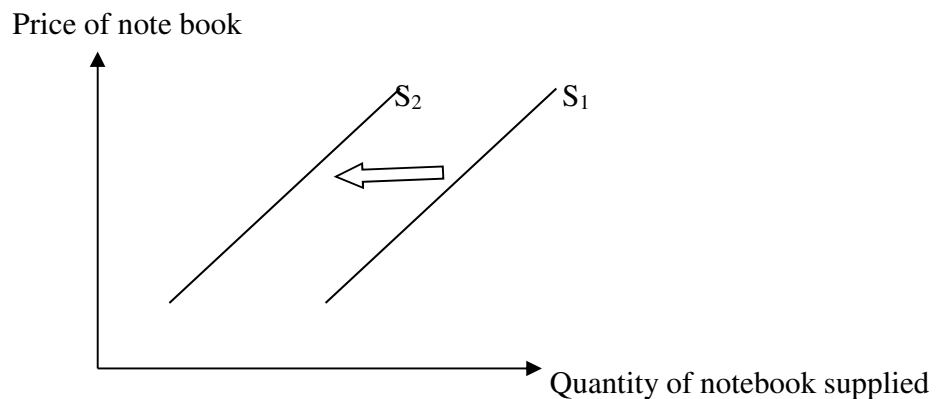
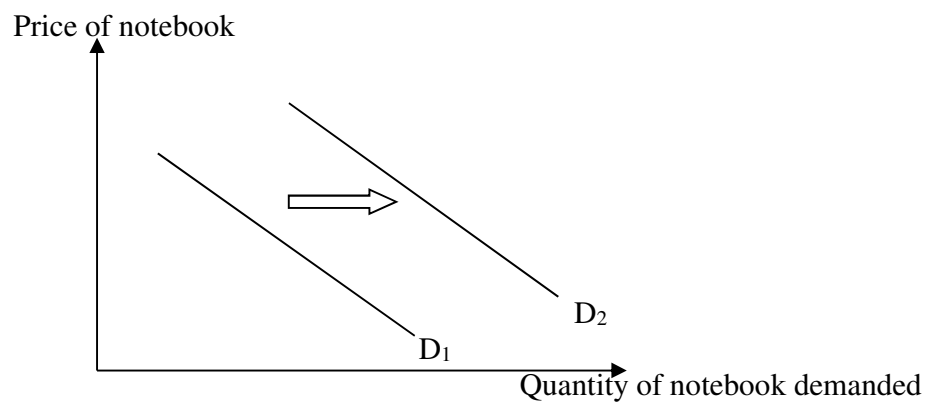
- (b) An increase in the number of computer games should increase demand for notebook with increased number of computer games since computer games and notebook are complements. The availability of a variety of computer games should make owning a notebook more desirable.



- (c) The lower price of resources should increase the supply of notebook since lower resource prices will result in the producer employing more resources and hence more notebook will be supplied in the market at all prices.



- (d) On the demand side, expectations about the higher future price will prompt the consumers to “buy now” to beat the future price increase. Thus the demand for notebook will increase. On the supply side, expectations about the higher future price will prompt the producers to supply less now so as to supply more in the future. Thus the supply of notebook will decrease.



7 Discussion Questions

Question 1

Which of the following will not cause a shift in the demand curve for apple?

- (A) An increase in income of consumers.
- (B) The price of pear increases and pear is a substitute for apple.
- (C) A decrease in the price of apple.
- (D) A research report concluding that eating apple is beneficial to health.

Question 2

Assume an alternate world where Social Media is NOT free. An increase in consumer incomes leads to a decrease in the demand for Social Media. This suggests that Social Media is _____.

- (A) a normal good
- (B) an inferior good
- (C) a complement good
- (D) none of the above

Question 3

The fictitious company RAXER makes gaming laptops. All of the following would cause the supply of RAXER gaming laptops to shift to the right, **EXCEPT** _____.

- (A) an improvement in the technology used to make RAXER gaming laptops
- (B) a rise in the price of RAXER gaming laptops
- (C) A fall in the wages of workers employed to make RAXER gaming laptops
- (D) RAXER's expectation that gaming laptop prices will fall in the future

Question 4

Suppose the price of petrol increases and that continental cars use more petrol compared to other types of cars. One would expect

- (A) the demand for petrol to decrease.
- (B) the demand for continental cars to decrease.
- (C) the demand for continental cars to increase.
- (D) the quantity demanded of continental cars to decrease.

Question 5

A market demand curve can be constructed by

- (A) adding the prices all consumers will pay for any given quantity.
- (B) adding the quantities that all consumers buy at each price.
- (C) adding the quantities that a consumer buys at the highest price.
- (D) None of the above answers is correct.

Question 6

For the following statement, state if they are true or false and justify your answer.

- (a) An increase in quantity demanded is only affected by a decrease in the current price and not by any other factor.
- (b) When the price of an input falls, the supply curve should shift rightward.
- (c) An increase in income must result in an increase in demand.

Question 7

What effect should each of the following have upon the demand or supply for cars? Explain your reasoning in each case and draw the relevant demand or supply curve.

- (a) The public transport becomes more expensive.
- (b) A substantial increase in the price of petrol.
- (c) An improvement in the technology of producing cars.

MICROECONOMICS

SESSION 3

MARKET EQUILIBRIUM AND EFFICIENCY

At the end of the session, students should be able to:

1. Explain how demand and supply determine the market equilibrium price and quantity
 2. Use this supply-demand framework to make predictions about how the equilibrium price and quantity of a product will be affected as demand and/or supply conditions change.
 3. Explain the connection between demand and marginal benefit and define consumer surplus
 4. Explain the connection between supply and marginal cost and define producer surplus
 5. Explain the conditions under which the market mechanism will lead to an efficient allocation of resources
-

1. Introduction

In this session, we combine the demand and supply curves to analyze the market. A market is a place where producers meet the consumers. The analysis of a market focuses on the determination of the equilibrium condition in the market. Next, we apply the demand and supply framework to analyze the effect of changes in the demand and supply on the market equilibrium. Then we connect the demand curve to marginal benefit and supply curve to marginal cost to analyze the concepts of consumer surplus and producer surplus which indicates the welfare of consumers and producers respectively. Finally we analyse the importance of market in efficient allocation of resources.

2 The Market Analysis

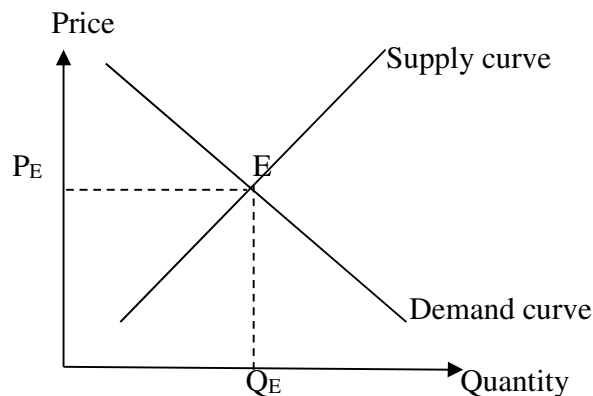
In this course, we implicitly assume the economy follows the free market system with minimum government intervention. We also assume that the market is competitive market where there are large number of buyers and sellers. This means no single buyer or seller can influence the market price and it is the market demand and supply that determine the price and the quantity of product produced and consumed. It is illustrated by combining a demand curve and a supply curve in the same diagram.

The Y-axis is price and the X-axis is the quantity. The intersection point illustrates market equilibrium. The term "equilibrium" means stability and no further change. The corresponding price and quantity are known as the equilibrium price and equilibrium quantity respectively. At this price, quantity demanded equals quantity supplied. There is no shortage and surplus and price will have no tendency to change.

2.1 The Market Equilibrium

By bringing together market demand and supply together, the market equilibrium can be determined. The equilibrium point is where the supply curve intersects demand curve, indicates quantity demanded equals quantity supplied. This is shown at Point E in Figure 3.1. The corresponding price is the equilibrium price P_E and the corresponding quantity is the equilibrium quantity Q_E .

Figure 3.1: Market Equilibrium

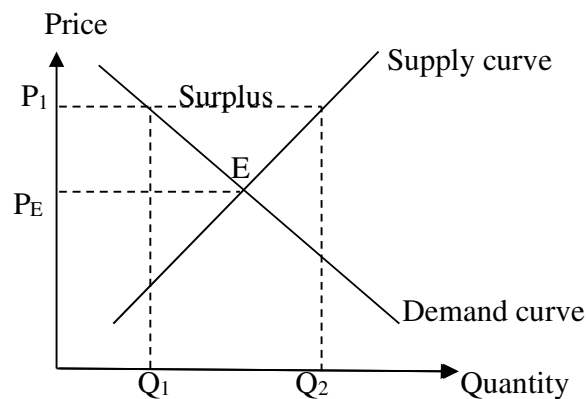


Suppliers and demanders have different views of price, since demanders pay the price and suppliers receive it. As price rises, consumers reduce their quantity demanded but producers increase their quantity supplied. A product's market sorts out the conflicting price perspectives of suppliers and demanders through the adjustment in the price.

2.2 Surplus or Excess Supply

If the price is higher than the market equilibrium price, the quantity supplied exceeds the quantity demanded, resulting in an excess quantity supplied, or a surplus. A surplus creates downward pressure on the price. This is shown in Figure 1.9.

Figure 3.2: Surplus in the Market



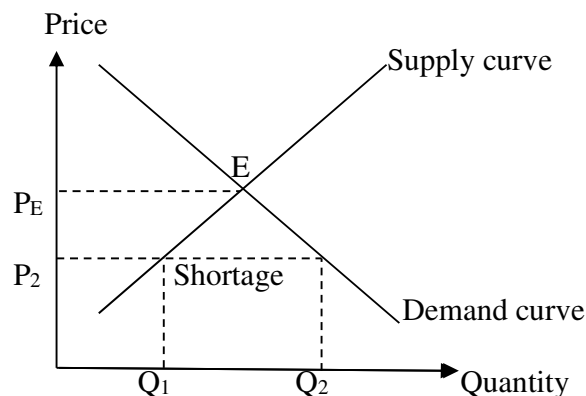
If the market price is P_1 which is higher than P_E , then the producer will want to supply a quantity Q_2 while the consumers only want to consume up to a quantity Q_1 . The producer will encounter unsold products.

There are several ways to treat the unsold products. One way is to store the product in the warehouse and clear them in the future. However, this only applies to durable products. In addition, it incurs storage cost and producers will encounter increasing difficulties to sell the product with time. Hence it will be a better choice to lower the price to entice consumers to buy. Thus the producer will be under pressure to reduce the price in order to sell more. As price decreases, the surplus will reduce. Price will continue to decrease until there is no more surplus.

2.3 Shortage or Excess Demand

If the price is lower than the market equilibrium price, the quantity demanded exceeds the quantity supplied, resulting in an excess quantity demanded, or a shortage. A shortage creates upward pressure on the price. This is shown in Figure 3.3.

Figure 3.3: Shortage in the Market



If the market price is P_2 which is lower than P_E , then the producer will want to supply a small quantity Q_1 while the consumers only want to consume a large quantity Q_2 . There will be insufficient of the product to meet every consumer's need and those who have a stronger desire for the product will have to offer a higher price to obtain the product. Thus the consumers will be under pressure to offer higher price and the price will continue to increase until there is no more shortage.

In general, the price of a product will continue to adjust upwards and downwards until the quantity demanded exactly equals the quantity supplied. The surplus give rise to unsold goods and producers will be under pressure to reduce price. The shortage will prompt consumers to offer a higher price to get the product. There will be no further adjustment once an equilibrium is reached. At this point the market is at equilibrium because the

quantity consumers are willing and able to buy equals the quantity producers are willing and able to sell. There is no shortage and surplus and no pressure for change.

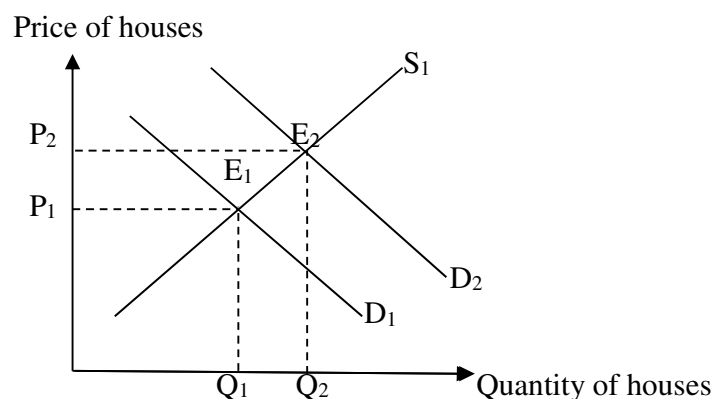
3 Changes in Market Equilibrium

Note that the equilibrium price is determined by the demand and supply curves. If demand or supply curve shifts the equilibrium price and quantity will be different. When the determinants of demand change such that demand curve shifts right, equilibrium price and quantity will increase. When the determinants of supply changes such that supply curve shifts left, equilibrium price increases while quantity decreases.

3.1 Impact of Changes in Demand

Consider the housing market. When there is an increase in the population, the demand for houses will increase. This is shown in Figure 3.4. The higher population leads to greater demand for houses, increases the price from P_1 to P_2 and increases the quantity from Q_1 to Q_2 .

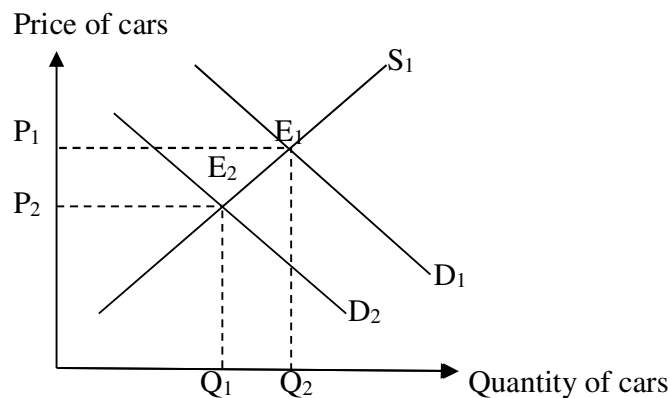
Figure 3.4: Increase in Demand



The adjustment from E_1 to E_2 can be analyzed as follows: At market price P_1 , when demand increases and demand curve shifts from D_1 to D_2 , there will be a shortage at the price P_1 . The shortage will push up the price. As price increases, consumers will want to buy less while producers will want to produce more. The shortage will become smaller and smaller until eventually there is no more shortage. This occurs at the higher price P_2 where the quantity demand again equals quantity supplied at Q_2 .

We can also analyze in decrease in demand by considering the car market. When there is an increase in the price of petrol which is a complementary good to car, the demand for car will decrease. This is shown in Figure 3.5. The higher price of a complementary good reduces the demand for car, decreases the price from P_1 to P_2 and reduces the quantity from Q_1 to Q_2 .

Figure 3.5: Decrease in Demand

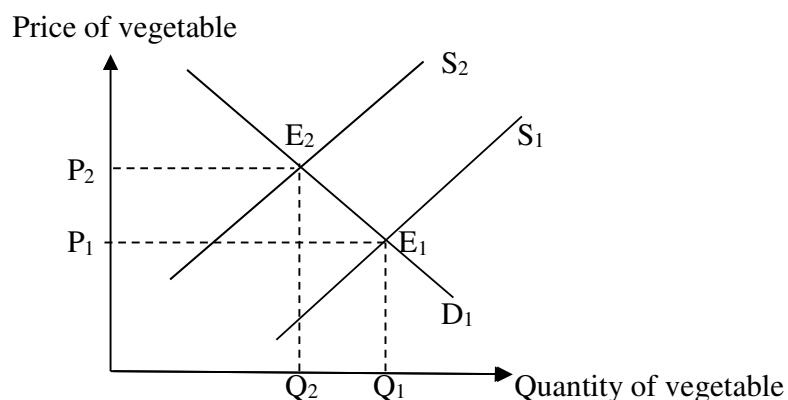


In general, starting with an initial equilibrium, if any of the factors of demand changes in a way that increases demand, the demand curve will shift to the right. The result is that the new equilibrium price and quantity will be higher than the previous one. If any of the factors of demand changes in a way that it decreases demand, the demand curve will shift to the left. The result is that the new equilibrium price and quantity will be lower than the previous one.

3.2 Impact of Changes in Supply

Consider the vegetable market as an illustration. When there is a flood that destroy many vegetable farms, the supply of vegetable will decrease. This is shown in Figure 3.6 where the supply curve shifts to the left from S_1 to S_2 .

Figure 3.6: Decrease in Supply of Vegetables

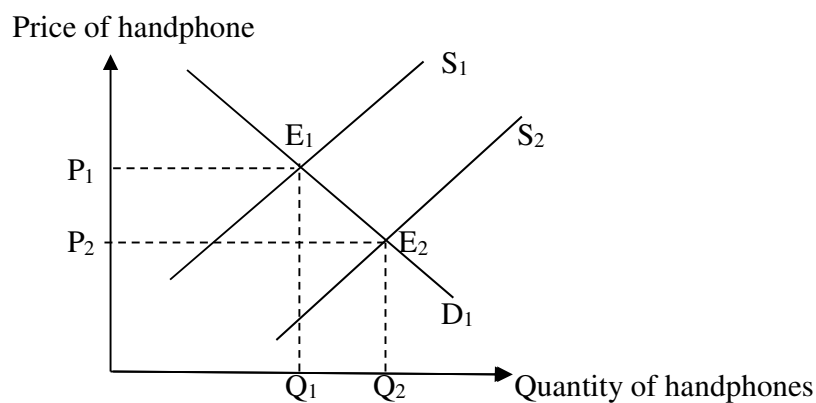


The flood reduces the supply of vegetables, increases the price from P_1 to P_2 and reduce the quantity from Q_1 to Q_2 . The adjustment from E_1 to E_2 can be analyzed as follows: At market price P_1 , when supply decreases from S_1 to S_2 , there will be a shortage at the price P_1 . The shortage will push up the price. As price increases, consumers will want to buy

less while producers will want to produce more. The shortage will become smaller and smaller until eventually there is no more shortage. This occurs at the higher price P_2 and a smaller quantity Q_2 where the quantity demanded again equals quantity supplied.

We can also illustrate an increase in supply by considering the handphone market. When there is an improvement in the technology of producing handphone, the supply of handphone will increase. This is shown in Figure 3.7. The technological improvement increases the supply of handphones, decreases the price from P_1 to P_2 and increases the quantity from Q_1 to Q_2 .

Figure 3.7: Increase in Supply of Handphones



In general, starting with an initial equilibrium, if any of the factors of supply changes in a way that it increases the supply, the supply curve will shift to the right. The result is that the new equilibrium price will be lower but the new equilibrium quantity will be higher. If any of the factors of supply changes in a way that it decreases the supply, the supply curve will shift to the left. The result is that the new equilibrium price will be higher but the new equilibrium quantity will be lower.

3.3 Simultaneous Changes in Demand and Supply

If there is only the demand curve or the supply curve shifts, the impact on the price and quantity can be determined with certainty. But if there is a simultaneous shift in both the demand and the supply curve, there will be three possibilities. The three possibilities are:

- (a) The demand curve shifts by a larger magnitude than the supply curve
- (b) The supply curve shifts by a larger magnitude than the demand curve
- (c) Both the demand curve and the supply curve shift by the same magnitude.

There will be three possible outcomes and one of the change, either price or quantity, we cannot determine with certainty. These are illustrated as follows:

Consider both demand and supply increase simultaneously. When demand increases, price and quantity increase. When supply increases, price decreases and quantity increases. Hence both demand and supply forces result in quantity increases but opposing directions in the price change. The result is the quantity will increase with certainty but the effect on price change is ambiguous.

Consider both demand and supply decrease simultaneously. When demand decreases, price and quantity decrease. When supply decreases, price increases and quantity decreases. Hence both demand and supply forces result in quantity decreases but opposing directions in the price change. The result is the quantity will decrease with certainty but the effect on price change is ambiguous.

Consider demand increases and supply decreases simultaneously. When demand increases, both price and quantity increase. When supply decreases, price increases and quantity decreases. Hence both demand and supply forces result in price increases but opposing directions in the quantity change. The result is the price will increase with certainty but the effect on quantity change is ambiguous.

Consider demand decreases and supply increases simultaneously. When demand decreases, both price and quantity decrease. When supply increases, price decreases and quantity increases. Hence both demand and supply forces result in price decreases but opposing directions in the quantity change. The result is the price will decrease with certainty but the effect on quantity change is ambiguous.

4. Market Demand, Market Supply, Marginal Benefit and Marginal Cost

We have been analyzing the market demand which shows the quantity demanded in the entire market over a range of price. The market demand curve is derived from aggregation of individual demand. In the same context, the market supply curve which shows the total quantity supplied at various prices, is also an aggregation of individual supply.

The market demand represents the marginal benefits of consumers while the market supply represents the marginal cost of producers in the market. The marginal benefit and marginal cost are useful concepts to analyze the surplus and efficiency in the market and the entire society. If the market is efficient, using the market system to allocate resources will also maximize the welfare of the society by maximizing the sum of producer and consumer surplus.

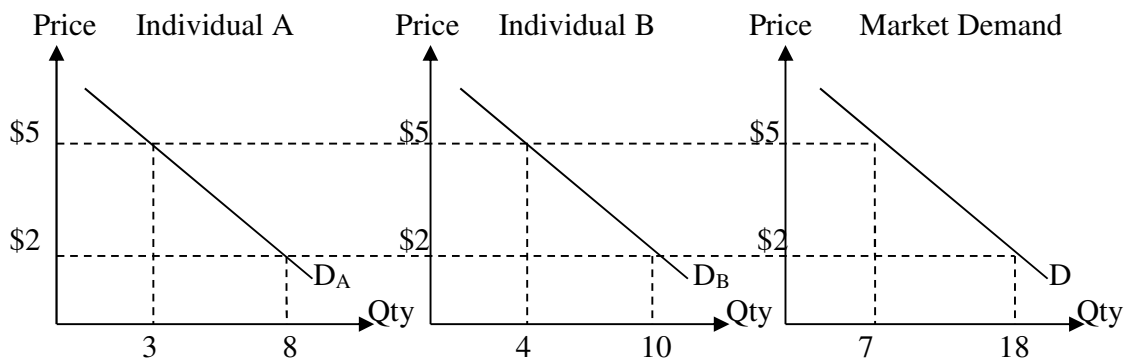
4.1 Individual Demand and Market Demand

In a typical product market, there are many consumers and each consumer has their own individual demand for the product. According to the law of demand, each individual will buy less when price increases and will buy more when price decreases. The individual

demand curve is downward sloping. The market demand curve is obtained by the horizontal summation of individual demand curve.

Horizontal summation refers to summing up the quantity demanded for all individual consumers at each price. Consider a market with only two consumers, A and B, with their individual demand curves D_A and D_B respectively in Figure 3.8.

Figure 3.8: Individual and Market Demand Curve



At price \$5 per unit, Individual A wants to buy 3 units while Individual B wants to buy 4 units. The total market quantity demanded will be 7 units. At price \$2 per unit, Individual A wants to buy 8 units while Individual B wants to buy 10 units. The total market quantity demanded at this price will be 18 units. Since the individual demand curves are downward sloping, the market demand curve is also downward sloping but it is flatter than the individual demand curves.

4.2 Marginal Benefit and Consumer Surplus

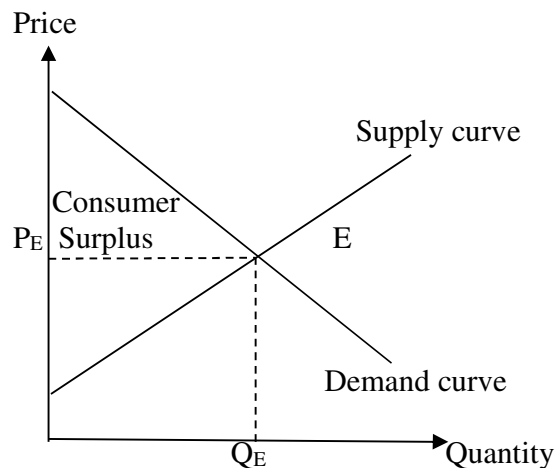
For all consumers, there is a maximum price that each would pay for a product. Each consumer's maximum price is called his willingness to pay or the reservation price, and it measures how much that buyers values the good. Buyer will be eager to buy at a price less than his willingness to pay and will refuse to buy at a price more than his willingness to pay.

The price is determined by the market system. If this price is lower than the price that the consumers are willing to pay, there will be extra welfare enjoyed by the consumer when he buy this product at the market price. This extra welfare is called the consumer surplus. If the market price is higher than the reservation price, the consumers will refuse the buy the product.

Consumer surplus is the amount a buyer is willing to pay for a good minus the amount the buyer actually pays for it. It measures the benefits to buyers of participating in a market. Consumer surplus is closely related to the marginal benefit represented by the demand curve for a product. In fact, the demand curve illustrates the willingness of consumers to

pay for a certain quantity of a product. The area below the demand curve and above the price is the consumer surplus. This is shown in Figure 3.9. Note that the lower the market price, the larger is the consumer surplus. Thus consumers' welfare increases when market price decreases.

Figure 3.9: Consumer Surplus

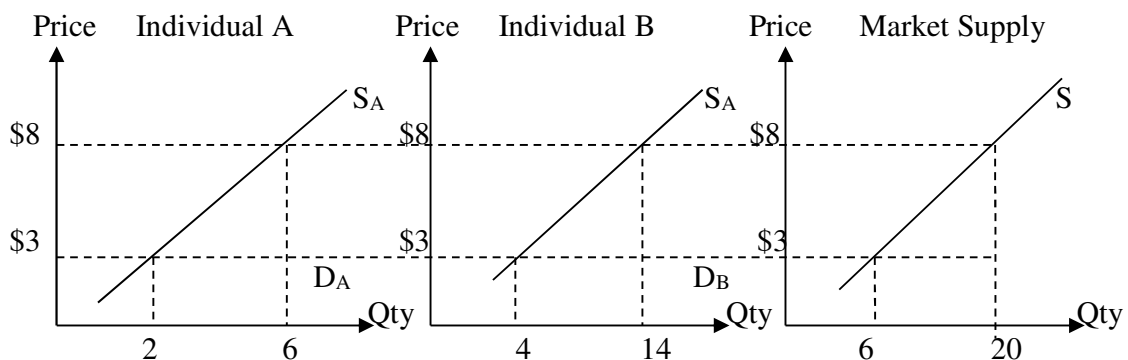


4.3 Individual Supply and Market Supply

In a competitive product market, there are many producers and each producer has their own individual supply of their product. According to the law of supply, each supplier will produce more when price increases and will produce less when price decreases. The individual supply curve is upward sloping. The market supply curve is obtained by the horizontal summation of individual supply curve.

Horizontal summation refers to summing up the quantity supplied for all individual supplier at each price. Consider a market with only two producers, A and B, with their individual supply curves S_A and S_B respectively in Figure 3.10.

Figure 3.10: Individual and Market Supply Curve



At price \$3 per unit, producer A wants to supply 2 units while producer B wants to supply 4 units. The total market quantity supplied will be 6 units. At price \$8 per unit, producer A wants to produce 6 units while producer B wants to produce 14 units. The total market quantity supplied at this price will be 20 units. Since the individual supply curves are upward sloping, the market supply curve is also upward sloping but it is flatter than the individual supply curves.

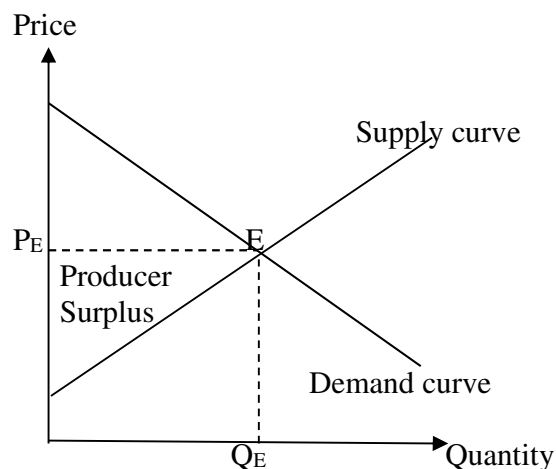
4.4 Marginal Cost and Producer Surplus

Producers will be willing to produce and supply a product if the price received exceeds the cost of supply. Cost here refers to opportunity cost, not just the cost of hiring resources. For each unit produced, the producer must cover the cost of production which is the marginal cost. The price that allow him to cover his marginal cost is the lowest price the producer must receive for his effort. Marginal cost is thus a measure of his willingness to sell. Each producer will be eager to supply at a price higher than his marginal cost and will refuse to supply at a price less than his marginal cost.

So long as the price, determined by the market system, is higher than the marginal cost incurred by producer, there will be extra welfare enjoyed by the producer when he produced and sell this product at the market price. This extra welfare is called the producer surplus.

Producer surplus is the amount a seller is paid minus the cost of production. It measures the benefit to sellers of participating in a market. Since the supply curve reflects seller's marginal costs, it can be used to measure producer surplus. The area below the price and above the supply curve measures the producer surplus in a market. This is shown in Figure 3.11. Note that the higher the market price, the larger is the producer surplus. Thus producers' welfare increases when market price increases.

Figure 3.11: Producer Surplus



5. Market and Efficiency

The concept of consumer surplus and producer surplus are important to analyze the welfare of a society. They are the basic tools that economists use to study the welfare of buyers and sellers in a market. We are interested to find out whether changes in allocation of resources can increase welfare of the people in an economy. If an allocation of resources maximizes total surplus, the allocation exhibits efficiency. An allocation is inefficient if a good is not produced by the lowest cost producers and not consumed by the highest value consumers.

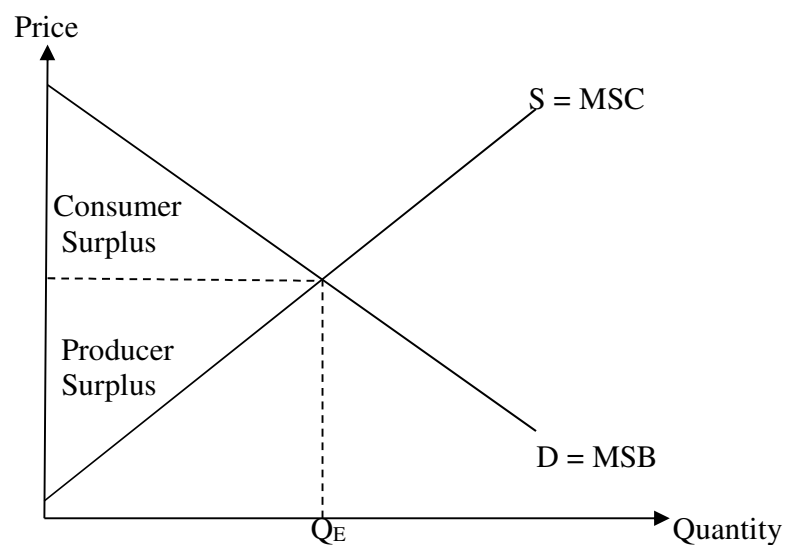
5.1 Market Equilibrium and Social Efficiency

Consider the market of a product. The demand curve measures the marginal benefit of consumers in the market, which is the marginal private benefit. If there is no other external parties in the society that can derive benefits from this product, the marginal private benefit is the same as the marginal social benefit (MSB), both represented by the market demand curve.

Similarly, the supply curve measures the marginal cost of producers in the market, which is the marginal private cost. If there is no other external parties in the society that incur cost in this product, the marginal private cost is the same as the marginal social cost (MSC), both represented by the market supply curve.

Refer to Figure 3.10 where the market is considered. we can compute the consumer surplus and the producer surplus when the market reaches its equilibrium. The society will maximizes its welfare at the output level where marginal social benefit equals marginal social cost.

Figure 3.10: Welfare of a Society Under Market System



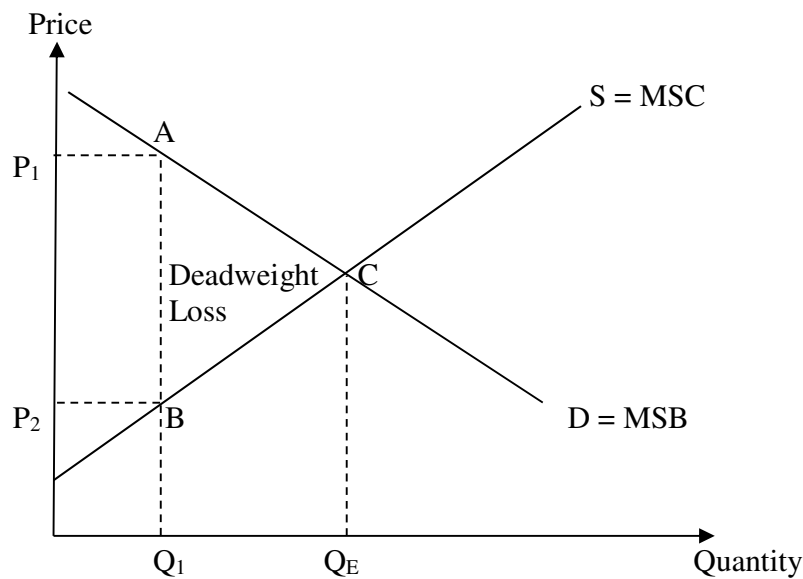
When a competitive market reaches its equilibrium, the total economic surplus is maximized. The market allocates the supply of goods to the buyers with highest value and allocates the demand for goods to sellers who with least cost, thus maximizes the sum of consumer surplus and producer surplus. This is shown in Figure 3.10. where the social welfare or economic surplus, which is the sum of producer surplus and consumer surplus, is maximized.

If the MSB is higher than MSC, the social welfare will increase with additional output. But if the MSC is larger than MSB, the social welfare will increase with a decline in output. Hence if the quantity is not at Q_E , then the social welfare will be reduced.

5.2 Effects of Under-Production

Assume that due to some intervention from the government, the market is producing at a quantity Q_1 below the market equilibrium quantity Q_E , as shown in Figure 3.11.

Figure 3.11: Welfare Effect of Under-Production

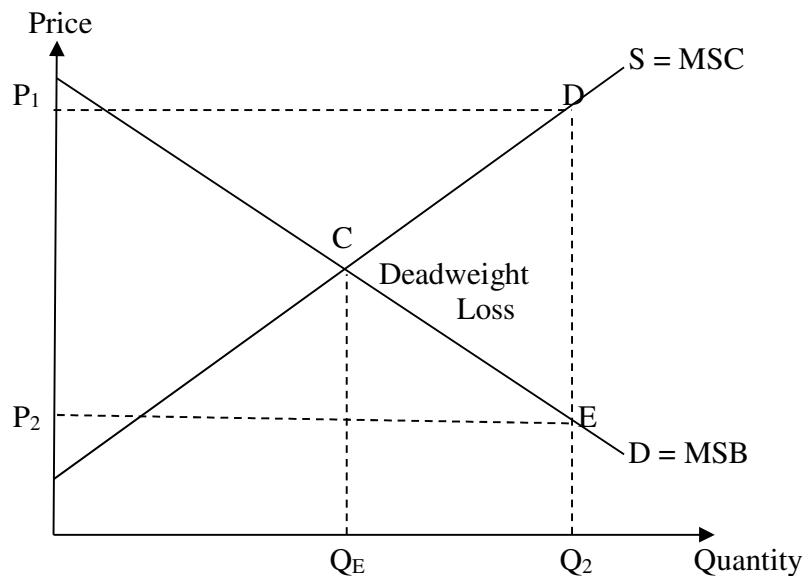


At the quantity Q_1 , the marginal social benefit, represented by P_1 is higher than the marginal social cost, represented by P_2 . Thus the welfare of the society can increase if output can increase further until MSB equals MSC at the market equilibrium quantity Q_E . If the market quantity is fixed at Q_1 , the economic surplus is not maximized. The amount of welfare loss will be given by the area represented by the triangle ABC. This is known as the deadweight loss. It is a loss of welfare in the society not gain by any party in the society. It also implies inefficiency as too few resources are been allocated to this production leading to under-production.

5.3 Effects of Over-Production

Assume that due to some intervention from the government, the market is now producing at a quantity Q_2 which is larger than the market equilibrium quantity Q_E , as shown in Figure 3.12.

Figure 3.12: Welfare Effect of Under-Production



At the quantity Q_2 , the marginal social cost, represented by P_1 is higher than the marginal social benefit, represented by P_2 . This means there is actually negative welfare or a loss in the society. The negative welfare or loss in the society can decrease if output were to decrease further until MSB equals MSC at the market equilibrium quantity Q_E .

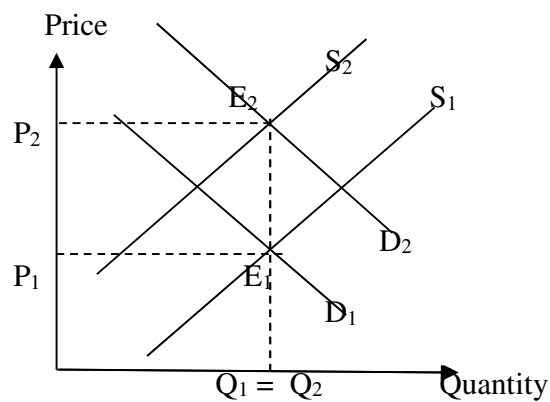
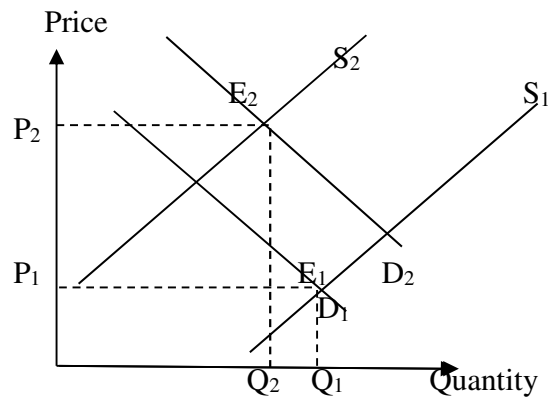
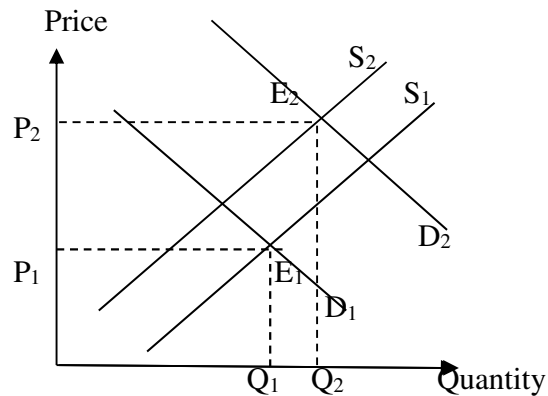
Hence if the market quantity is fixed at Q_2 , the economic surplus is again not maximized. The amount of welfare loss will be given by the area represented by the triangle CDE. This is the deadweight loss due to overproduction and it is inefficient as too much resources have been allocated to the production.

6 Illustration Questions

The tourism sector is an important sector in the Singapore. Recently two incidents occurred in the Singapore tourism industry. One incident is that there are more and more tourist attractions, such as the Gardens by the Bay, the Maritime Museum and the Marine Life Park. The other incident is the greater restriction imposed by the Singapore government for firms to employ foreign labour, where many of them are working in the tourism industry. Analyze the effects on the tourism industry in Singapore when these two incidents occurred simultaneously. Use suitable demand-supply diagrams to support your analysis.

Suggested answers:

The availability of more tourist attractions increase preferences of travel and lead to a larger demand for tourism services, thus demand curve shifts right. The restriction in foreign labour leads to lesser inputs and reduces the supply of tourism services, thus supply curve shifts left. With demand curve shifts right and supply curve shifts left, there are three possible outcomes as shown in the three diagrams as follows.



The first diagram shows demand curve shifts more than the supply curve, resulting in a higher price and a larger quantity. The second diagram shows supply curve shifts more than the demand curve, resulting in higher price and a smaller quantity. The final diagram shows demand and supply curves shift by the same magnitude, resulting in higher price and unchanged quantity.

7. Discussion Questions

Question 1

Which of the following would cause the equilibrium price of bread to decrease and the equilibrium quantity of bread to increase?

- (A) An increase in the price of butter, a complement for bread.
- (B) A decrease in the price of flour.
- (C) An increase in the price of cake, a substitute for bread.
- (D) An increase in the price of flour.

Question 2

Which of the following would cause the equilibrium price of bread to decrease and the equilibrium quantity of bread to increase?

- (A) An increase in the price of butter, a complement for bread.
- (B) A decrease in the price of flour.
- (C) An increase in the price of cake, a substitute for bread.
- (D) An increase in the price of flour.

Question 3

When the price is fixed at _____, there is always deadweight loss.

- (A) the equilibrium level,
- (B) higher than the equilibrium level,
- (C) lower than the equilibrium level,
- (D) higher or lower than the equilibrium level

Question 4

When people's incomes increase, the demand for a good increases. The result in the market is

- (A) equilibrium price and quantity increase.
- (B) equilibrium price and quantity decrease.
- (C) equilibrium price increases and equilibrium quantity decreases.
- (D) equilibrium price decreases and equilibrium quantity increases.

Question 5

Homer, Bart, and Lisa are the only consumers in the market. Using the information in the table below, what is the market demand for chocolate chip cookies at \$4.00 per box?

Price (dollars per box)	Bart's quantity demanded (boxes)	Lisa's quantity demanded (boxes)	Homer's quantity demanded (boxes)
2	9	5	7
3	7	4	6
4	4	2	5
5	1	0	3

- (A) 21 boxes
- (B) 17 boxes
- (C) 11 boxes
- (D) 4 boxes

Question 6

What are the effects on the mobile phone market when the following incidents occur? Analyse each case independently and support your analysis with a market diagram.

- (a) The price of phablets increases. Major components in the production of both mobile phones and phablets can be shared.
- (b) Consumers are increasingly concerned about reports on mobile phones causing brain tumours.

Question 7

Cupcakes have become quite popular in Singapore, evidenced by the rise in the number of cupcake shops. Cupcakes are known to be a normal good. Using Demand and Supply

diagrams, show and explain the effects of the following events on the price of cupcakes and quantity of cupcakes sold.

Please note that Parts (a) and (b) have each taken place SEPARATELY.

- (a) The cost of sugar (a key raw material of cupcakes) rises.
- (b) The incomes of students (an important group of cupcake buyers) rises dramatically.

MICROECONOMICS

SESSION 4

ELASTICITY

At the end of the session, students should be able to:

1. Define, calculate, and explain the factors that influence the price elasticity of demand
 2. Explain the relationship between price elasticity of demand and total revenue
 3. Define, calculate and explain the factors that influence the cross (price) elasticity of demand and the income elasticity of demand
 4. Define, calculate, and explain the factors that influence the elasticity of supply
-

1. Introduction

Recall in Session 2, we learnt that consumers will buy more when price decreases. However, producers need more specific information about the magnitude of the change in quantity demanded when price changes in order to make decision. This information is provided by the price elasticity of demand. In this session, we begin with an introduction to the concept of price elasticity of demand. Next we analyse the impact on producer's revenue when price changes using the concept of price elasticity of demand. Then, we introduce the concept of income elasticity of demand and cross-price elasticity of demand. Finally, we analyze the concepts of price elasticity of supply and explore its determinants.

2. Price Elasticity of Demand

Due to the law of demand, when price decreases quantity demanded increases. But the magnitude of the change is determined by the elasticity of the demand curve. Let us consider the effect of a technological improvement in a market which increases the supply. When supply increases, the effect is price decreases and quantity increases. However, the magnitude of change in the price and quantity can be very different in different market.

Refer to Figure 4.1(a). When supply increases, the effect is a large decrease in price and a small increase in quantity demanded. The consumers are not very responsive to the change in price. On the other hand, in Figure 4.1(b), when supply increases, the effect is a small decreases in price and a large increases in quantity demanded. The consumers are very responsive to the change in price. This highlights the needs for a measure of the responsiveness of the quantity demanded to a price change. This measure is the price elasticity of demand.

Figure 4.1(a)

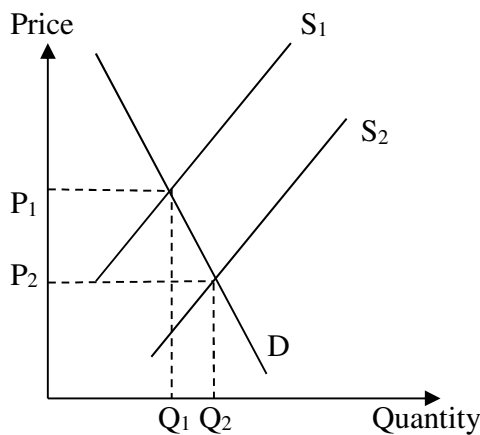
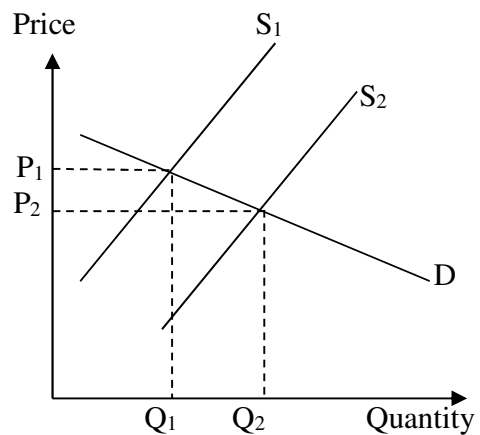


Figure 4.1(b)



2.1 Definition of Price elasticity of demand

Price elasticity of demand, denoted by P_{ED} , is defined as percentage change in quantity demanded divided by percentage change in price, as shown below. Based on the law of demand, price and quantity demanded always move in opposite directions. If price change is positive, change in quantity demanded must be negative. Thus the term change in quantity divided by change in price is always negative.

$$P_{ED} = \frac{\% \text{ change in quantity demanded}}{\% \text{ change in price}}$$

When analyse price elasticity of demand we always ignore the negative sign and consider the absolute value. This is because we may need to compare price elasticity of demand across different product to determine which product is more responsive to a given price change. Comparison using negative value may create confusion since we are only interested in the magnitude and the negative sign is only an indication of the inverse relationship between price and quantity demanded.

If the absolute value exceeds 1, it means the percentage change in quantity demanded is larger than the percentage change in price. Consumers are very responsive to the price change and the demand is known as elastic. The demand curve will be relatively flat.

If the absolute value is less than 1, it means the percentage change in quantity demanded is smaller than the percentage change in price. Consumers are not responsive to the price change and the demand is known as inelastic. The demand curve will be relatively steep.

If the absolute value equals 1, it means the percentage change in quantity demanded is the same as the percentage change in price. Consumers respond to the price change in an equal proportion and the demand is known as unit elastic. This is mainly a theoretical concept.

If the value equals 0, it means the percentage change in quantity demanded is zero regardless of the percentage change in price. Demand is totally inelastic and the demand curve is vertical.

If the absolute value is infinite, it means the percentage change in price is zero regardless of the percentage change in quantity demanded. Demand is totally elastic; the demand curve is horizontal.

2.2 Calculating Price Elasticity of Demand

If the price changes from P_1 to P_2 and the quantity demanded changes from Q_1 to Q_2 , the price elasticity of demand can be calculated over the region of the price and quantity change using the mid-point formula. It can also be calculated at a particular price and quantity, using the point formula.

Using the midpoint formula or the arc formula, the elasticity calculated is known as mid-point elasticity or arc elasticity. The formula is:

$$P_{ED} = \frac{Q_2 - Q_1}{P_2 - P_1} \times \frac{(P_1 + P_2)/2}{(Q_1 + Q_2)/2}$$

This elasticity is measured on the distance between the two points and hence the midpoint price and quantity are used in the calculation. The reference point is the average price and average quantity.

If price increases from \$0.9 to \$1.10 and the quantity demanded decreases from 105 to 95, the price elasticity of demand using the midpoint formula is

$$P_{ED} = \frac{95 - 105}{1.1 - 0.9} \times \frac{(0.9 + 1.1)/2}{(105 + 95)/2} = \frac{-10}{0.2} \times \frac{1}{100} = -0.5$$

The second formula to compute elasticity is the point formula and the elasticity calculated is known as point elasticity. Using the original point as the reference point, the formula is:

$$P_{ED} = \frac{Q_2 - Q_1}{P_2 - P_1} \times \frac{P_1}{Q_1}$$

Again consider the price increases from \$0.9 to \$1.10 and the quantity demanded decreases from 105 to 95. , the price elasticity of demand using the point formula and compute the elasticity at the original point is

$$P_{ED} = \frac{95 - 105}{1.1 - 0.9} \times \frac{0.9}{105} = \frac{-10}{0.2} \times \frac{0.9}{105} = -0.43$$

This elasticity is measured on the original point and hence the original price and quantity are used in the calculation. We can also compute the price elasticity of demand at the final point. In this case the formula is

$$P_{ED} = \frac{Q_2 - Q_1}{P_2 - P_1} \times \frac{P_2}{Q_2}$$

Using the final point as the reference point, we have

$$P_{ED} = \frac{95 - 105}{1.1 - 0.9} \times \frac{1.10}{95} = \frac{-10}{0.2} \times \frac{1.10}{95} = -0.58$$

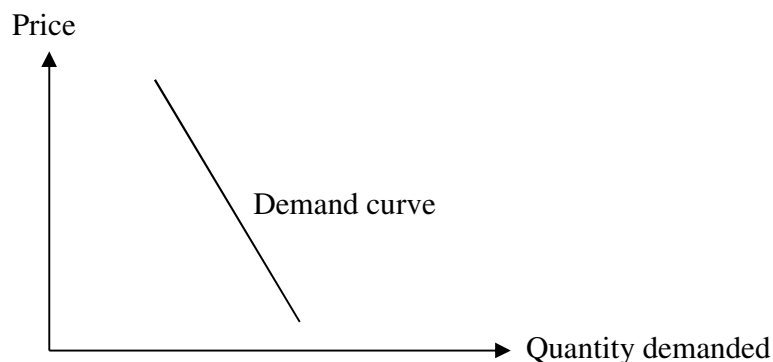
Since using different reference point will produce different values of the price elasticity of demand, for a given price range it is more accurate to use the midpoint formula to compute the price elasticity of demand.

2.3 Interpreting Price Elasticity of Demand

As mentioned in 2.1, When interpreting the price elasticity of demand, we ignore the negative sign and take the absolute value, $|P_{ED}|$.

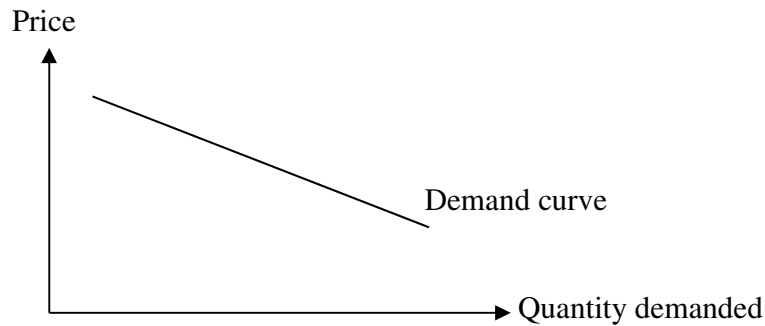
If the percentage change in quantity demanded is smaller than the percentage change in price, $|P_{ED}|$ has a value between 0 and 1, and demand is inelastic. An inelastic demand curve is relatively steeper, where a large change in price is accompanied by a small change in quantity demanded. This is shown in Figure 4.2

Figure 4.2 Inelastic Demand Curve



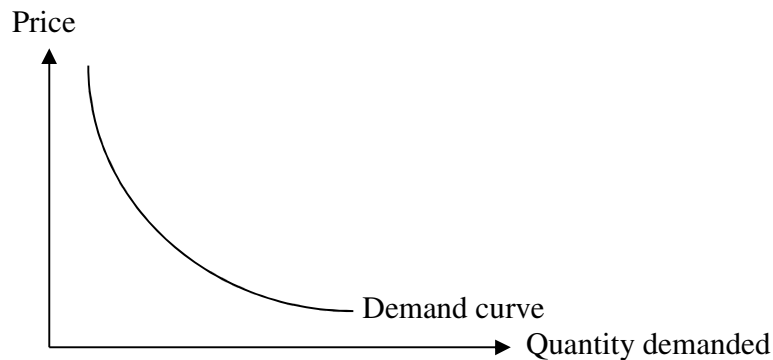
If the percentage change in quantity demanded exceeds the percentage change in price, $|P_{ED}|$ has a value of greater than 1, and demand is elastic. A elastic demand curve is relatively flatter, where a small change in price is accompanied by a large change in quantity demanded. This is shown in Figure 4.3

Figure 4.3 Elastic Demand Curve



If the percentage change in quantity demanded just equals the percentage change in price, $|P_{ED}|$ has a value of 1, and demand is unit elastic. The demand curve is a downward sloping curve known as a rectangular hyperbola, as shown in Figure 4.4.

Figure 4.4 Unit Elastic Demand Curve

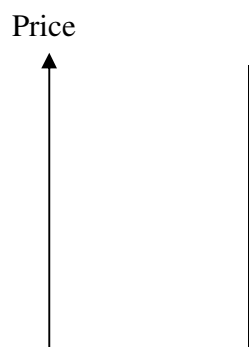


Most of the product in real life are either elastic or inelastic. For unit elastic demand to occur, it requires the change in quantity demanded to be exactly the same magnitude as the percentage change in price which is unlikely to be true for real life product. It is difficult to think of a product where consumers will exactly 10% less when the price increases by 10%. Hence the unit elastic demand is more of a theoretical possibility.

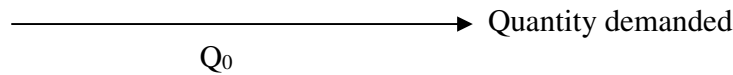
There are two extreme cases of price elasticity of demand, known as perfect inelastic and perfectly elastic demand.

If the percentage change in quantity demand is zero, the $|P_{ED}| = 0$ and the demand is perfectly inelastic. The demand curve is vertical. vertical demand curve indicates that the quantity demanded does not vary at all when the price changes. Regardless of price increases by a large amount or drop all the way to zero, the quantity demanded is always fixed at a specific amount, say at Q_0 . This is shown in Figure 4.5.

Figure 4.5 Perfectly Inelastic Demand Curve

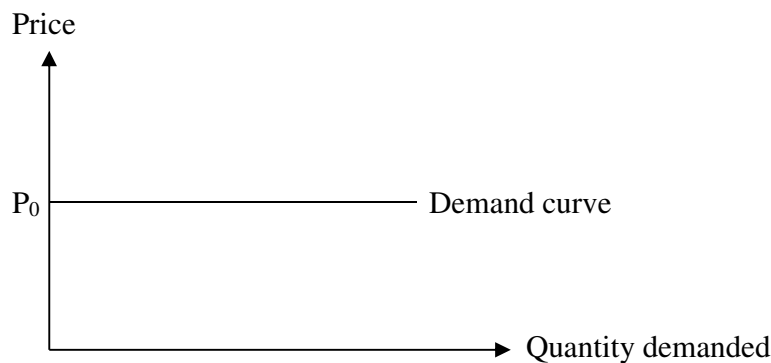


Demand curve



If the percentage change in price is zero, the $|P_{ED}| = \infty$ and the demand is perfectly elastic. The demand curve is horizontal. A horizontal demand curve indicates that the consumer will demand all that is offered for sale at the given price, say at P_0 . If the price rises above the given price, even by a small amount, the quantity demanded drops to zero. It also implies that at the current price, there is an infinite quantity demanded. This is shown in Figure 4.6.

Figure 4.6 Perfectly Elastic Demand Curve



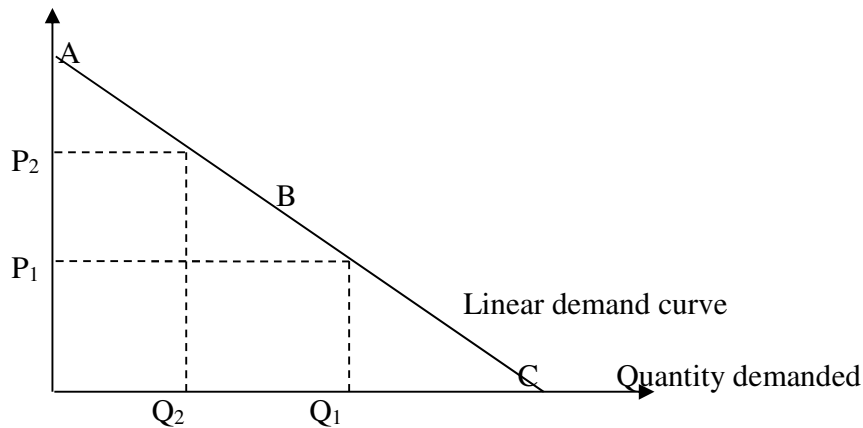
2.4 Elasticity and Slope

While there is a link between price elasticity of demand and the slope of the demand curve, the two are not the same. Specifically, in a straight line demand curve, the slope is the same along the demand curve. But the price elasticity of demand is different at different region of the demand curve.

Demand curve is drawn with price on the Y axis and quantity demanded on the X-axis. Thus the slope of the demand curve is measured by change in price divided by change in quantity. Consider a straight line demand curve with original point P_1 and Q_1 and the final point P_2 and Q_2 , shown in Figure 4.7.

Figure 4.7: Slope of Linear Demand Curve

Price



The slope of the demand curve is given by $(P_2 - P_1)/(Q_2 - Q_1)$. The slope is a constant since it is a straight line demand curve.

Using the point formula and the original point as the reference point, we have the price elasticity of demand as:

$$P_{ED} = \frac{Q_2 - Q_1}{P_2 - P_1} \times \frac{P_1}{Q_1}$$

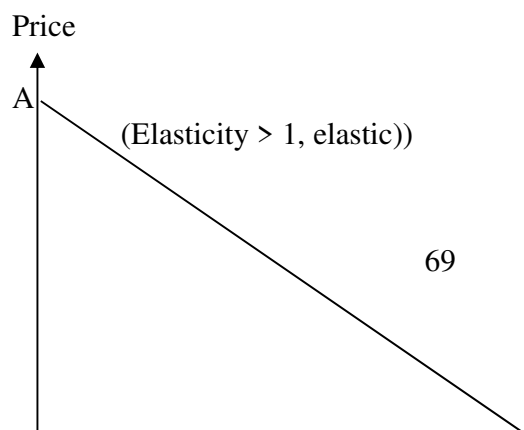
The formula can be expressed as:

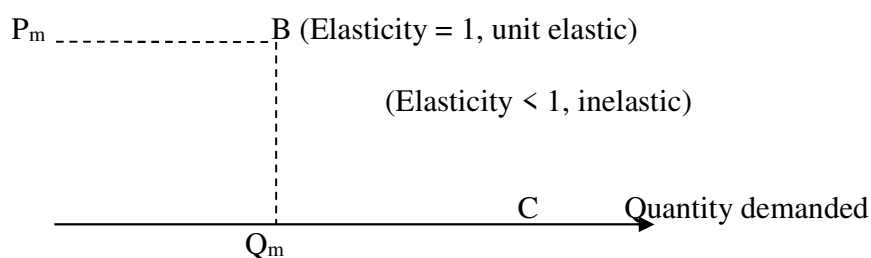
$$P_{ED} = \frac{1}{\text{Slope}} \times \frac{P_1}{Q_1}$$

Moving along the demand curve, the value of price and quantity demanded will change although the slope remains unchanged. Specifically, starting from the Y intercept at point A to the mid-point at point B and eventually to the X-intercept at point C, the value of the price elasticity of demand decreases along the demand curve since moving down the demand curve the price decreases and the quantity demanded increases.

Specifically, at the mid-point of the linear demand curve at point B, the price elasticity of demand will be equal to 1 (in absolute value), thus the demand is unit elastic. At the upper portion of the demand curve between point A and point B, the price elasticity of demand will be larger than 1 in absolute value and the demand is elastic. At the lower portion of the demand curve between point B and point C, the price elasticity of demand will be smaller than 1 in absolute value and the demand is inelastic. This is reflected in Figure 4.8.

Figure 4.7: Elasticity of Demand Curve





2.5 Determinants of Price Elasticity of Demand

Most of the products have either elastic or inelastic price elasticity of demand and different products tend to have different price elasticity of demand. For some products, a small percentage change in the price will result in a large percentage change in the quantity demanded. For other products, a large percentage change in price only results in a small percentage change in quantity demanded. Some factors that affect the price elasticity of demand are as follows:

(a) Availability of substitutes

A product that has many close substitutes will have high value of elasticity (elastic demand). A small price change will induce a large change in quantity demanded since the consumers can easily switch to the close substitutes.

For example, there are many different types of fruit juice. If the price of apple juice increases, consumers can switch to orange or lime juice and will cut down the consumption of apple juice by a large amount, thus the demand for apple juice is elastic. But water has no close substitutes and when price of water increases, consumers will only reduce consumption by a small amount. Thus demand for water is inelastic.

In general, the greater the availability of substitutes for a good and the closer these substitutes, the greater the price elasticity of demand.

(b) Proportion of the consumer's budget spent on the good

A product that occupies a large portion of consumer income will have elastic demand. When the price of this product increases consumers will reduce the consumption of this product substantially. Thus the larger the proportion of the consumer's budget for a product, the greater will be the response from the consumer when the price change, so the more elastic will be the demand for the item.

For example, car is a big-price item and a 1% increase in the car price is a large amount of money and occupies a large proportion of consumer's budget. Hence a 1% increase in the car price may discourage many people from buying cars and the demand for house is elastic. However, bread is a small price item and occupies a small proportion of consumers' budget. A 10% increase in the price of bread may only lead to a small decrease in the quantity of bread consumed.

(c) Time frame

Consumers can substitute lower-priced goods for higher-priced goods but this usually takes time. The longer the period for adjustment, the greater the ability to substitute away from relatively higher-priced products toward lower-priced alternatives, so the greater the response in the change in quantity demanded from a given change in price.

For example, when apple juice becomes expensive today, consumers who have strong preference of drinking apple juice may still continue to buy a large amount of apple juice and the market quantity demanded may only decrease by a small amount and the demand is inelastic. With time passes, consumers may feel the pinch in paying more for apple juice and begin to explore other types of fruit juice, such as orange juice or lime juice. Once the consumers are accustomed to drinking other cheaper juice, they will reduce apple juice consumption by a large amount and the demand becomes more elastic.

3 Price Elasticity of Demand and Total Revenue

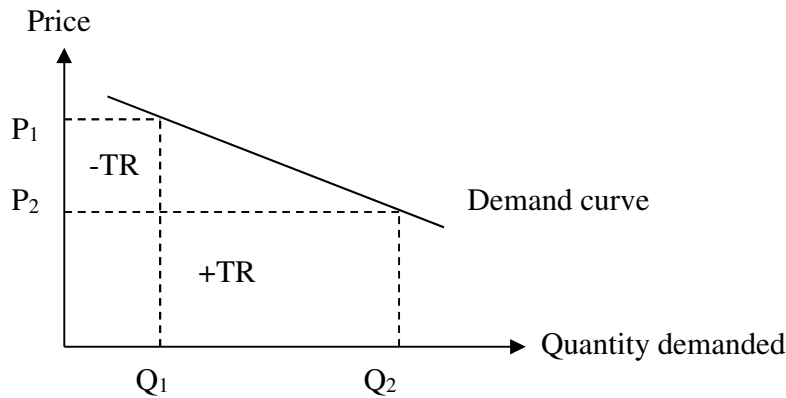
One of the most important applications of price elasticity of demand is to analyse the effect on total revenue when price changes. Total revenue (TR), or total sales, is defined as price multiplied by quantity. Other things equal, a firm may seek to maximize its total revenue by changing its price.

There are two effects when a firm changes its price. When the price is increased, the benefit is that the firm can earn more from each unit of the good but the disadvantage is that consumers will buy less. Conversely when the firm reduces its price, it earns less from each unit sold but consumers may buy more. The overall effect on total revenue depends on the price elasticity of demand.

3.1 Impact on Revenue for Elastic Demand

If the demand is elastic, this means consumers are very responsive to price. A small reduction in price will induce a large increase in quantity demanded. In this case the firm can earn a higher total revenue by reducing its price. This is shown in Figure 4.8.

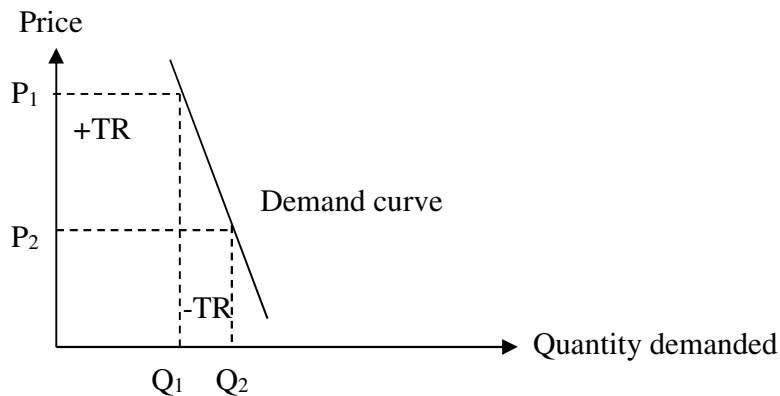
Figure 4.8 Elastic Demand Curve and Total Revenue



3.2 Impact on Revenue for Inelastic Demand

If the demand is inelastic, this means consumers are not responsive to price. Even a large reduction in price did not attract more sales. But a large increase in price only results in a small decrease in quantity demanded. In this case the firm can earn a higher total revenue by increasing its price. This is shown in Figure 4.9.

Figure 4.9 Inelastic Demand Curve and Total Revenue



In general, if the demand is elastic, a lower price leads to a higher total revenue. But if the demand is inelastic, a higher price will lead to a higher total revenue. If the demand is unit elastic, total revenue remains unchanged when price changes. This is true only if the midpoint formula is used in calculating the price elasticity of demand.

3.3 Total Revenue Test

To determine whether a product has elastic or inelastic demand, the common method is to compute the price elasticity of demand when price changes. If the price elasticity of demand is less than 1, the product has inelastic demand. If it is greater than 1, the product has elastic demand. If it is equal to 1, the demand is unit elastic.

We can also use the total revenue test to determine the nature of elasticity of the product. Total revenue is measured by multiplying price with quantity. When price changes and hence quantity demand changes, the total revenue will be affected.

If a price decrease results in total revenue increases, the demand is elastic. For example, when price decreases from \$10 to \$5 and quantity increases from 10 units to 30 units, total revenue increases \$100 to \$150, the demand is elastic.

If a price decrease results in total revenue decreases, the demand is inelastic. For example, when price decreases from \$10 to \$5 and quantity increases from 10 units to 12 units, total revenue decreases \$100 to \$60, the demand is inelastic.

If a price decrease results in total revenue remain unchanged, the demand is unit elastic. For example, when price decreases from \$10 to \$5 and quantity increases from 10 units to 20 units, total revenue remains unchanged at \$100, the demand is unit inelastic.

4. Income and Cross Elasticity of Demand

Besides price elasticity of demand, there are two other types of demand elasticities which are important to business decision making. They are the income elasticity of demand and the cross-price elasticity of demand.

4.1 Income Elasticity of Demand

The income elasticity of demand measures the responsiveness of demand to a change in consumer income (Y). It is defined as percentage change in demand divided by percentage change in income and is denoted by Y_{ED} .

To calculate the income elasticity of demand, we can use the formula:

$$Y_{ED} = \frac{\% \text{ change in demand}}{\% \text{ change in income}} = \frac{\text{change in demand}}{\text{change in income}} \times \frac{\text{income}}{\text{demand}}$$

Consider income changes from I_1 to I_2 and the quantity demanded changes from Q_1 to Q_2 . There are two ways to calculate the income elasticity of demand.

One way is to use the midpoint method. The midpoint formula is

$$Y_{ED} = \frac{Q_2 - Q_1}{Y_2 - Y_1} \times \frac{(Y_1 + Y_2)/2}{(Q_1 + Q_2)/2}$$

The other method is to use the point formula, Using the original point as the reference point, the point formula is

$$Y_{ED} = \frac{Q_2 - Q_1}{Y_2 - Y_1} \times \frac{Y_1}{Q_1}$$

Unlike the price elasticity of demand which is always negative, the income elasticity of demand can be positive or negative. Hence it is of utmost important to keep track of the sign when computing the income elasticity of demand.

If the income elasticity of demand of a product is positive, consumers buy more of this product when their incomes increase. This product is known as a normal good.

If the income elasticity of demand is between 0 and 1, this product is classified as a necessity. Consumers buy more but by a smaller proportion than the increase in income.

For example, rice is a common staple food in the Asia countries. When a consumer has a higher income, he may consume slightly more rice but not a lot more since the consumer consumes rice on a daily basis. Consider a consumer earns monthly income of \$2000 and tend to consume one bowl of rice per meal. When he earns monthly income of \$4000, he may consume one and a half bowls of rice but unlikely to consume a lot more just because he can afford to buy more rice.

If the income elasticity of demand exceeds 1, this means consumers buy proportionately more of this product than their increase in income. This product is classified as a luxury.

For example, overseas travel tend to be expensive, good to have but not necessary must have. When a consumer earns monthly income of \$2000, he may travel overseas once per year. When he earns monthly income of \$4000, he may travel to overseas 3 or 4 times per year since he can afford to do so.

If the income elasticity of demand of a product is negative, consumers buy less of this product when their incomes increase. This product is known as an inferior good.

For example, when a consumer has a low income, he may consume many instant noodles since they are cheap. When his income increases, he may reduce the consumption of instant noodle and switch to foods that are more nutritious. Thus the income elasticity of demand is negative and instant noodle can be considered as an inferior good for this consumer.

4.2 Cross Price Elasticity of Demand

The cross elasticity of demand or cross price elasticity of demand. The responsiveness of demand for one good to changes in the price of another good is called the cross-price elasticity of demand. It is defined as the percentage change in the demand for one good divided by the percentage change in the price of another good. For goods A and B, the

cross-price elasticity is defined as % change in quantity of Good A divided by % change in price of Good B. It is denoted by the symbol C_{ED}

To calculate the cross elasticity of demand between two products A and B, we can use the formula:

$$C_{ED} = \frac{\% \text{ change in demand of A}}{\% \text{ change in price of B}} = \frac{\text{change in quantity of A}}{\text{change in price of B}} \times \frac{\text{price of B}}{\text{quantity of A}}$$

Consider the price of Good B changes from P_{B1} to P_{B2} and the quantity demanded of Good A changes from Q_{A1} to Q_{A2} . There are two ways to calculate the cross price elasticity of demand.

One method is to use the midpoint formula. The midpoint formula is:

$$C_{ED} = \frac{Q_{A2} - Q_{A1}}{P_{B2} - P_{B1}} \times \frac{(P_{B2} + P_{B1})/2}{(Q_{A2} + Q_{A1})/2}$$

The other method is to use the point formula, Using the original point as the reference point, the point formula is

$$C_{ED} = \frac{Q_{A2} - Q_{A1}}{P_{B2} - P_{B1}} \times \frac{P_{B1}}{Q_{A1}}$$

Just like the income elasticity of demand, the cross elasticity of demand can be positive or negative. Hence it is of utmost important to keep track of the sign when computing the cross-price elasticity of demand.

If the cross-price elasticity of demand is negative, it means demand for good A increases when price of good B decreases. This implies consumers buy more of good A when good B becomes cheaper. Thus good A and B must be complements.

For example, when price of petrol increases, consumers may decide to buy less cars since it is more costly to use cars. Thus cars and petrol are complements.

If the cross-price elasticity of demand is positive, it means demand for good A increases when price of good B increases. This implies consumers buy more of good A when good B becomes more expensive. Thus good A and B must be substitutes.

For example, when desk top computers become more expensive, consumers may switch to buy other computing devices such as laptop. Thus laptop and desk top are substitutes.

If the cross-price elasticity is zero, it implies that the two goods are unrelated.

5. Price Elasticity of Supply

Due to the law of supply, when price increases the quantity supplied will increase. But the magnitude of the change is determined by the elasticity of the supply curve. Let us consider the effect of an increase in preference in a market which increases the demand. When demand increases, the effect is price increases and quantity also increases. However, the magnitude of change in the price and quantity can be very different in different market.

Refer to Figure 4.10(a). When demand increases, the effect is a large increase in price and a small increase in quantity supplied. The producers are not very responsive to the change in price. On the other hand, in Figure 4.10(b), when demand increases, the effect is a small increase in price and a large increase in quantity supplied. The producers are very responsive to the change in price.

Figure 4.10(a)

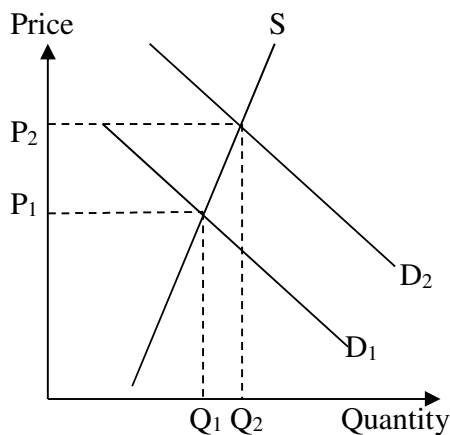
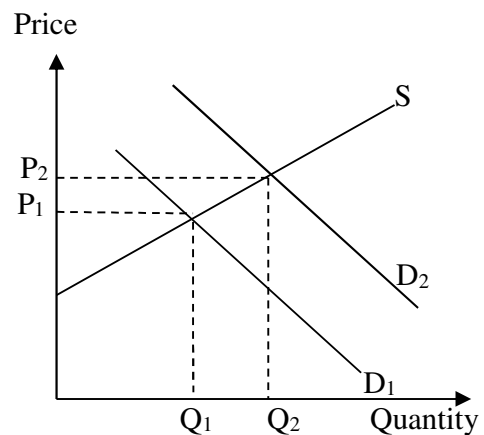


Figure 4.10(b)



This highlights the need for a measure of the producer's responsiveness of the quantity supplied to a price change. This measure is the price elasticity of supply.

5.1 Definition of Price Elasticity of Supply

The price elasticity of supply measures how responsive producers are to a price change. It is the percentage change in the quantity supplied divided by the percentage change in price. It is denoted by the symbol P_{ES} .

$$P_{ES} = \frac{\% \text{ change in quantity supplied}}{\% \text{ change in price}}$$

Based on the law of supply, a higher price usually results in an increased quantity supplied. Thus the price elasticity of supply is always positive. High price discourages consumption but encourages production.

5.2 Calculating Price Elasticity of Supply

Consider price changes from P_1 to P_2 and the quantity supplied changes from Q_1 to Q_2 . Just like the price elasticity of demand, there are two methods to compute the price elasticity of supply. The midpoint or the arc method and the point method.

Using the midpoint formula, we have

$$P_{ES} = \frac{Q_2 - Q_1}{P_2 - P_1} \times \frac{(P_1 + P_2)/2}{(Q_1 + Q_2)/2}$$

Using the point formula and the original point as the reference point, we have

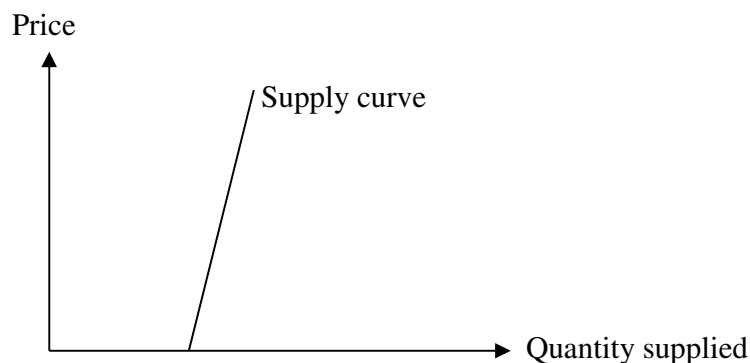
$$P_{ES} = \frac{Q_2 - Q_1}{P_2 - P_1} \times \frac{P_1}{Q_1}$$

In general, it is more accurate to use the mid-[point formula to compute the price elasticity of supply.

5.2 Categories of supply elasticity

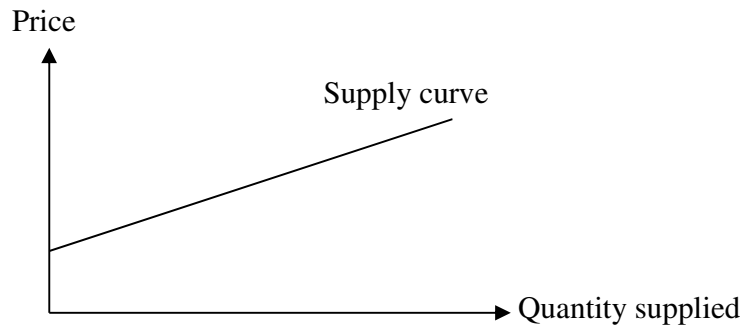
If the percentage change in quantity supplied is smaller than the percentage change in price, P_{ES} has a value between 0 and 1, and the supply is inelastic. An inelastic supply curve is relatively steep touching the Y axis. It shows a large change in price is accompanied by a small change in quantity supplied in Figure 4.11.

Figure 4.11 Inelastic Supply Curve



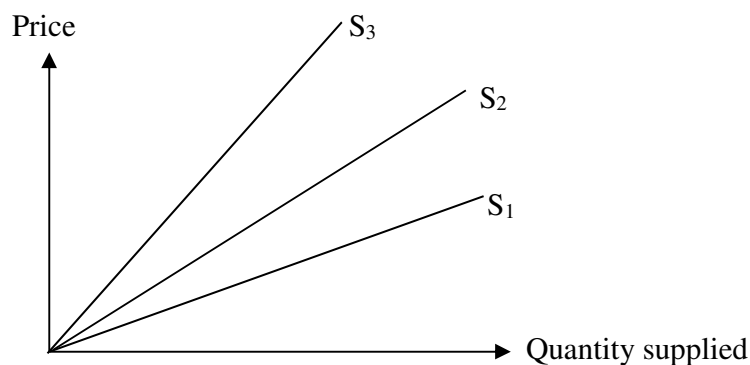
If the percentage change in quantity supplied exceeds the percentage change in price, P_{ES} has a value of greater than 1, and the supply is elastic. An elastic supply curve is relatively flat and touches the X axis. It shows a small change in price is accompanied by a large change in quantity supplied in Figure 4.12

Figure 4.12 Elastic Supply Curve



If the percentage change in quantity demanded just equals the percentage change in price, P_{ES} has a value of 1, and the supply is unit elastic. Any supply curve that can be represented as a straight line from the origin is unit elastic. A percentage change in price will always result in an identical percentage change in quantity supplied. This is shown in the supply curves S_1 , S_2 and S_3 in Figure 4.13.

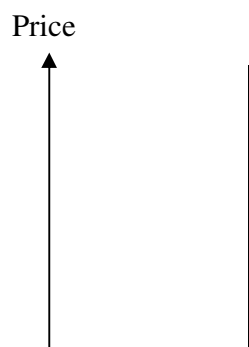
Figure 4.13 Unit Elastic Supply Curve



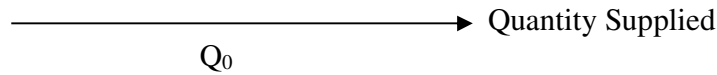
Most of the product in real life are either elastic or inelastic in supply and unit elastic supply is more of a theoretical possibility. There are also two extreme cases of price elasticity of supply, known as perfectly inelastic and perfectly elastic supply.

If the percentage change in quantity demand is zero, the $P_{ES} = 0$ and the supply is perfectly inelastic. A perfectly inelastic supply curve is vertical. It indicates that the quantity supplied does not vary at all when the price changes. Regardless of price increases by a large amount or drop all the way to zero, the quantity supplied is always fixed at a specific amount, say at Q_0 . This is shown in Figure 4.14. An example of a perfectly inelastic supply curve is the amount of land in a city which is always fixed.

Figure 4.14 Perfectly Inelastic Supply Curve

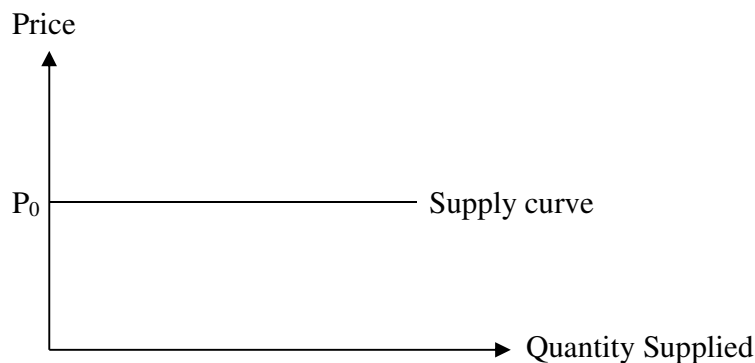


Supply curve



If the percentage change in price is zero, the $P_{ES} = \infty$ and the supply is perfectly elastic. A perfectly elastic supply curve is horizontal, which indicates that the producers will produce all the quantity that consumers are willing to pay at the given price, say at P_0 . If the price drops below the given price, even by a small amount, the quantity supplied drops to zero. It also implies that at the current price, there is an infinite quantity supplied. This is shown in Figure 4.15. An example of perfectly elastic supply curve is the mobile phone lines where the producers seems to have unlimited capacity to provide new mobile lines to consumers as long as consumers are willing to pay for the subscription charges.

Figure 4.15 Perfectly Elastic Supply Curve



5.3 Determinants of supply elasticity

The elasticity of supply indicates how responsive producers are to a change in price. Their responsiveness depends on how easy or difficult to increase output when the price increases. Two determinants are considered.

(1) Availability of Resources

If the cost of supplying each additional unit rises sharply as output expands, then a higher price will elicit little increase in quantity supplied, so supply will tend to be inelastic.

If the additional cost rises slowly as output expands, the lure of a higher price will prompt a large increase in output, so supply will tend to be elastic.

(2) Time factor

Supply tends to become more elastic over time as producers adjust to price changes. The longer the time period under consideration, the more able producers are to adjust the rate at which they employ some resources. Thus firms will have a greater ability to vary output and hence supply is more elastic. In general, short term supply tend to be inelastic while long term supply tend to be elastic.

6. Illustration Questions

The seller of Good A and Good B discovered that the number of units sold for Good A is affected by the price of Good B. When he sets the price of Good B at \$5 per unit, he can sell 1200 units of Good A. However, when the price of Good B becomes \$6, he can only sell 1000 units of Good A.

- (a) Calculate the cross elasticity of demand between Good A and B and explain their relationship.
- (b) What should the seller do to the price of Good B if he wants to earn more revenue from Good A? Explain.
- (c) What should the seller do to the price of Good A if he wants to earn more revenue from Good A? Explain.

Suggested Answers:

- (a) Cross Elasticity of Demand

$$= \frac{\text{percentage change in Quantity Demanded of Good B}}{\text{percentage change in Price of Good A}}$$

$$= \frac{(1000-1200) / [(1000+1200)] / 2}{(6-5) / [(6+5)] / 2}$$

$$= \frac{(-200)/1100}{1/(5.5)}$$

$$= \frac{-0.1818}{0.1818} = -1$$

- (b) Cross elasticity is calculated to be negative, thus the two goods A and B are complements in consumption. The seller should reduce the price of Good B. When price of Good B decreases, its quantity demanded increases and consumers will increase demand for Good A. An increase in demand will result in an increase in both equilibrium price and quantity. Total revenue must increase for Good A.

- (c) To earn more revenue from Good A, he needs to know the price elasticity of demand for Good A. If demand is elastic, he should reduce price of Good A. If demand is inelastic, he should increase price of Good A.

7. Discussion Questions

Question 1

According to a study of the price elasticities of products sold in common supermarkets, the price elasticity of demand for toothbrushes is estimated at -0.22. Which of the following could most suitably explain why the price elasticity of demand for toothbrushes is so low?

- (A) Toothbrushes are heavily endorsed by dentists.
- (B) The toothbrush industry is highly competitive.
- (C) There are few close substitutes for toothbrushes.
- (D) Toothbrushes are relatively cheap compared to other goods sold in the supermarkets.

Question 2

What causes the demand for a particular good X, to be price-inelastic?

- (A) Good X is a luxury.
- (B) There are many substitutes for Good X.
- (C) Good X is a necessity.
- (D) Good X occupies a large portion in the budget.

Question 3

Given that the cross elasticity of demand between A and B is 1.5, we can conclude that

- (A) A and B are substitutes
- (B) A and B are complements
- (C) A is a necessity and B is a luxury
- (D) A is a luxury and B is a necessity

Question 4

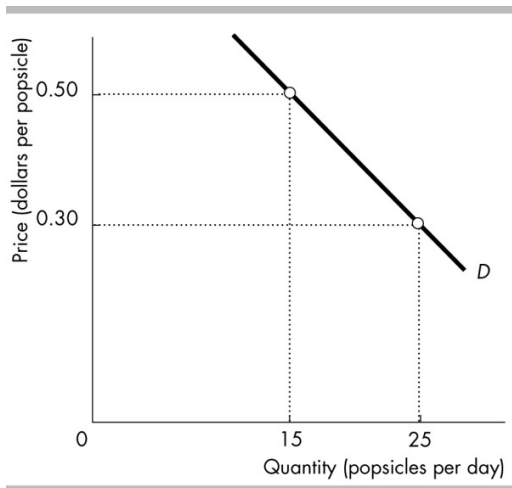
When the seller reduces the price and can earn more revenue, the product

- (A) must be a luxury good.
- (B) must be a necessity.
- (C) must have inelastic demand.

(D) must have elastic demand.

Question 5

The figure shows the demand curve for popsicles.



The price elasticity of demand when the price of a popsicle increases from \$0.30 to \$0.50 is _____.

- (A) 0
- (B) 1
- (C) $1/2$
- (D) 2

Question 6

(a) An experienced farmer has meticulously compiled data on tomatoes for many years and has estimated that the price elasticity of tomatoes to be -3.2. Calculate the new quantity demanded if he originally sells 140 tons of tomatoes and prices were to decrease from \$510 per ton to \$450 per ton. If the seller wants to increase total revenue, should he have decreased the price of tomatoes? Justify your answer.

(b) The seller of Good X feels that the number of units sold for Good X is somehow affected by the price of Good Y. By experimenting with the price, he realises that when price of Good Y is \$50, he can sell 12,000 units of Good X. However, when the price of Good Y becomes \$60, he can now sell 10,000 units of Good X. Calculate the cross elasticity of demand between Good X and Y. Analyse the effect on the seller's revenue when price of Good Y falls.

Question 7

SIM Donut Factory (SDF) has just opened its first outlet in Block C. It originally charged \$5 per donut, but found that sales were poor and only 80 donuts were sold every day. SDF then decided to lower its donut price to \$3, and sales boomed to 250 per day.

- (a) What is the Price Elasticity of Demand for the SDF donuts based on the information above?
- (b) The Cross Price Elasticity of Demand for SDF donuts and coffee is -3.5. What is the relationship between SDF donuts and coffee?
- (c) The Income Elasticity of Demand for SDF donuts is -2. What is likely to happen if SDF's customers all received an increase in their incomes?

MICROECONOMICS
SESSION 5
UTILITY AND DEMAND

At the end of the session, students should be able to:

1. Explain what limits a household's consumption choices
 2. Describe preferences using the concept of utility and distinguish between total utility and marginal utility
 3. Explain the marginal utility theory of consumer choice
 4. Use marginal utility theory to predict the effects of changing prices and incomes
-

1. Introduction

In this session, we first define household budget which limit household's consumption choices and explain the method to construct the budget line. Next we introduce the concept of total utility and marginal utility to explain consumer preferences. Then we analyze the law of diminishing marginal utility and its impact on consumption choices. Finally we apply the marginal utility theory to determine the optimal consumption choices and analyze the effects of changes in prices and incomes of consumers.

2. Household Consumption Choices

Households tend to have limited income and hence can only buy a limited amount of goods and services for it desires for consumption. Assume that households did not have any ability to influence the market prices of the products, the income of the households and the prices of the products will confine the consumption possibilities of the household. These consumption possibilities can be represented by a budget line.

2.1 Budget Line

Consider a household with income I and two products A and B . The unit prices of A and B are P_A and P_B respectively. We can construct the budget line which shows all the combinations that the household can purchase. The budget line will define the limits to the household consumption choices. The equation which describe the budget line is:

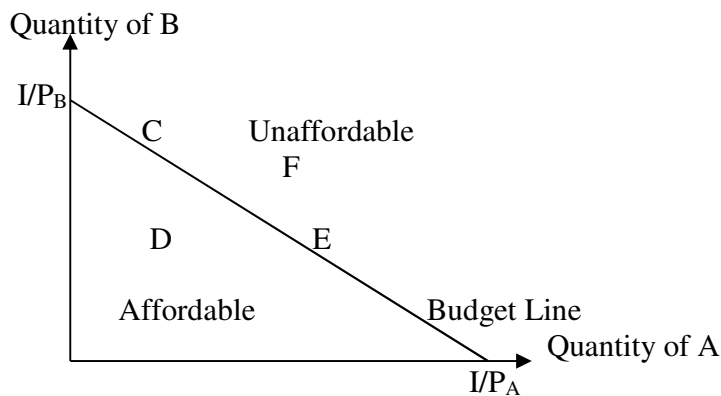
$$P_A Q_A + P_B Q_B = I$$

where Q_A is the quantity of A and Q_B is the quantity of product B purchased.

The household can use all the income to buy only product A. In this case the maximum amount of product A, measured by I/P_A will be purchased and the household will not purchase any product B. The household can also use all the income to buy only product B. In this case the maximum amount of product B, measured by I/P_B will be purchased and the household will not purchase any product A. Between these two extremes, the household can also allocate different amounts of money to buy different quantities of product A and B. However, there will be a trade off in that if more product A are purchased, there will be less money available for product B.

If we expressed the quantities of the two products in the two axis, we can obtain the budget line of the household by drawing a straight line that join the two intercepts, indicated by I/P_A and I/P_B respectively. This is shown in Figure 5.1.

Figure 5.1 Budget Line



The Y intercept of the budget line shows the maximum amount of product represented by the Y axis (product B) that the household can afford to buy. This is the real income of the household expressed in product B. The X intercept of the budget line shows the maximum amount of product represented by the X axis (product A) that the household can afford to buy. This is the real income of the household expressed in product A.

The slope of the budget line is $(I/P_B)/(I/P_A)$ which is P_A/P_B . This is the relative price of product A. It shows the amount of product B that the household must give up in order to exchange for one unit of product A.

The budget line divides in diagram into two region, the region on and below the budget line and the region above the budget line. The region on and below the budget line shows the affordable combinations of the two products. For example, combinations such as C, D and E are affordable. The difference between C, D and E are that C and E are on the budget line, which means the household has exhaust its budget when buying these combinations. In contrast, a combination such as D which is below the budget line means there are unused money.

In contrast, a combination such as F which is above the budget line means unaffordable. Given the household income and the prices of A and B, the household is not possible to buy the combination. The combination is only possible if the income increases or the price of the two products decrease.

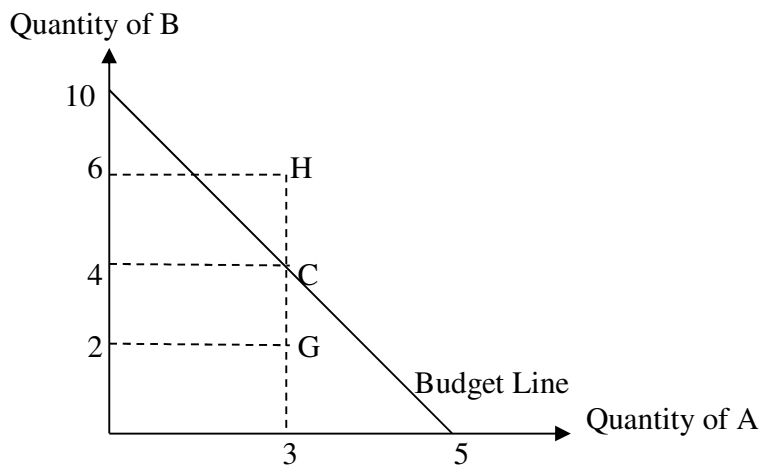
For a numerical illustration, assume that income is \$100, product A is \$20 per unit while product B is \$10 per unit. If A and B must be purchased by the whole unit, we can list the possible combinations of A and B in Table 5.1.

Table 5.1: Household Possible Consumption Combinations

Combination	Quantity of A	Quantity of B
A	5	0
B	4	2
C	3	4
D	2	6
E	1	8
F	0	10

Using the information and assuming perfectly divisible quantity, we can construct the budget line in Figure 5.2.

Figure 5.2: An Illustration of Budget Line



The combination C with 3 units of A and 4 units of B will cost the household \$100. A combination G with 3 units of A and 2 units of B will be below the budget line. The cost is \$80 and hence the household did not use up its entire budget of \$100.

On the other hand, a combination H with 3 units of A and 6 units of B is above the budget line. It costs \$120 which is above the household budget of \$100 and hence the household is unable to afford it.

2.2 Shifting of Budget Line

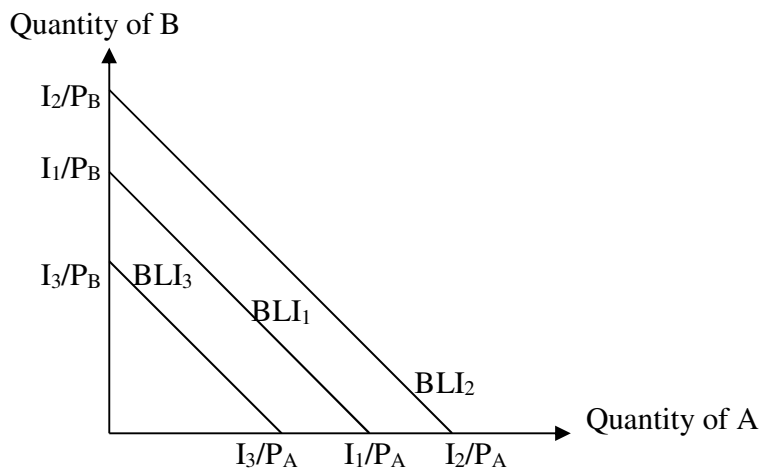
From the equation of the budget line, $P_A Q_A + P_B Q_B = I$, we can rearrange the budget line in the following steps:

$$\begin{aligned} P_A Q_A + P_B Q_B &= I \\ \Rightarrow P_B Q_B &= I - P_A Q_A \\ \Rightarrow Q_B &= (I/P_B) - (P_A/P_B) Q_A \end{aligned}$$

This is the common straight line equation expression where I/P_B is the Y-intercept and P_A/P_B is the slope of the straight line and the negative sign indicates that the budget line is downward sloping.

When there is a change in the income I , this means the Y-intercept of the budget line will change. But since there is no change in P_A and P_B , the slope of the budget line will not be affected. Thus there will be a parallel shift in the budget line. Higher I results in an outwards parallel shift of the budget line from BLI_1 to BLI_2 , while lower I results in an inwards parallel shift of the budget line from BLI_1 to BLI_3 , as shown in Figure 5.3

Figure 5.3: Parallel Shift in Budget Line

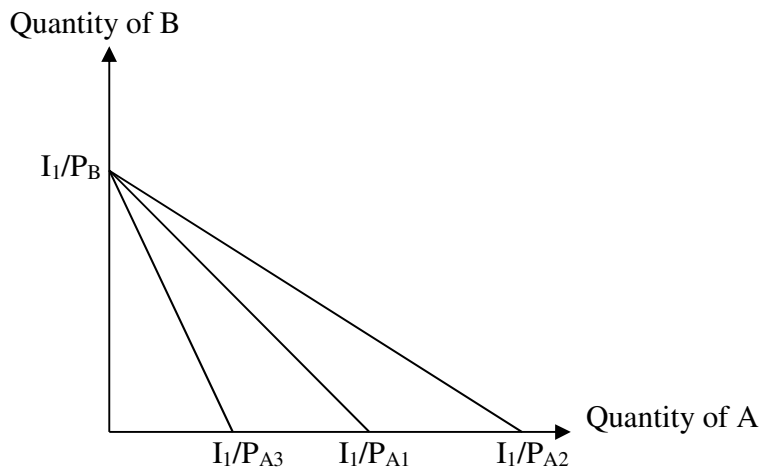


If there is a change in the relative prices of product A and product B, then the slope of the budget line will be affected. If the price of product A increases, with the same income only a smaller quantity of A can be purchased. Thus the X-intercept of the budget line will decrease and the budget line will be steeper.

On the other hand, if the price of product A decreases, with the same income a larger quantity of A can be purchased. Thus the X-intercept of the budget line will increase and the budget line will be flatter.

The change in price of A is shown in Figure 5.4. When price of A decreases from P_{A1} to P_{A2} , the budget line rotate outwards along the X-axis and becomes flatter. When price of A increases from P_{A1} to P_{A3} , the budget line rotate inwards along the X-axis and becomes steeper. In both cases, the Y intercept will not be affected since I and P_B did not change.

Figure 5.4: Rotational Shift in Budget Line



3. Analysis of Utility

The budget line shows the possible combinations of two products that a household can purchase with given income and prices of the two products. However, which combination of the two products that the household will purchase depends on its preferences.

Consumers buy goods and services to derive satisfaction from consuming them. With limited income and budget, the objective of a consumer is to maximize total satisfaction subject to the budget constraint. In economics, satisfaction is called utility. It is assumed that utility can be measured and expressed quantitatively in an arbitrary unit known as utils. If a consumer derives a lot of satisfaction from consuming a certain product, then the satisfaction is expressed as a large number of utils. Conversely, a small satisfaction is represented by a small number of utils.

3.1 Total Utility and Marginal Utility

Total utility is the total satisfaction that a consumer derives from consuming various quantities of a product within a period of time. In general, for any product, more is preferred to less and hence more consumption give rise to more total utility, up to a certain extent.

Marginal utility is the change in total utility when the consumer consumes one more unit of the product.

Consider a consumer, John, who derives the utility from consuming buns. His total utility and marginal utility is shown in Table 5.2

Table 5.2 Total Utility and Marginal Utility

Quantity of buns	Total Utility (utils)	Marginal Utility (utils)
0	0	-
1	8	8
2	14	6
3	18	4
4	20	2
5	21	1
6	19	-2

Starting with no bun consumed, John will have no utility at all. Hence the total utility is zero and the marginal utility is not defined. With the first buns consumed, the total utility is 8 utils and the marginal utility is also 8 utils. With 2 buns consumed, the total utility becomes 14 utils and the marginal utility is $14 - 8 = 6$ utils. With 3 buns consumed, John's total utility reaches 18 utils and the marginal utility is $18 - 14 = 4$ utils. With 4 buns consumed, John's total utility increases to 20 utils and the marginal utility is $20 - 18 = 2$ utils. John's total utility is maximized at 21 utils with 5 buns consumed and the marginal utility is 1 util. With 6 buns consumed, his total utility actually decreases to 19 and the marginal utility is $19 - 21 = -2$ utils.

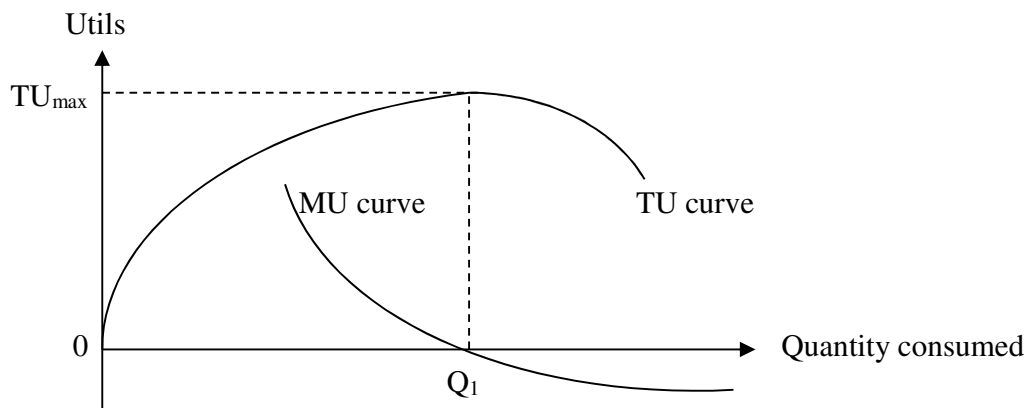
3.2 Law of Diminishing Marginal Utility

Although total utility tends to increase as the consumption increases, the increase is by a diminishing amount and may eventually decrease as consumption increases. This is explained by the law of diminishing marginal utility which states that as a consumer consumes more of a product, he or she derives less and less utility from each additional unit of the product consumed. This is due to human nature such that we tend to value less of the product which we have in abundance and value more of a product which is scarce.

Plotting total utility and marginal utility against the quantity of output consumed, we have the total utility curve and the marginal utility curve. The total utility curve is a concave curve, upward sloping initially but with decreasing slope and eventually reach a maximum and then becomes downward sloping. The marginal utility curve will be a downward sloping curve if the diminishing marginal utility occurs after the first unit.

The typical total utility curve and marginal utility curve are shown in Figure 5.5. Note that when total utility is maximized at output Q_1 , marginal utility is zero and for quantities larger than Q_1 , total utility is downward sloping while marginal utility is negative. If affordability is not an issue, then a rational consumer will consume up to a maximum quantity of Q_1 for the product.

Figure 5.5 Total Utility and Marginal Utility



4 Determination of Optimal Consumption

Consider a consumer with an income Y to spend on two goods, A and B with prices P_A and P_B respectively. How should he allocate the income on the two goods? Based on the law of diminishing marginal utility, it is not optimal to buy too many units of any particular good since the additional utility from each additional unit of a good will eventually become smaller. In addition, money alone did not provide any satisfaction to the consumer. The consumer needs to spend the entire income on the two goods in order to maximize the total utility from the two goods.

4.1 Optimal Consumption Rule

Different goods provide different amount of utility based on consumer's preference. To make comparison between two goods meaningful, we divide the marginal utility of the good by its price to compute the marginal utility per dollar spent on the good.

The marginal utility per dollar is the change in total utility when the consumer allocates one more dollar on the good. Thus MU_A/P_A is the extra utility that the consumer can gain by spending one more dollar on Good A, while MU_B/P_B is the extra utility that the consumer can gain by spending one more dollar on Good B.

If MU_A/P_A is larger than MU_B/P_B , then the same one dollar generates more utility from Good A compared to Good B. To increase total utility within the same budget, the consumer should purchase less of Good B, release the money to buy more of Good A.

But as more and more Good A are purchased, the marginal utility from Good A will decrease. Likewise with less and less of Good B purchased, the marginal utility from Good B will increase. The adjustment will eventually reach a stage where the marginal utility per dollar on both goods are the same. When this combination is reached, it is not possible

to increase the total utility further by adjusting the consumption pattern. Thus the optimal consumption bundle is reached.

The same is true if MU_B/P_B is larger than MU_A/P_A where consumer should respond by buying more Good B and less Good A until the marginal utility per dollar spent on both goods are the same. The utility maximizing rule or optimal consumption rule is thus defined as:

$$\frac{MU_A}{P_A} = \frac{MU_B}{P_B}$$

If this rule is not fulfilled, it is always possible for the consumer to adjust the consumption bundle and increase the total utility with the same budget.

For a numerical illustration, assume that at the current combination of purchase for two goods A and B, MU for A = 20, MU for B = 6, price of A is \$4, price of B is \$2. Thus we have

$$\frac{MU_A}{P_A} = \frac{20}{4} = 5 > \frac{MU_B}{P_B} = \frac{6}{2} = 3$$

Since $(MU_A/P_A) = 5$ while $MU_B/P_B = 3$, this means spending \$1 on Good A can increase the consumer satisfaction by 5 utils, while spending \$1 on Good B can only increase the consumer's satisfaction by 3 utils.

If the consumer were to spend \$1 less on Good B, his total utility will decrease by 3 utils. If he then transfer this \$1 to Good A, his total utility can increase by 5 utils. This will result in a net increase of 2 utils with the same budget. Thus the consumer should buy more Good A and buy less Good B.

As the consumer buy more of Good A, based on the law of diminishing marginal utility, the marginal utility of Good A will decrease, say decrease to 10. As he buy less of Good B, the marginal utility of Good B will increase, say increase to 10. Thus we have

$$\frac{MU_A}{P_A} = \frac{10}{4} = 2.5 = \frac{MU_B}{P_B} = \frac{10}{2} = 5$$

Since for both products A and B, MU/P is the same which equals to 2.5, the consumer will not be able to have any net increase in total utility by adjusting his consumption choices. Thus he would have maximized his total utility at the current combination of the two goods.

4.2 Optimal Consumption Rule: An Illustration

Consider Tom who has \$100 to spend on food and clothing. The price of food is \$10 per unit and the price of clothing is \$20 per unit. Tom has computed his marginal utility for both products at various quantities as shown in Table 5.3:

Table 5.3: Marginal Utilities of Food and Clothing

Food	MU for Food	Clothing	MU for Clothing
1	60	1	150
2	50	2	140
3	20	3	120
4	5	4	100

Determine the optimal consumption bundle for food and clothing for Tom.

The optimal consumption bundle must exhaust the entire budget of \$100 and also fulfil the condition:

$$\frac{MU_{\text{Food}}}{P_{\text{Food}}} = \frac{MU_{\text{Clothing}}}{P_{\text{Clothing}}}$$

Construct two columns for MU/P for both food and clothing, we have Table 5.4:

Table 5.4: Marginal Utilities Per Dollar of Food and Clothing

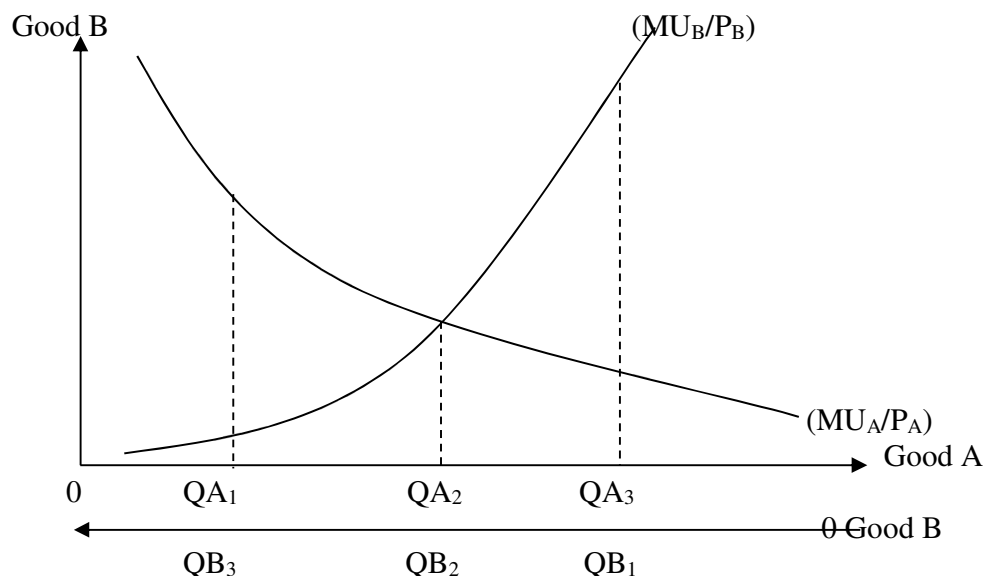
Food	MU for Food	MU/P for Food	Clothing	MU for Clothing	MU/P for Clothing
1	60	6	1	150	7.5
2	50	5	2	140	7
3	20	2	3	120	6
4	5	0.5	4	100	5

There are two optimal consumption bundles. They are 1 unit of food with three units of clothing which needs \$70, and 2 units of food with 4 units of clothing which needs \$100. Since only the combination 2 units of food with 4 units of clothing use up all the budget \$100, it is the optimal consumption bundle.

4.3 Optimal Consumption Rule: A Diagrammatic Approach

We can also illustrate the optimal consumption rule using diagrams. Consider two products A and B with prices P_A and P_B respectively and also the law of diminishing marginal utility. We measure the quantity of A in the usual way from the left to the right starting from 0 from the left. However, we measure the quantity of B in the opposite way from the right to the left, again starting from 0 from the right. This is shown in Figure 5.6.

Figure 5.6: Optimal Consumption Rule



Given the prices of A and B and the law of diminishing marginal utility, the curve MU/P will be downward sloping from left to right for product A. But since product B is measured by right to left, it will be upward sloping for product B.

A combination of QA_1 and QB_3 will have MU_A/P_A larger than MU_B/P_B , hence the consumer can gain more total utility by buying more A and buying less B. In contrast, a combination of QA_3 and QB_1 will have MU_A/P_A smaller than MU_B/P_B , hence the consumer can gain more total utility by buying less A and buying more B. The optimal consumption combination is the combination of QA_2 and QB_2 where MU_A/P_A is equal to MU_B/P_B ,

5. Effect of Price and Income Change

We can use the concept of marginal utility and total utility to analyze the effect of income change and price change. These concepts will also be consistent with the law of demand which reflects an inverse relationship between price and quantity demanded, as well as the determinants of demand.

5.1 Effect of Price Change

The law of demand states that when price decreases, the quantity demanded will increase, other things equal. This can be illustrated using the optimal consumption rule.

Consider two products A and B with marginal utility MU_A and MU_B , and prices P_{A1} and P_{B1} respectively. Product A and Product B are considered as substitutes in that they can both contribute to the total utility of the consumer and the consumer will choose between them to obtain the optimal consumption combination.

Assume that initially the combination fulfils the optimal consumption rule of

$$\frac{MU_A}{P_{A1}} = \frac{MU_B}{P_{B1}}$$

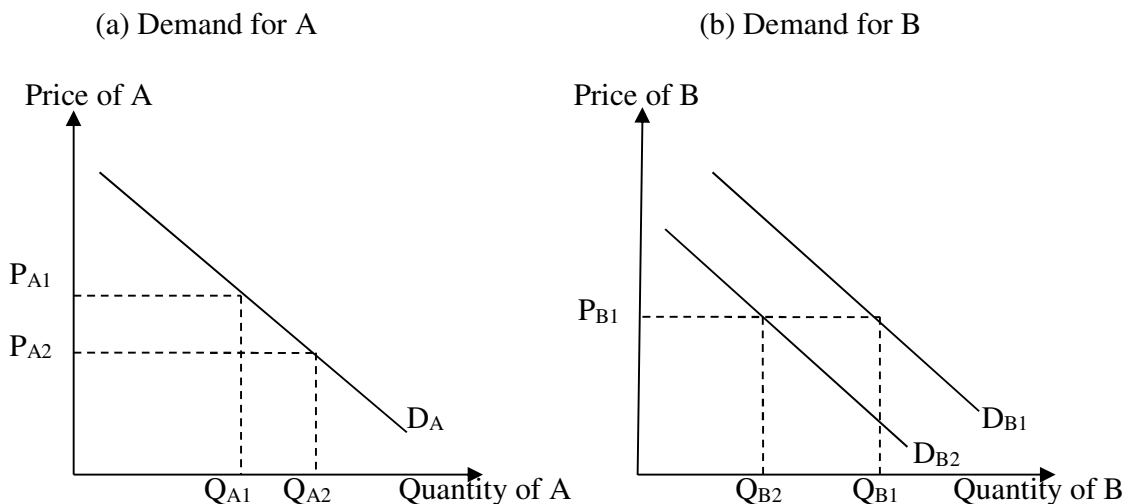
If P_A decreases from P_{A1} to P_{A2} , then we will have

$$\frac{MU_A}{P_{A2}} > \frac{MU_B}{P_{B1}}$$

The consumer will buy more A and buy less B. This is consistent with the law of demand and it will be demonstrated as a movement along the demand curve, as shown in Panel (a) of Figure 5.7 where price of A decreases from P_{A1} to P_{A2} results in a larger quantity demanded from Q_{A1} to Q_{A2} .

When price of A decreases, product B becomes less attractive at the same price P_{B1} , other things equal. The consumer will buy less product B, and this is shown as a leftward shift in the demand curve for product B from D_{B1} to D_{B2} in Panel (b) of Figure 5.7 where the same price of B at P_{B1} results in a smaller quantity demanded from Q_{B1} to Q_{B2} .

Figure 5.7: Effects of Price of Product A Changes



Now consider the effect of price of B changes. Assume that initially the combination fulfils the optimal consumption rule of

$$\frac{MU_A}{P_{A1}} = \frac{MU_B}{P_{B1}}$$

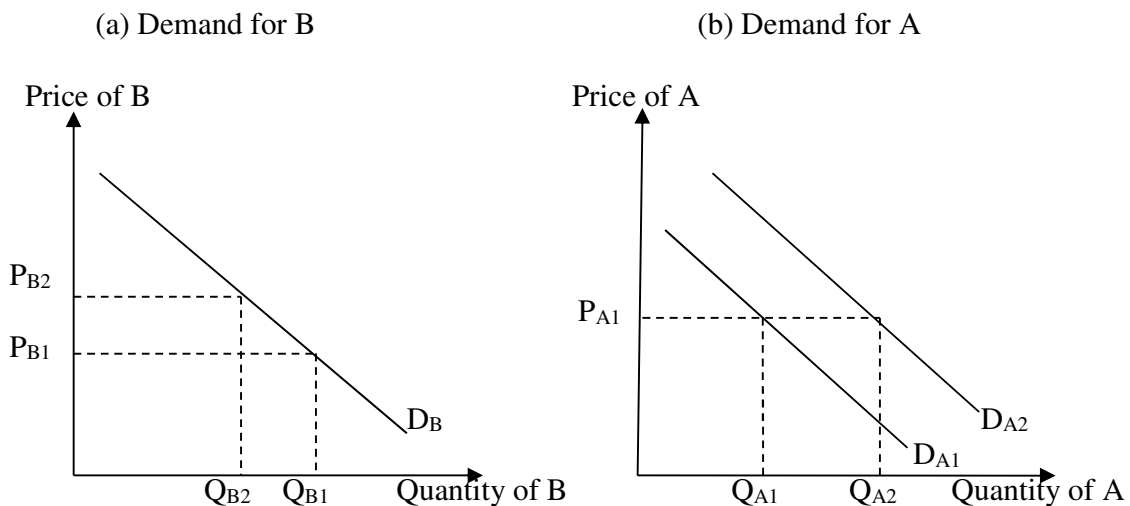
If P_B increases from P_{B1} to P_{B2} , then we will have

$$\frac{MU_A}{P_{A1}} > \frac{MU_B}{P_{B2}}$$

The consumer will buy less B and buy more A. This is consistent with the law of demand and it will be demonstrated as a movement along the demand curve for product B, as shown in Panel (a) of Figure 5.8 where price of B increases from P_{B1} to P_{B2} results in a smaller quantity demanded from Q_{B1} to Q_{B2} .

When price of B increases, product A becomes more attractive at the same price P_{A1} , other things equal. The consumer will buy more product A, and this is shown as a rightward shift in the demand curve for product A from D_{A1} to D_{A2} in Panel (b) of Figure 5.8 where the same price of A at P_{A1} results in a larger quantity demanded from Q_{A1} to Q_{A2} .

Figure 5.8: Effects of Price of Product B Changes



5.2 Effect of Income Change

When income changes, the budget line shifts but the effect on consumption choices is dependent on the nature of the products. It is important to take note that the consumer should exhaust all the income in order to maximize total utility. Money itself will not generate total utility. Consumers need to use the money to buy goods they desire in order to generate total utility. Hence the optimal consumption choice is always a combination on the budget line.

If the product is a normal good, the new optimal consumption choice will show a larger quantity of the product after consumer's income increases. However, if the product is an inferior good, the new optimal consumption choice will show a smaller quantity of the

product after consumer's income increases. Total utility is maximized when the marginal utility per dollar spent on all products are equal.

6. Illustration Questions

Lawrence has a preference for burger and fries. Based on past consumption habits, he is able to provide the following information on his marginal utility (MU) levels measured in Utils when consuming burgers and fries.

Quantity of Burgers	MU of Burgers (Utils)	Quantity of Fries	MU of Fries (Utils)
1	48	1	44
2	33	2	29
3	25	3	16
4	12	4	8
5	6	5	4
6	3	6	2

Lawrence has an allowance of \$20 and the price of burger is \$3 per unit while the price of fries is \$2 per unit. Apply the optimal consumption rule to determine the optimal consumption of burgers and fries for Lawrence.

Suggested answers:

First, we construct a table containing the information of marginal utility per dollar for both burgers and fries, as shown in the table:

Quantity of Burgers	MU of Burgers	MU/P of Burgers	Quantity of Fries	MU of Fries	MU/P of Fries
1	48	16	1	44	22
2	33	11	2	29	14.5
3	25	8.33	3	16	8
4	12	4	4	8	4
5	6	2	5	4	2
6	3	1	6	2	1

Since the condition to maximise satisfaction is to equate MU/P for each product, there are three combinations which fit this condition. The possible optimal consumption bundles are:

- (1) 4 burgers and 4 fries
- (2) 5 burgers and 5 fries
- (3) 6 burgers and 6 fries

With income of \$20, he can buy only the bundle of 4 burgers and 4 fries, which costs $(4 \times \$3) + (4 \times \$2) = \$20$. All other combinations are beyond Lawrence's budget.

7. Discussion Questions

Question 1

Total utility _____.

- (A) has a constant rate of increase as a person consumes more and more of a good.
- (B) is negative when marginal utility is declining.
- (C) is equal to the sum of the marginal utilities of all units consumed.
- (D) cannot decrease as a person consumes more and more of a good.

Question 2

Sally gets 24, 32 and 36 unit of total utility from consuming 2, 3 and 4 chocolate bars respectively, and the price per chocolate bar is 50 cents. Thus, one can infer that Sally

- (A) is maximizing utility.
- (B) is not maximizing utility.
- (C) should NOT consume any more chocolate bars
- (D) is experiencing diminishing marginal utility.

Question 3

The table below gives Andy's utility from popcorn.

Quantity (boxes)	Total utility	Marginal utility
0	0	-
1	30	30
2	50	20
3	66	16
4	?	12

Andy's total utility from four boxes of popcorn is

- (A) 66.
- (B) 70.
- (C) 78.
- (D) 82.

Question 4

Ai Choon's marginal utility from her second bar of chocolate in a month is 35. Her marginal utility from her third bar of chocolate

- (A) is greater than 35.
- (B) equals 35.
- (C) is less than 35.
- (D) might be more than, less than, or equal to 35 but more information is needed.

Question 5

The marginal utility of consuming the third cupcake is _____.

- (A) three times the average utility of the three cupcakes.
- (B) three cupcakes times the price of a cupcake.
- (C) the total utility of three cupcakes divided by three.
- (D) the change in total utility between the third cupcake and the second cupcake.

Question 6

A survey of a consumer named Harry has turned up the following information on his marginal utility (MU) levels when consuming chocolate and candy.

Quantity of Chocolate (Bars)	MU of Chocolate (Utils)	Quantity of Candy (Bags)	MU of Candy (Utils)
1	48	1	44
2	33	2	29
3	25	3	16
4	12	4	8
5	6	5	4
6	3	6	2

Assume that Harry has a weekly allowance of \$20, the price of chocolate is \$3 per bar and the price of candy is \$2 per bag, find Harry's optimal consumption of chocolate bars and candy using only the Utility Maximising Rule.

Question 7

You are choosing between two goods, X and Y with an income of \$9 and your marginal utility from each is as shown below.

Units of X	MU _x	Units of Y	MU _y
1	10	1	8
2	8	2	7
3	6	3	6
4	4	4	5
5	3	5	4
6	2	6	3

- (a) If the prices of X and Y are \$2 and \$1, respectively, what quantities of each will you purchase to maximize utility? What total utility will you realize?
- (b) If the price of X decreases to \$1 while price of Y remains at \$1, what quantities of each will you purchase to maximize utility? What total utility will you realize?

MICROECONOMICS

SESSION 6

POSSIBILITIES, PREFERENCES AND CHOICES

At the end of the session, students should be able to:

1. Describe the budget line of a household with a given outlay
 2. Show how it changes when prices and/or income change
 3. Understand the concept of an indifference curve
 4. Construct a preference map using indifference curves
 5. Explain the optimal consumption choice
-

1. Introduction

In this session, we begin with a discussion of the budget line to show the consumption choices available to households, follow by an analysis of the shift of the budget line. Next we introduce the concept of indifference curve, which shows the consumption choices where the consumer is indifferent. Then we combine both the indifference curve and budget line to illustrate the utility maximization rule or the optimal consumption rule. Finally we analyze the effect of changes in income and price on the optimal consumption choice using the indifference curve and budget line framework.

2. Budget Line

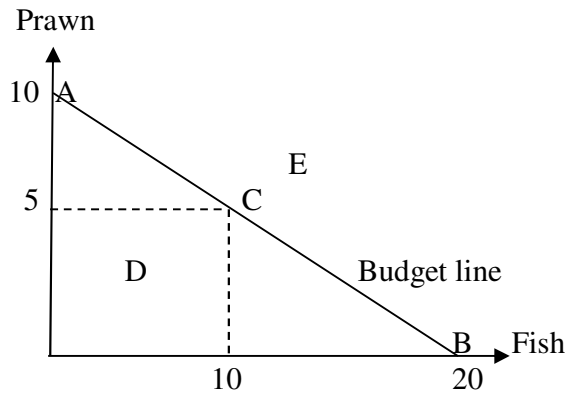
The budget line shows all the combinations of two goods, say Good X and Good Y, that a consumer can purchase, given the income and the prices of the two goods. When analyzing a budget line, it is important to take note money did not provide any satisfaction to the consumers directly. Consumers need to use the money to buy goods and services and total utility is only derived through consumption of goods and services. Hence the optimal consumption choice is always obtained in a combination on the budget line.

The combination below the budget line which shows unused income will not be considered. The combinations above the budget line which are unaffordable by the consumers will also not considered unless there is a shift on the budget line. The budget line will shift when there is a change in the consumer's income or when there is a change in the relative price of the two products. When there is an increase in consumers income or a decrease in the prices of the products, a combination which previously is unaffordable can become affordable. The new optimal consumption choice will be based on the new budget line.

2.1 A Numerical Illustration of Budget Line

Assuming John has \$100 to spend on two goods, fish and prawn. The price of fish is \$5 per kg and the price of prawn is \$10 per kg.

Figure 6.1: Budget Line



If John spends all his money on fish, he can buy the maximum of 20 kg of fish and no prawn. If he spends all his money on prawn, he can buy the maximum 10 kg of prawn and no fish. Thus his budget line is simply a downward sloping straight line with 20 kg of fish and 10 kg of prawn, as shown in Figure 6.1.

Given the price of fish, prawn and his income, the Y-intercept at point A shows the maximum amount of prawn John can buy, while the X-intercept at point B shows the maximum amount of fish he can buy. John can allocate his spending on fish and prawn to buy any combinations as defined by the budget line, such as combination C with 5 kg of prawn and 10 kg of fish. He can buy any combination below the budget line, such as combination D but that implies he did not use up all his money. He is unable to buy the combination above the budget line, such as combination E.

Given limited income, if John wants to buy more fish, he will have to reduce the purchase on prawn. The slope of the indifference curve shows the amount of prawn (the product on the Y-axis) he needs to give up in order to buy one more unit of fish (the product on the X axis). The slope of the indifference curve is $-\frac{1}{2}$, which is the ratio of the price of fish to the price of prawn.

2.2 Mathematical Expression of Budget Line

In general, for an income I to be spent on two goods X and Y with prices P_X and P_Y respectively, the budget line can be expressed as an equation:

$$P_X Q_X + P_Y Q_Y = I$$

where Q_X and Q_Y are the quantities of Good X and Good Y respectively. $P_X Q_X$ is the total expenditure on Good X while $P_Y Q_Y$ is the total expenditure on Good Y . Adding up the

total expenditures on both products will be equal to the income assuming that there is no unspent income.

It is convenient to express the equation in the form of a linear equation:

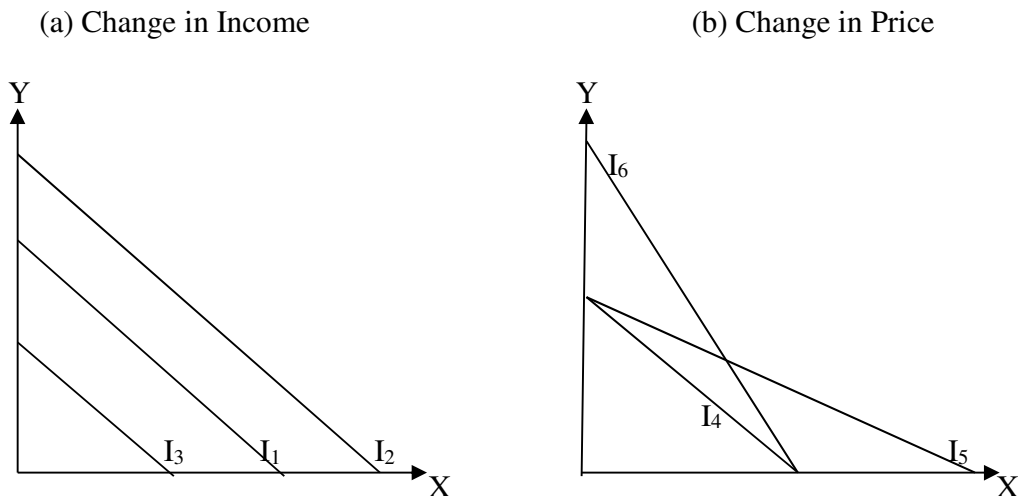
$$Q_Y = I/P_Y - (P_X/P_Y)Q_X$$

Where I/P_Y is the Y-intercept and the slope of the budget line is $-P_X/P_Y$. If there is a change in I , it will affect the Y-intercept and the X-intercept but not the slope of the budget line. But if there is a change in the relative price P_X/P_Y , then the slope of the budget line will be affected.

2.3 Shifting and Pivoting of Budget Line

Budget line shifts due to income (I) change and pivots due to relative price (P_X/P_Y) change. When income increases, this is shown in the outwards shift of the budget line from I_1 to I_2 , as shown in Panel (a) of Figure 6.2. When income decreases, this is shown in the inwards shift of the budget line from I_1 to I_3 , as shown in Panel (a) of Figure 6.2.

Figure 6.2: Shifting of Budget Line



When price of X decreases, the budget line pivot on the X axis and rotate outwards. It changed from I_4 to I_5 as shown in Panel (b) of Figure 6.2. When price of Y decreases, the budget line changed from I_4 to I_6 as shown in Panel (b) of Figure 6.2.

3 Indifference Curve

The indifference curve shows all the combinations of two goods, Good X and Good Y which provide the same total utility to the consumer. Recall that the objective of a consumer is to maximize total utility and utility can be derived from the two goods. Thus the two goods act as substitutes and the consumer will choose between the two products to generate the total utility. It is possible that to some extent, Good X can replace Good Y to generate the same total utility. Thus a consumer can be indifferent between various combinations of X and Y since they have the same total utility.

There are three important characteristics of indifference curve:

- (1) The indifference curves must slope downward from left to right. As the consumer increases the consumption of good A, he or she has to give up certain units of good B in order to maintain the same level of satisfaction.
- (2) Indifference curves will not intersect
- (3) Indifference curves are convex to the origin

These characteristics are based on the three rules of ranking of consumer preferences, discussed as follows:.

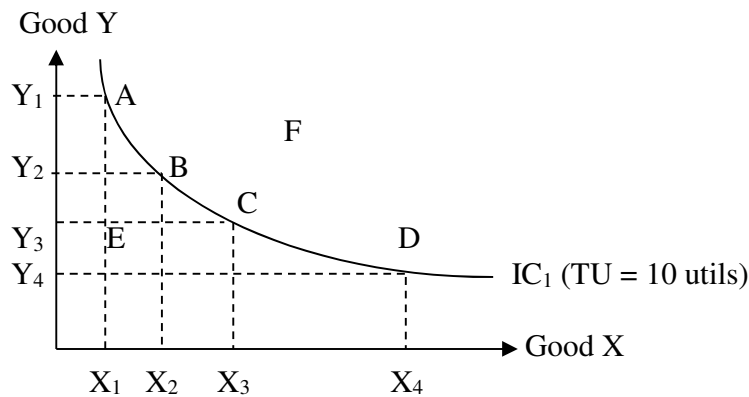
- (1) The first rule is that more is preferred to less. Thus a bundle with 4 units of Good X and 3 units of Good Y must be preferred to one with 3 units of Good X and 2 units of Good Y. This rule gives rise to the downward sloping indifference curve.
- (2) The second rule is that the ranking must be consistent. If Bundle Alpha is preferred to Bundle Beta and Bundle Beta is preferred to Bundle Gamma, then Bundle Alpha must be preferred to Bundle Gamma. This rule gives rise to the requirement that an indifference curve must be either strictly above or below another indifference curve and hence they never intersect.
- (3) The third rule is the law of diminishing marginal utility. If a consumer has many Good Y but few Good X, then the consumer is willing to give up many units of Good Y to exchange for one more unit of Good X. As the consumer has more and more Good X, Good X becomes less valuable to the consumer and he is willing to give up lesser and lesser of Good Y to exchange for one more unit of Good X. This rule gives rise to the shape of indifference curve that is convex to the origin. However, there are special cases where the indifference curve is not convex but straight line or "L" shaped.

3.1 Typical Indifference Curve

A typical indifference curve is shown in IC_1 of Figure 6.3. It is downward sloping and convex to the origin. Consider an indifference curve that represents a total utility of 10 utils. There are many possible combinations of X and Y that can generate total utility of 10 utils. For example, a combination of X_1 and Y_1 , X_2 and Y_2 , X_3 and Y_3 and also X_4 and Y_4 represented by A, B, C and D. Since all these combinations A, B, C and D give the

same total utility 10 utils to the consumers, they must all be on the same indifference curve IC_1 and the consumer is indifferent between the two combinations.

Figure 6.3 Indifference Curve

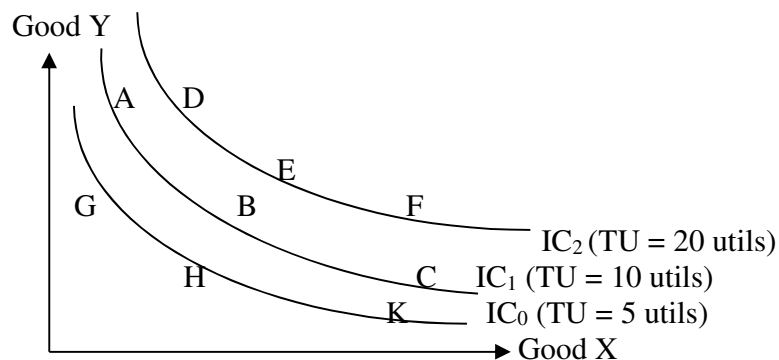


A combination of X_1 and Y_3 , represented by combination E, has the same amount of X but lesser Y compared to combination A, and has the same amount of Y but lesser X compared to combination C. Since more is always preferred to less, E must be less preferred to A and C. On the other hand, combination F has more of X and Y compared to B and C and must be preferred to B and C.

3.2 Indifference Map

If there is more than one indifference curve in the diagram, the diagram becomes an indifference map as shown in Figure 6.4. It is assumed that the consumer can rank all the possible combinations of two goods according to his or her preferences. Hence all combinations must be represented by one indifference curve. Although Figure 6.4 only shows three indifference curves, there are many indifference curves below IC_0 , between IC_0 and IC_2 and above IC_2 . Indifference curves cover the entire X-Y plane.

Figure 6.4: Indifference Map



Based on the first ranking rule where more is preferred to less, the higher the indifference curve, the higher is the total utility and the greater is the preference for the consumers. Hence IC_2 must represent total utility more than 10 utils while IC_0 must represent total utility less than 10 utils.

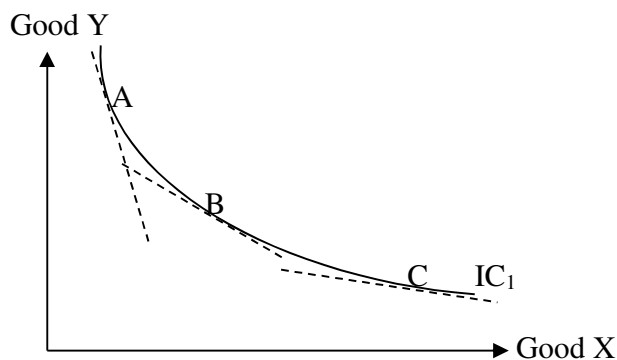
Based on the second ranking rule of consistency, IC_2 is strictly above IC_1 while IC_0 is strictly below IC_1 . Since combination E has more of X and Y compared to combination B, E is preferred to combination B. But since D and F are on the same indifference curve as E, this means D and F must also be preferred to B. In the same context, combination B must be preferred to combinations G, H and K. In general, any combination on a higher indifference curve is always preferred to any combination on a lower indifference curve. A consumer who can attain a combination on a higher indifference curve will not settle for any combination on a lower indifference curve.

Based on the third ranking rule of the law of the diminishing marginal utility, all the indifference curves IC_0 , IC_1 and IC_2 are convex to the origin. Moving down the curve from the left to the right, the slope of the indifference curve becomes flatter and flatter.

3.3 Marginal Rate of Substitution

The slope of the indifference curve is known as the marginal rate of substitution (MRS). It is defined as the amount of Y (measured in the Y-axis) needs to be given up to exchange for 1 unit of X (measured in the X-axis) and retain the same total utility (remain in the same indifference curve). Refer to Figure 6.5 which shows the changes in the slope of an indifference curve.

Figure 6.5: Slope of Indifference Curve



Consider a combination A where the individual has many units of Y but very few units of X. Thus X will be considered as more precious compared to Y. The slope of the tangent line at combination A will tend to be steep. If the slope is -5, this means the consumer is willing to give up 5 units of Y to exchange for 1 unit of X and has the same total utility represented by IC_1 .

At combination B, the consumer has a moderate amount of X and Y. Thus X will be less precious compared to combination A and the slope of the tangent line at B will be relatively flatter. If the slope is -3, this means the consumer is now willing to give up 3 units of Y to exchange for 1 unit of X and to retain the same total utility represented by IC_1 .

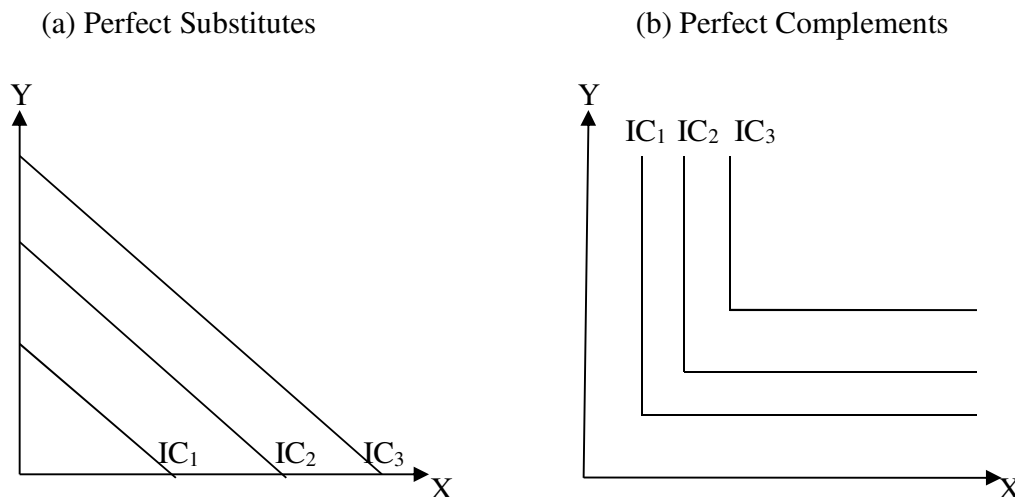
At combination C, the consumer has a large amount of X but very little Y. Thus X will be very much less precious compared to combination A and the slope of the tangent line at C will be very flat. If the slope is -1, this means the consumer is now only willing to give up 1 unit of Y to exchange for 1 unit of X and to remain indifferent.

The declining slope moving down an indifference curve demonstrates the diminishing marginal rate of substitution. This is a key assumption in consumer theory which states the general tendency for a person to be willing to give up lesser and lesser amount of a product Y to exchange for another product X when the quantity of X increases.

3.4 Special Indifference Curves

There are two special types of indifference curve. One is for two products which are perfect substitutes while the other is for two products that are perfect complements. They are shown in Figure 6.6.

Figure 6.6: Special Indifference Curves



For two products that are perfect substitutes, the indifference curve will be straight line. For example, a canned food purchased from provision shops is the same as one purchased from the supermarket. Regardless of how many units of X or Y which the consumer already has, the trade off is always the same for between them and the indifference curve will be downward sloping straight line. This is shown in Panel (a) of Figure 6.6.

For two products that are perfect complements, say left shoes and right shoes, the indifference curve will be "L" shaped. A consumer who has one left shoe and one right shoe will have the same total utility compared to another combination of one left shoe with two right shoes, or one right shoes with two left shoes, since the extra left or right shoe will be redundant. But a consumer will prefer to have two pairs of shoes to one pair of shoes.

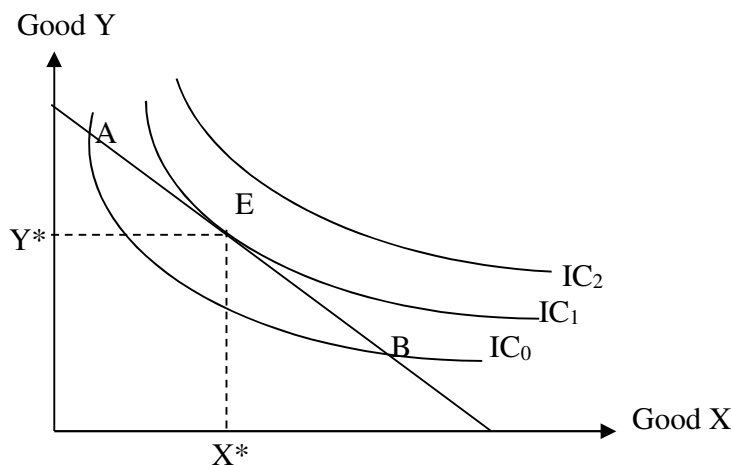
4 Optimal Consumption Bundle

Since the budget line represents the affordable consumption combinations while indifference curves represents consumption combinations with preferences, we can combine both the budget line and indifference curve to obtain the optimal consumption bundle.

4.1 Diagrammatic Analysis of Optimal Consumption

Combining the indifference curve and the budget line, we have Figure 6.7. The consumer can buy all the combinations of the two products as defined by the budget line. But different combination may generate different total utility and the consumer objective is to maximize total utility. This means the consumer should try to reach the highest indifference curve which is reachable by the budget line.

Figure 6.7: Optimal consumption Bundle Diagram



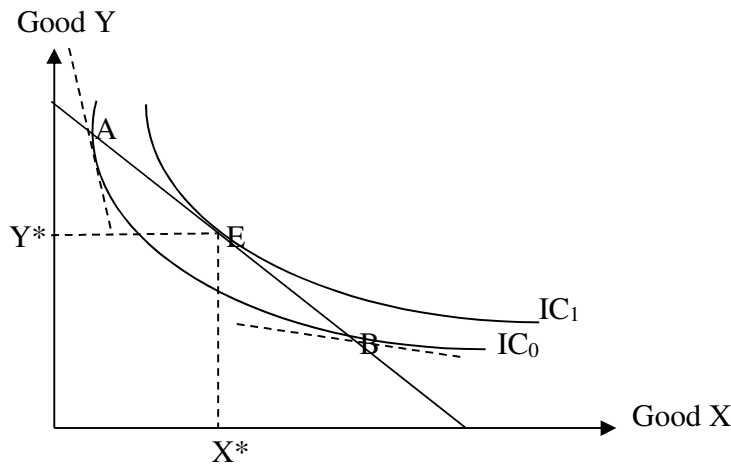
Consider indifference curve IC_0 which intersects the budget line at points A and B. Although the consumer can buy either of the two combinations, the total utility is not maximized yet as the consumer can go for the higher indifference curve. Thus the consumer should consider the next higher indifference curve until indifference curve IC_1 where there is only one point that touches the budget line at point E. Any higher indifference curve, such as IC_2 , will be above the budget line which is non-attainable by the consumer. Thus the optimal consumption bundle is Y^* of Good Y and X^* of Good X

defined by point E of the budget line. At this point, given the budget line, the consumer can reach the highest total utility.

4.2 Mathematical Analysis of Optimal Consumption

We can also determine the optimal consumption combination by analyzing the slope of the indifference curve and the slope of the budget line. Consider two products X and Y with product Y represented on the Y axis and product X on the X axis. Based on the budget line equation $Q_Y = I/P_Y - (P_X/P_Y)Q_X$, the slope of the budget line is given by (P_X/P_Y) . The slope of an indifference curve is given by (MU_X/MU_Y) .

Figure 6.8: Slope of Indifference Curve and Budget Line



Consider the combinations A, B and E. They are all on the budget line and hence they are all affordable by the consumers. However, the slope of the tangent line to combination A which measures the slope of indifference curve at combination A is steeper than the slope of the budget line. This means

$$\frac{MU_X}{MU_Y} > \frac{P_X}{P_Y} \text{ or } \frac{MU_X}{P_X} > \frac{MU_Y}{P_Y}$$

The consumer will be better off to buy more X and buy less Y, thus moving down the budget line. On the other hand, for a combination B, the slope of the tangent line to combination B which measures the slope of indifference curve at combination B is flatter than the slope of the budget line. This means

$$\frac{MU_X}{MU_Y} < \frac{P_X}{P_Y} \text{ or } \frac{MU_X}{P_X} < \frac{MU_Y}{P_Y}$$

The consumer will be better off to buy more Y and buy less X, thus moving up the budget line. The optimal combination is E where the indifference curve is tangential to the budget line, which means they have the same slope. Thus we have

$$\frac{MU_X}{MU_Y} = \frac{P_X}{P_Y} \text{ or } \frac{MU_X}{P_X} = \frac{MU_Y}{P_Y}$$

This fulfils the optimal consumption rule.

5 Effect of Income and Price Change

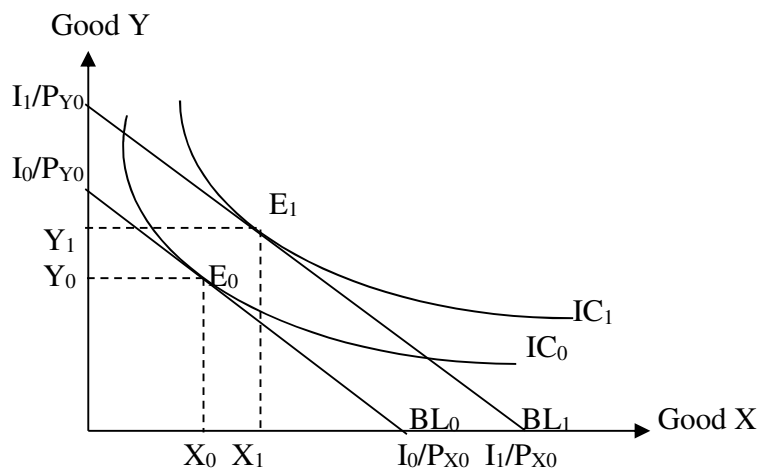
Two analysis of changes in budget line are common with the indifference curve budget line framework. One involves the income change which reflects in a parallel shift in the budget line. The other involves a change in the price of one good and hence the slope of the budget line is affected. In both cases, a new optimal consumption bundle will occur. We will discuss the effect of income change in Section 4 and the effects of price change in Section 5.

5.1 Effect of Increase in Consumer Income

When the consumer income increases, the budget line shifts outwards in a parallel manner, resulting in a larger maximum amount of both goods A and B. If both goods are normal good, then the new optimal consumption point will indicate a larger amount of both goods. This is known as the income effect.

Refer to Figure 6.9. Consider the initial budget line BL_0 with income I_0 , price of X equals P_{X0} and price of Y equals P_{Y0} . The optimal consumption point is given by E_0 where the budget line BL_0 is tangential to the indifference curve IC_0 .

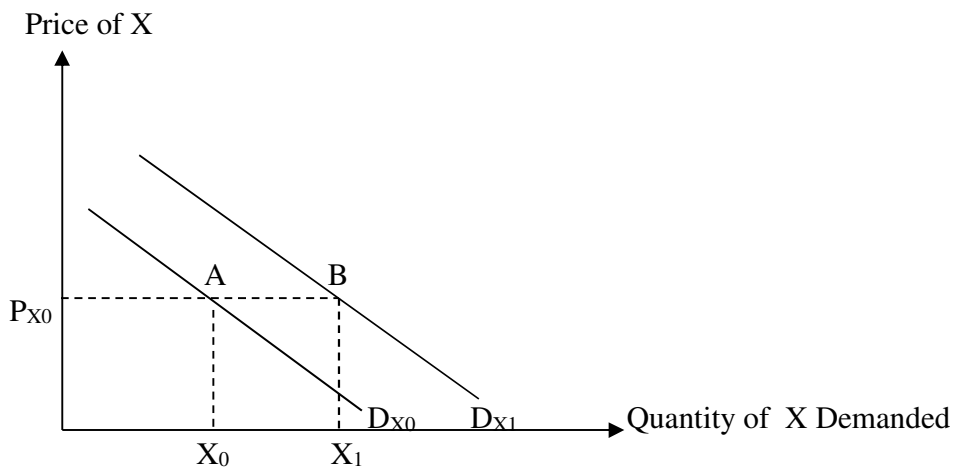
Figure 6.9 Effect of Income Increases for Normal Goods



If there is an increase in income from I_0 to I_1 , the budget line will have a parallel shift outwards to BL_1 . The new optimal consumption point is given by E_1 where the new budget line BL_1 is tangential to the higher indifference curve IC_1 . If both Good X and Good Y are normal goods, the final equilibrium will show a higher consumption of both goods, such as E_1 compared to E_0 .

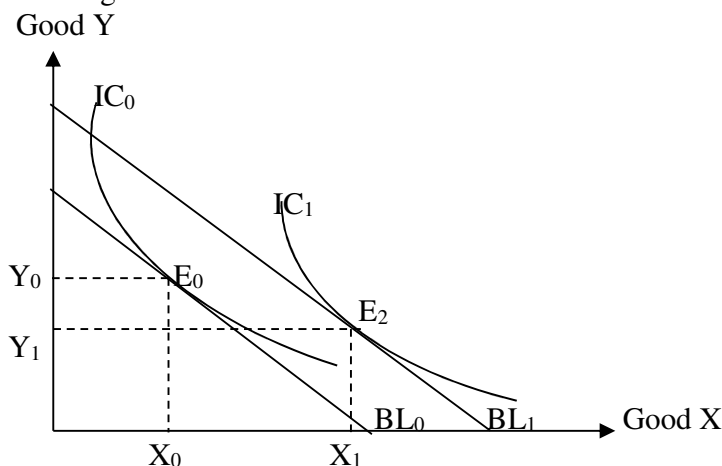
Suppose we focus on the analysis of Good X when income changes. Initially at the given price of good X at P_{X0} with income I_0 , the consumer consumes the quantity of X equals to X_0 . This is reflected at point A on demand curve D_{X0} , as shown in Figure 6.10. At the same price P_{X0} , when income increases and assuming X is a normal good, the new quantity of X is X_1 . This is reflected at point B on demand curve D_{X1} in Figure 6.10.

Figure 6.10 Effect of Income Increases for Inferior Good Y



If Good Y is inferior while Good X is normal, then the final optimal consumption point should indicate a larger amount of Good X but a smaller amount of Good Y, such as E_2 compared to E_0 in Figure 6.11

Figure 6.11 Effect of Income Increases for Inferior Good Y

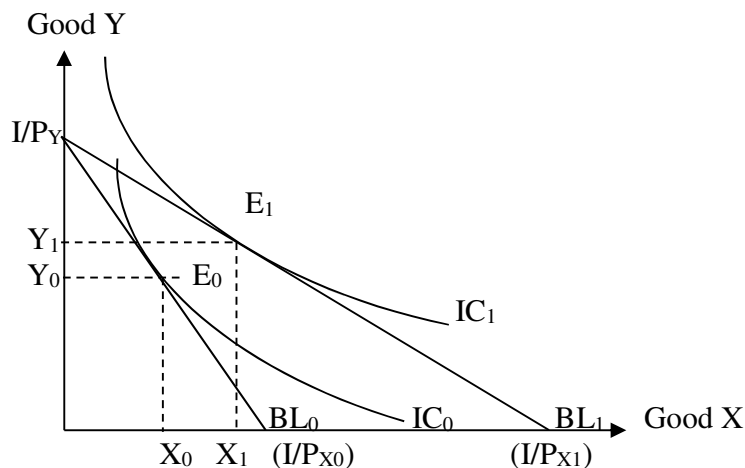


5.2 Effect of Price Changes

When the relative price change, the slope of the budget line will be affected. When the price of a good decreases, there is both income and substitution effect that affect the quantity demanded. Substitution effect always indicate to the consumer to buy more of the cheaper product. However, income effect is dependent on the nature of the product. If the product is a normal good, a lower price increases real income of the consumer and lead to a higher consumption of the cheaper product.

Refer to Figure 6.12 which analyze the effect of price of Good X decreases. Consider the initial budget line BL_0 where the optimal consumption point is given by E_0 where the budget line BL_0 is tangential to the indifference curve IC_0 . Given income I and the price of Good Y equals P_Y , When the price of Good X decreases from P_{X0} to P_{X1} , the budget line will becomes flatter and indicate a larger maximum amount of Good X which can be purchased (from I/P_{X0} to I/P_{X1}). The maximum amount of Good Y can be purchased remain unchanged at I/P_Y .

Figure 6.12: Effect of Price of Good X Decreases



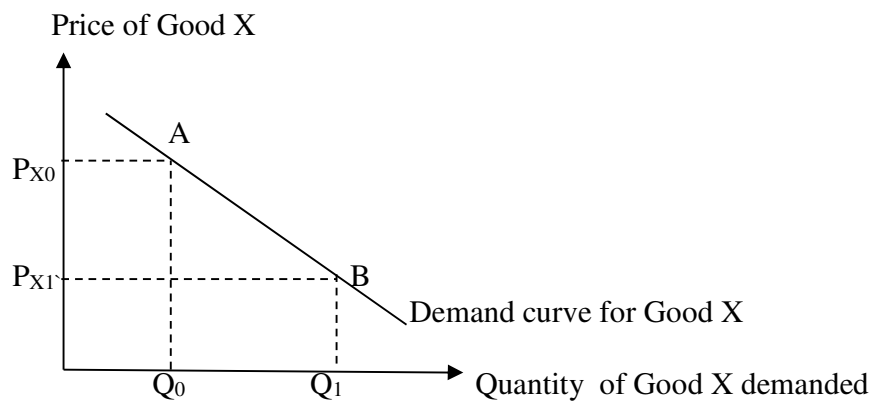
The new optimal consumption point is given by E_1 where the new budget line BL_1 is tangential to the higher indifference curve IC_1 . If Good X is a normal good, both the substitution effect and the income effect indicate to a larger quantity of Good X consumed after the price of Good A decreases. The final consumption point must indicate a larger amount of Good X but the amount of Good Y can be higher, lower or remain unchanged.

If the product is an inferior good, a lower price increases real income of the consumer but will lead to a lower consumption of the cheaper product. However, we assume that the income effect is weaker than the substitution effect for an inferior good and hence the overall effect is still an increase in the quantity demanded of the good that becomes cheaper.

5.3 Derivation of the Demand Curve

The indifference curve and the budget line framework allows us to derive the demand curve when the price of a product change. From Figure 6.12, when the price of Good X is P_{X0} , the optimal consumption of Good X is X_0 . when the price of Good A decreases to P_{X1} , the optimal consumption of Good X increases to X_1 . Thus we have two points, (P_{X0}, X_0) and (P_{X1}, X_1) reflected by point A and B in Figure 6.13. Joining the two prices and two quantities of Good X demanded, we can derive the downward sloping demand curve for Good X from the indifference curve and budget line framework.

Figure 6.13: Demand Curve for Good X



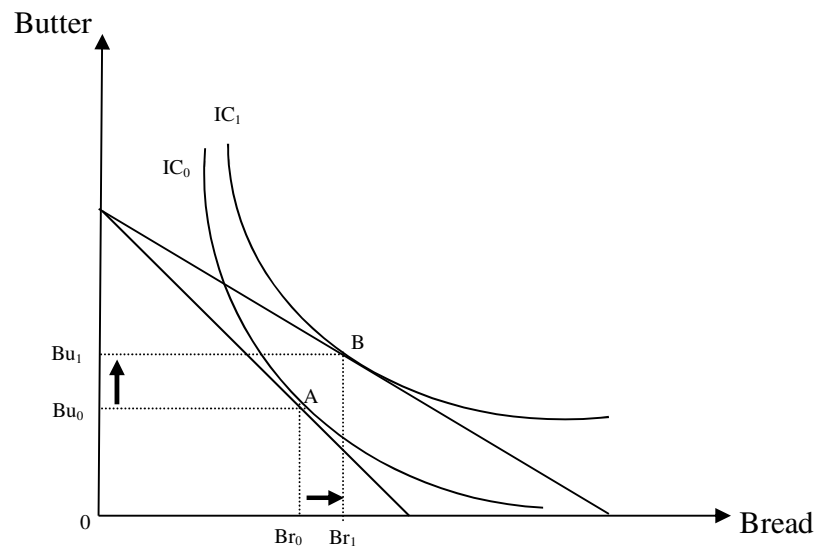
6 Illustration Questions

- Using an indifference curve and budget line diagram, explain how the optimal consumption bundle of two goods, bread and butter, is derived. Place bread on the x-axis and butter on the y-axis.
- The price of bread is now assumed to decrease while bread and butter are also assumed to be complements in consumption. Using the same diagram, explain and illustrate how the optimal consumption bundle has changed.

Answers

- The correct answer should include a downward sloping straight budget line and a downward sloping convex shaped indifference curve, with Y axis showing butter and X-axis showing bread. The optimal consumption point is the tangency point of budget line with the highest attainable indifference curve.

Refer to the diagram that follows. The best affordable point is Point A which occurs when an individual spends away all his income and achieves the highest level of satisfaction possible; thus graphically resulting in a tangency point where consumption occurs on the budget line just touching the highest possible indifference curve.



(b) Due to a decrease in price of bread, the budget line will swing outward. One will expect to see an increase in consumption of bread. Since bread and butter are complements in consumption, there should also be an increase in consumption of butter. The new best affordable point should move from an initial equilibrium point A to final point B.

7 Discussion Questions

Question 1

An indifference curve _____.

- (A) is a U-shaped curve.
- (B) shows the maximum total utility of consuming 2 products.
- (C) shows the combination of 2 products that cost the same amount of money.
- (D) shows the combination of 2 products that provide the same total utility.

Question 2

Which of the following is true at the optimal consumption point?

- (A) The consumer has the highest total utility given his budget
- (B) The slope of indifference curve is larger than the slope of budget line
- (C) The marginal utility of both products are equal
- (D) The price of both products are equal

Question 3

Which of the following is not true at the optimal consumption point?

- (A) The consumer has the highest total utility given his budget
- (B) The slope of indifference curve is the same as the slope of budget line
- (C) The marginal utility of both products are equal
- (D) The marginal utility per dollar of both products are equal

Question 4

An indifference curve _____.

- (A) cannot be a straight line.
- (B) cannot be L-shaped.
- (C) cannot be downward sloping.
- (D) cannot be upward sloping

Question 5

If the slope of budget line is larger than the slope of the indifference curve, then

- (A) The consumer has the highest total utility given his budget
- (B) The consumer should buy more of the product on the Y axis
- (C) The consumer should buy more of the product on the X axis
- (D) The consumer should buy more of both products

Question 6

Evaluate whether the following statements are true or false. Justify your answers.

- (a) For a person who consumes only steak and lobster, a fall in *either* the price of a steak *or* the price of a lobster shifts the budget line for the two leftward and does not change its slope.
- (b) When your budget line is just tangent to your indifference curve, you are at your best affordable point.

Question 7

LordIronChef (LIC) is a famous foodie - someone who loves food and is happier the more food he consumes. Unfortunately LIC only has \$100 to spend on food in total and can only eat Fried Chicken and Mashed Potatoes. Fried Chicken costs \$2 per serving and Mashed Potatoes cost \$1 per serving.

- (a) With this information, draw a Budget Line / Indifference Curve diagram for LIC. Put Fried Chicken Meals on the vertical axis.
- (b) Assume that LIC now has a new \$30 budget. Redraw your Budget Line / Indifference Curve diagram from 3(b)(i). In your diagram, add a new Budget Line and Indifference Curve which shows LIC maximising utility on his new \$30 budget. Assume that Fried Chicken and Mashed Potatoes are both normal goods. Label your old and new Budget Lines and Indifference Curves clearly.
- (c) Assume that LIC's budget stays at \$30, and Mashed Potatoes have now doubled in price. Draw a Budget Line / Indifference Curve which shows LIC maximising utility on his \$30 budget with the original and new price of Mashed Potatoes. Label your old and new Budget Lines and Indifference Curves clearly.

MICROECONOMICS

SESSION 7

OUTPUT AND COSTS

At the end of the session, students should be able to:

1. Explain the objective and profit of a firm
 2. Distinguish between short run and long run analysis
 3. Explain the relationship between output and labour employed in the short run
 4. Explain the relationship between output and cost in the short run and derive the short-run cost curves
 5. Explain the relationship between output and cost in the long run and derive the long-run average cost curve
-

1. Introduction

In this session, we begin with a discussion of the objective of firms, which is to maximize profit. Next we specify the timeframe of production and distinguish between short run and long run. Then we analyze the relationship between output, labour employed and cost in the short run. Finally, , we discuss the long run production and derive the long run average cost curve from the short run average cost curves.

2. Decision of Firms

A firm is an organization which hires resources to produce output and sell the output to consumers to make profit. Although in reality there might be non-profit oriented firms exist to fulfil social function instead of making profit, we assume in this course that the sole objective of firm is to maximize profit. Thus the firm has to make decision on the amount of resources employed, quantities of output produced and setting appropriate prices of its products in order to maximize profit.

A firm makes profit when its earning from the sales of goods is more than its cost of production. Thus profit is defined as total revenue less total cost of production.

$$\text{Profit} = \text{Total Revenue} - \text{Total Cost}$$

Total revenue (TR) is defined as price multiply by quantity sold. Costs are incurred to acquire resources or input in the production process. A firm may use several resources and the total cost (TC) is the costs of using all the resources needed in the production.

We assume that the objective of any firm is to maximize profit, firms need to maximize the difference between total revenue and total cost.

If total revenue exceeds total cost, the firm is making a positive economic profit. To earn more profit, the firm will have to increase total revenue which is the product of price and quantity, and also decrease the costs of production.

If total revenue equals total cost, the firm is making zero economic profit. However, this does not mean that the firm is earning zero dollars and cents. It means the firm is earning the same amount as its next best alternative. We will discuss the concept of economic profit in Section 2.1. It is important to distinguish between accounting profit and economic profit.

If total revenue is less than total cost, the firm is making a negative economic profit or incurring a loss. In this case the firm will have to consider shutting down (cease operation temporary) or to continue operate at a loss.

2.1 Different types of profit

Economists and Accountant have different ways of calculating profit by considering different types of costs. This result in the differences between accounting profit and economic profit.

(a) Accounting Profit

Accountant only keep tracks of all payments made to external parties in calculating total cost : Rental, wages, raw materials, utilities, insurance, taxes etc. Thus when a firm acquire external resources, explicit costs are incurred. Explicit cost includes all payments made to outsiders for the use of their resources. This includes:

- (i) Rental cost paid to landlord
- (ii) Wages paid to workers
- (iii) Payment to raw materials suppliers
- (iv) Machines costs paid to machine suppliers
- (v) Miscellaneous cost such as water and electricity bills etc

Accountant defines profit as total revenue earned by the firm less explicit cost incurred by the firm. Thus the formula of accounting profit is

$$\text{Account profit} = \text{Total revenue} - \text{Explicit cost}$$

If the firm owns a resource and use the resource in the production process, then there is no cost incurred from the accountant point of view. For example, if a firm owns an office and operate in the office, there is no rental cost incurred and the accountant will record the rental cost as 0.

(b) Economic Profit

Accountant only considers cost incurred when there is a payment to an external party. When the firm uses its own resources, there will be no payment involved and the accountant will consider as no cost is incurred. In contrast, economists considers cost not only payment to use resources own by external parties but also include cost of using the firm's own resources. This is the opportunity cost and when the firm uses own resources, implicit cost (opportunity cost) are incurred.

When an individual set up his own firm, he has to forgo wages earned elsewhere. Thus there is an opportunity cost incurred and this is an implicit cost. When the firm uses its own premises for operation, it will have to give up rental it can earn by renting the premises to an external party, This is also an implicit cost. Economists include both explicit and implicit cost in calculating total cost. Thus economist calculate profit as total revenue less explicit cost less implicit cost.

$$\text{Economic profit} = \text{Total revenue} - (\text{Explicit cost} + \text{Implicit cost})$$

Since implicit cost is positive, the accounting profit is always larger than economic profit. A firm may be earning negative economic profit but still earns a positive accounting profit. In this course, we focus on economic profit.

(c) Normal Profit

When total revenue equals total cost, economic profit is zero but accounting profit is positive. The firm is earning a profit equivalent to the opportunity cost of its resources. This zero economic profit is also known as normal profit or break even. Normal profit does not mean that the firm is not earning any profit. It means that the firm is earning the same amount at the next best use of the firm's resources which is the implicit cost.

$$\text{Total revenue} - (\text{Explicit cost} + \text{Implicit cost}) = 0$$

This is known as zero economic profit or normal profit.

2.2 Numerical Example

A person gives up his job of monthly salary \$3,000 to set up a company selling shoes. He converts his house to a shop to sell the shoes. Previously he rented out his house to collect rental of \$1000 per month. He also hires an assistant for \$800 per month . The raw

materials, machines, utilities etc cost him \$20,000. Within one year, the company produces 1500 pairs of shoes and they are sold at \$30 per pair. How much profit/loss does he make for the year?

Total revenue = $\$30 \times 1,500 = \$45,000$

Wage cost = $\$800 \times 12 = \$9,600$

Raw materials and other costs = \$20,000

Salary forgone = $\$3,000 \times 12 = \$36,000$

Rental forgone = $\$1,000 \times 12 = \$12,000$

Accounting profit = $\$45,000 - \$20,000 - \$9,600 = \$15,400$ (Profit)

Economic profit = $\$45,000 - \$20,000 - \$9,600 - \$36,000 - \$12,000 = -\$32,600$ (Loss)

2.3 Definitions of Inputs, Short Run and Long Run

Inputs are resources used in the production process. There are two types of inputs, fixed input and variable input.

Fixed inputs are inputs that cannot be increased within a given period. The fixed inputs are the building and machines known as capital which the firm normally require a certain amount of time before they can be acquired and put into the production process.

Variable inputs are inputs that can be increased within a given period. Labour are usually considered as the variable input and the firm can normally increase the quantity of labour within a short time frame such as requesting the workers to work overtime.

Short run and long run are different time frame in production process. Short run refers to the time period which at least one fixed input is used. That is, the time period is short enough such that firm cannot increase the quantity of at least one of its inputs. It is assume that capital and land are fixed but labour is variable in the short run. Thus in the short run, firms can only produce more output by increasing the quantity of variable inputs to work with a certain fixed inputs.

In contrast, long run is the time period where all inputs are variable. That is, the time period is long enough for firms to build more factories and acquire more machines. Thus in the long run, firms can increase the quantity of machines and hire more labour to increase output. The firm will use the long run period to adjust its scale of production and acquire the optimal amount of labour and capital.

For example, consider a can-food producer using machines operated by workers in a factory to produce can-food. If the producer receives a last minute order from a customer to produce more can-food than the daily amount, the producer is unable to set up another factory and obtain another set of machines to produce the additional can-food. It can only use the same machine in the same factory but request the workers to work overtime or

operate another shift to fulfil the order. In this sense, one day is a short run period since there is at least one resource that is fixed.

But if the producer foresees that five years later the demand for can-food will increase due to increasing population. The producer can start to plan to build another factory, acquire another sets of machines and employ another batch of workers. The new factory and machines can be ready in five years time. In this sense five years is the long run period where all resources are variable.

3 Short Run Theory of Production

In the short run, firms produce more output by using more variable inputs (labour) with fixed inputs (machines). The production process is subjected to the Law of Diminishing (Marginal) Returns.

3.1 The Law of diminishing returns

The law of diminishing returns states when more and more of labour are being used together with a fixed amount of capital, eventually the contribution of each additional worker to the total output will decline.

Consider a firm with a fixed capital (machine) and begin to hire more and more workers to work on the same amount of machines. Initially with very few workers, each worker has sufficient machines to work with and thus total output increases by an increasing rate as more workers are used. Each machine needs an optimal number of workers to operate.

When the number of workers is approaching this optimal number, the machines are better and better utilized and hence the workers are able to contribute more and more output. Eventually when more and more workers are used, the workers encounter insufficient machines to work with and their productivity decline.

Once the optimal number of workers are exceeded, the additional workers will encounter constraint in using the machines and will become increasing less productive. Thus total output increases at a decreasing rate and may even decline with more workers used.

3.2 Total Product, Average Product and Marginal Product

In the short run where the quantity of capital is fixed, output can be increased only by increasing labour input. The firm must be adding ever-increasing amounts of labour to a given amount of plant and machinery. This change in output due to labour input changes is given by the total product of labour (TP).

The marginal product of labour is the increase in output obtained by adding 1 unit of labour, holding constant the fixed capital input.

$$\text{Marginal product} = \frac{\text{Change in Total Product}}{\text{Change in Labour}}$$

Average product of labour (AP) is defined as Total output divided by total labour.

$$\text{Average product} = \frac{\text{Total Product}}{\text{Total Labour}}$$

Table 7.1 shows the relationship between the labour input, the quantity of output and the marginal product of labour (MP):

Table 7.1: Total Product, Average Product and Marginal Product

Labour	Total Product (TP)	Marginal Product (MP)	Average Product (AP)
0	0	-	-
1	5	5	5
2	14	9	7
3	30	16	10
4	42	12	10.5
5	52	10	10.4
6	58	6	9.67
7	62	4	8.86
8	65	3	8.13
9	66	1	7.33
10	64	-2	6.4

The law of diminishing returns states that holding all factors constant except one, beyond a certain level of the variable input, further increases in the variable input lead to a steadily decreasing marginal product of that input.

Note that as labour increases, the total product of labour increases but the rate of increase is declining as more and more labour are added. Eventually total product reaches a maximum and may decrease with more units of labour added.

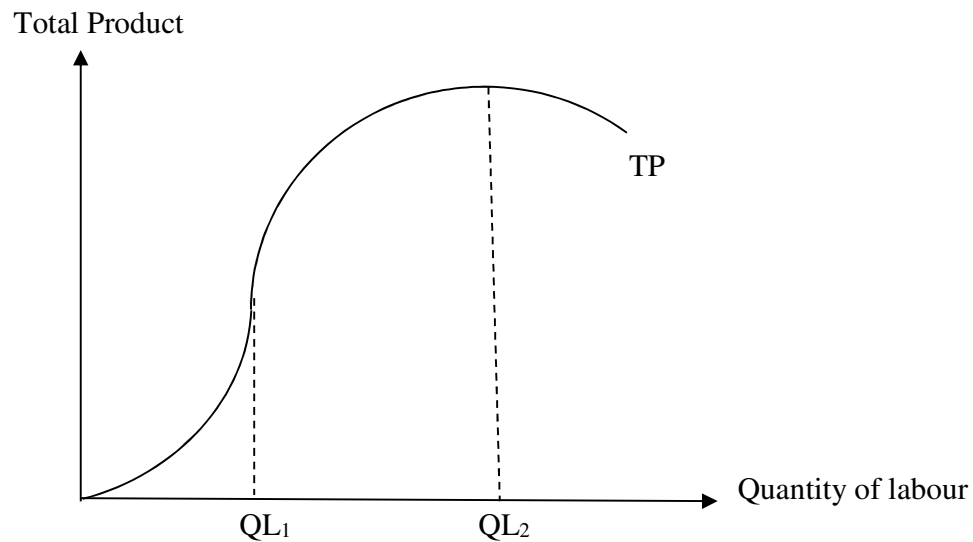
For the marginal product of labour, the first three units of labour experience increasing marginal product. But from the fourth unit of labour onwards, the marginal product of labour is declining. Thus there are diminishing returns to labour starting from the 4th worker workers.

Total product reaches a maximum of 66 units with 9 workers employed. With the 10th worker added, total product starts to decrease. At this juncture the marginal product becomes negative. A firm will not employ the amount of workers with declining total product and negative marginal product for profit maximization consideration.

3.3 Total Product Curve, Average Product Curve and Marginal Product Curve

Plotting total product versus total quantity of labour, the total product of labour curve is derived. A typical total product curve is shown in Figure 7.1.

Figure 7.1: Total Product Curve



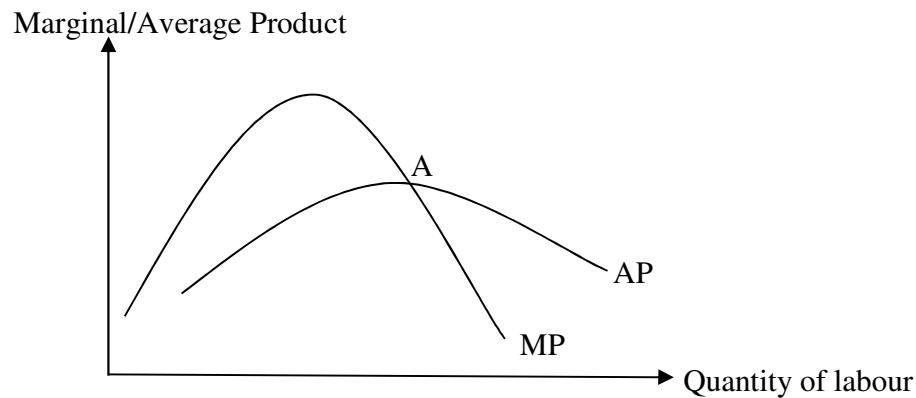
A typical total product curve is a "S" shaped curve. Starting from the origin, initially as the quantity of labour increases, the workers are able to make better use of the machines and hence they are very productive. The total product increases at an increasing rate and it is convex

However, after QL_1 of labour, there will be constraint in the availability of machines to be used by the newly added workers. The production will encounter diminishing returns to labour and the workers are becoming less and less productive. The total product increases at a decreasing rate and the total product curve becomes concave. After QL_2 , the productivity of labour becomes negative and the total product actually decreases with more labour. From the profit maximization point of view, additional workers incur costs and hence it is irrational to hire any workers beyond the quantity QL_2 where the total product decreases.

Plotting Marginal product of labour and average product of labour versus quantity of labour, the marginal product of labour curve and the average product of labour curve are derived. The marginal product curve is the slope of the total product curve. When total product curve is upward sloping and convex, the marginal product is positive and increasing. When total product curve is upward sloping and concave, the marginal product is positive and decreasing. When total product curve is downward sloping, the marginal product is negative. A profit maximizing firm will not employ workers with negative marginal product.

A typical marginal product and average product curve are shown in Figure 7.2.

Figure 7.2: Marginal Product and Average Product Curves



Both the marginal product and the average product curves are inverted U-shaped curve. There is an important relationship between the two curves.

Initially when labour are increasingly being used in the production process, the increasing workers are productive and both the marginal product and average product increases. Thus both curves slope upwards. Eventually as labour increases, diminishing returns kicks in and both marginal product and average product decrease. Thus both curves eventually slope downwards.

If the marginal product is higher than average product, the average product will be increasing. If the marginal product is lower than the average product, the average product will be decreasing. Thus when the marginal product equals the average product, it is the maximum of the average product. This is shown at point A of Figure 3.2

3.4 Short Run Total Cost

Since capital (machines) is fixed in the short run, the firm can only increase its production by hiring more variable factors, such as labour. Thus in the short run the firm incurs both fixed cost and variable cost.

Fixed costs (FC) are the costs of hiring fixed factors of production. These fixed costs must be borne even if output is zero and they do not vary with output levels. Variable costs (VC) are the costs of hiring variable factors of production. The variables are zero when output is zero and they increase as output increases. Thus the short run total cost of production (TC) is the sum of the short run total fixed cost (TFC) and the short run total variable cost (TVC).

Table 7.2 shows a typical short run total fixed cost, total variable cost and total cost. Take note that even when output is 0, total fixed cost is incurred and hence total cost equals total fixed cost.

Table 7.2: Total Fixed Cost, Total Variable Cost and Total Cost

Output	Total Fixed Cost (TFC)	Total Variable Cost (TVC)	Total Cost (TC)
0	10	0	10
1	10	5	15
2	10	8	18
3	10	10	20
4	10	11	21
5	10	15	25
6	10	20	30
7	10	30	40
8	10	45	55
9	10	65	75
10	10	93	103

The total fixed cost remains unchanged as output increases. However, when output is zero, total variable cost is also zero. As output increases, total variable cost also increases. Initially because the workers are productive, total variable cost only increases slowly as output increases. Eventually when diminishing returns occur, total variable cost will increase rapidly as output increases.

3.5 Short run Average Cost and Marginal Cost

We may also divide the total cost by the output level to obtain the average cost. There are three average costs to consider.

The short run average fixed cost (AFC) equals short run total fixed cost (TFC) divided by total output.

$$\text{Average Fixed Cost} = \frac{\text{Total Fixed Cost}}{\text{Total Output}}$$

Since total fixed cost did not change with output, as total output increases, average fixed cost will decrease.

The short run average variable cost (AVC) equals short run total variable cost (TVC) divided by total output.

$$\text{Average Variable Cost} = \frac{\text{Total Variable Cost}}{\text{Total Output}}$$

The short run average total cost (ATC) equals short run total cost (TC) divided by total output, which is also the sum of AFC and AVC.

$$\text{Average Total Cost} = \frac{\text{Total Cost}}{\text{Total Output}}$$

$$\text{Average Total Cost} = \text{Average Fixed Cost} + \text{Average Variable Cost}$$

The short run marginal cost (MC) equals change in total cost divided by change in output. Since total cost changes is due to changes in total variable cost only, the marginal cost can also be obtained by change in total variable cost divided by change in output

$$\text{Marginal Cost} = \frac{\text{Change in Total Cost}}{\text{Change in Total Output}}$$

$$\text{Marginal Cost} = \frac{\text{Change in Total Variable Cost}}{\text{Change in Total Output}}$$

Table 7.3 shows a typical short run average fixed cost, average variable cost and average total cost. Take note that average fixed cost is decreasing throughout as output increases. But for average variable cost, average total cost and marginal cost, they tend to decrease initially and eventually increase as output increases.

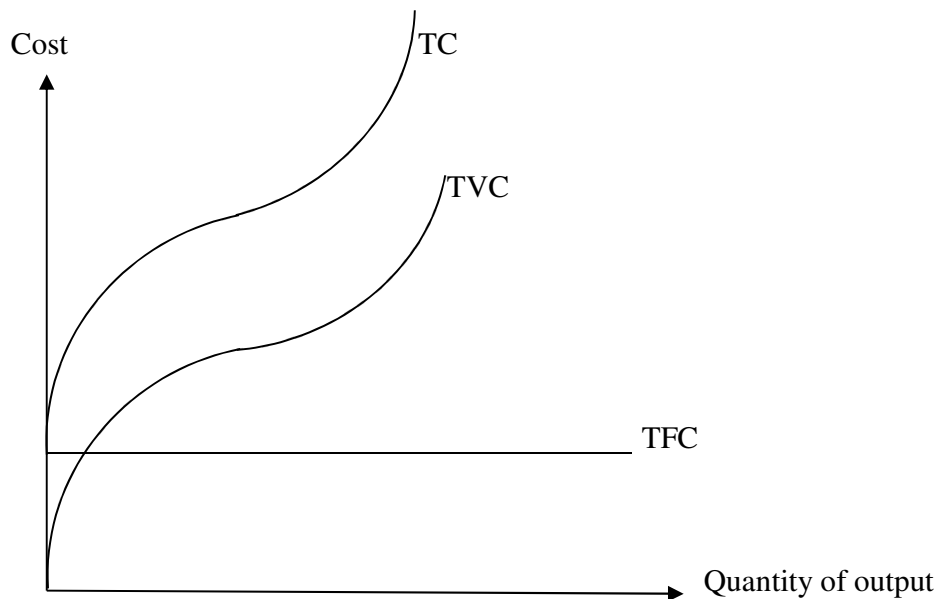
Table 7.3: Average Fixed Cost, Average Variable Cost and Average Total Cost

Output	TFC	TVC	TC	AFC	AVC	ATC	MC
0	10	0	10	-	-	-	-
1	10	5	15	10	5	15	5
2	10	8	18	5	4	9	3
3	10	10	20	3.33	3.33	6.67	2
4	10	11	21	2.5	2.75	5.25	1
5	10	15	25	2	3	5	4
6	10	20	30	1.67	3.33	5	5
7	10	30	40	1.43	4.29	5.71	10
8	10	45	55	1.25	5.63	6.88	15
9	10	65	75	1.11	7.22	8.33	20
10	10	93	103	1	9.3	10.3	28

3.6 Short Run Cost Curves

Plotting the cost of production versus quantity of output, we have the cost curves. It is important to recognize the shape of the various cost curves and the relationship between the cost curves. The TFC, TVC and TC curves are plotted in Figure 7.3.

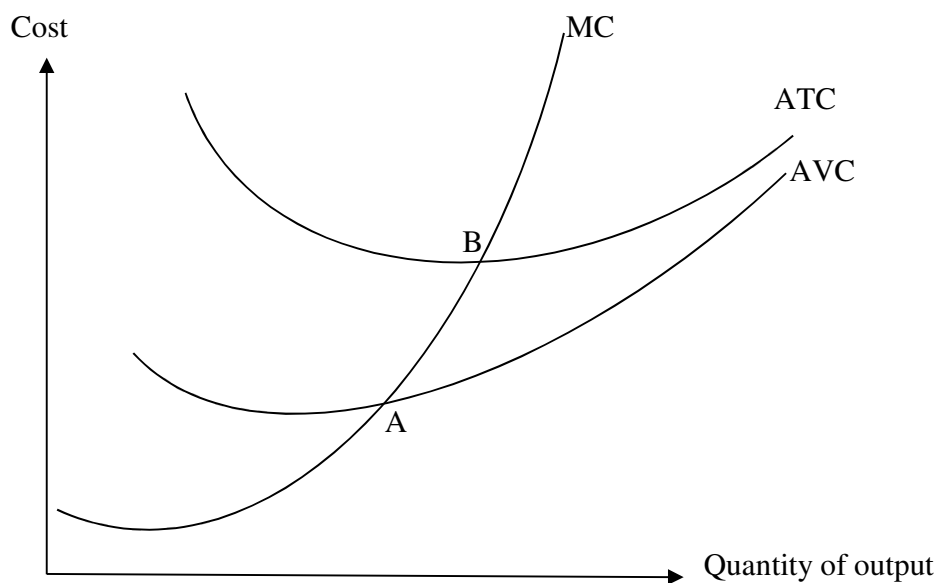
Figure 7.3: Various Short Run Total Cost Curves



The TFC curve is a horizontal straight line at the fixed cost level, since fixed cost does not change with output. The TVC curve increases as output increases but it initially increases slowly and eventually increases rapidly. The TC curve follows the shape of the TVC curve and it is vertically above the TVC curve by the amount of the fixed cost. Thus the vertical gap between TVC and TVC is TFC for each output level which is a constant.

The ATC, AVC and MC curves are plotted in Figure 7.4.

Figure 7.4: Various Short Run Average and Marginal Cost Curves



The three curves are all U-shaped curves and there are important relationship between the three cost curves. Note that ATC curve is always above AVC curve since $ATC = AVC + AFC$ and AFC is a positive value. But the gap between ATC and AVC curves decreases as output increases. This is because the gap between ATC curve and AVC curve is AFC and AFC decreases as output increases.

Initially as output increases, the workers are productive and hence MC is decreasing and MC curve is downward sloping. Eventually when the workers are less productive due to diminishing returns, MC will be increasing and MC curve will be upward sloping. Thus the typical MC curve is a U-shaped curve.

If MC is less than AVC, AVC is decreasing. If MC is higher than AVC, AVC is increasing. Thus when MC equals AVC, it is the minimum of AVC. This is shown in point A of Figure 7.4.

Likewise if MC is less than ATC, ATC is decreasing. If MC is higher than ATC, ATC is increasing. Thus when MC equals ATC, it is the minimum of ATC. This is shown in point B of Figure 7.4.

Hence ATC and AVC are both U-shaped curves. Thus another feature of the curves is that MC curve cuts through the lowest point of AVC curve and ATC curve from below.

4 Long Run Theory of Production

In the long run, all inputs are variable. A firm can change the quantity of its machines, factory size and the amount of labour employed in the long run. Thus it is a time period for a firm to expand or contract according to the demand for its product. However, the production in the long run is subject to the returns to scale.

4.1 Concepts of Returns to Scale

Consider a firm increases all its inputs by the same proportion. There are three possible outcomes. They are increasing returns to scale, constant returns to scale and decreasing returns to scale.

Increasing returns to scale or economies of scale occurs when output increases by a larger proportion than inputs increase. This could be due to specialisation and division of labour, indivisibilities, greater efficiency of large machines, organisational economies, spreading overheads, financial economies etc. Increasing returns to scale will lead to economies of scale which means as the output increases, the average cost of production decreases. This is because if output increases by a larger proportion than all inputs, it will cost the firm less on the average to produce one unit of output. Thus with economies of scale, there will be a decreasing long run average total cost curve as output increases.

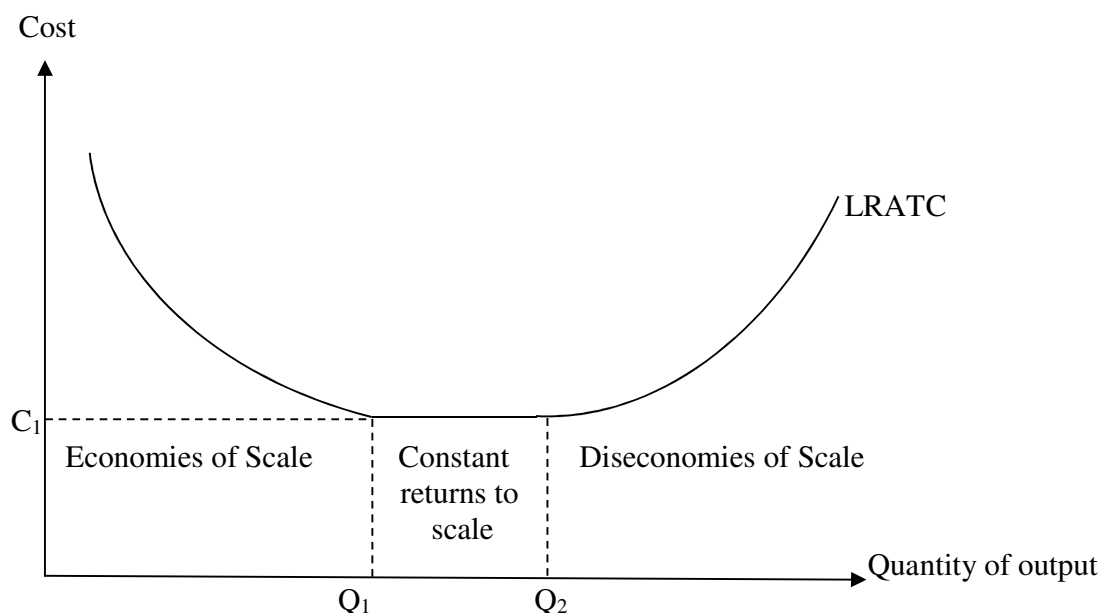
Decreasing returns to scale or diseconomies of scale occurs when output increases by a smaller proportion than inputs increase. This could be due to management problems of co-ordination increase as firms become large, workers feel alienated, deteriorate industrial relations and disruption in complicated mass production processes. This will result in an increasing long run average total cost as output increases. Decreasing returns to scale will lead to diseconomies of scale which means as the output increases, the average cost of production increases. With diseconomies of scale, there will be an increasing long run average total cost curve as output increases.

Constant returns to scale or constant costs occurs when output increases by the same proportion as inputs increase. This could be due to the forces of increasing returns to scale just offset the forces of decreasing returns to scale. This will result in a constant long run average total cost as output increases. With constant returns to scale, there will be a horizontal long run average total cost curve as output increases.

4.2 Long Run Average Total Cost Curve

In a typical firm in the long run, as output increases, it is likely that a firm will experience increasing returns to scale, follow by constant returns to scale and eventually increasing returns to scale as output increases. Thus the long run average total cost (LRATC) curve of a firm is also U-shaped. This is shown in Figure 7.5.

Figure 7.5: Long Run Average Total Cost Curves



Economies of scale occurs when long run average costs decrease as output rises. It occurs mainly due to spreading of high fixed cost over more units of output as output is increased, division of labour resulting in each worker can become more efficient by concentrate on

fewer tasks and justification of using sophisticated machinery and advance technology in production. In Figure 7.5, the economies of scale region covers up to output quantity Q_1 .

Diseconomies of scale occurs when long run average costs increase as output rises. It occurs mainly due to managerial diseconomies of scale. This arises because management becomes more difficult as the firm becomes larger. Large company need many layers of management, lead to communication, control and coordination problems. In Figure 7.5, the diseconomies of scale region occurs from output quantity Q_1 onwards.

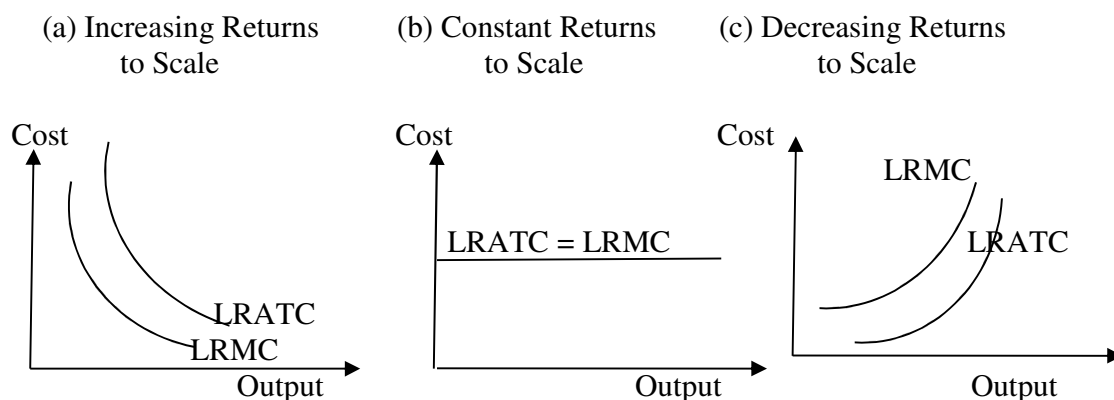
Constant returns of scale occurs when the long run average total cost remain unchanged as output increases. This could be due to the positive cost effect from economies of scale is just sufficient to offset the negative cost effect from diseconomies of scale. In Figure 7.5, the constant returns to scale region occurs from between output quantity Q_1 and Q_2 .

The term minimum efficient scale refers to the smallest quantity of output which allows the long run average cost to reach its minimum. This is indicated by the output Q_1 in Figure 7.5 where the long run average total cost is minimized at C_1 .

4.3 Relationship Between Long Run Marginal and Average Cost Curves

With extensive economies of scale, the long run average total cost curve is downward sloping. Since the production is increasingly efficient, the additional cost of one more unit of output will be lower than the average cost of production and this will pull down the average cost of production. Thus the long run marginal cost curve will also be downward sloping and is below the long run average cost curve. This is shown in Panel (a) of Figure 7.6.

Figure 7.6: Long Run Marginal Cost and Average Total Cost Curves

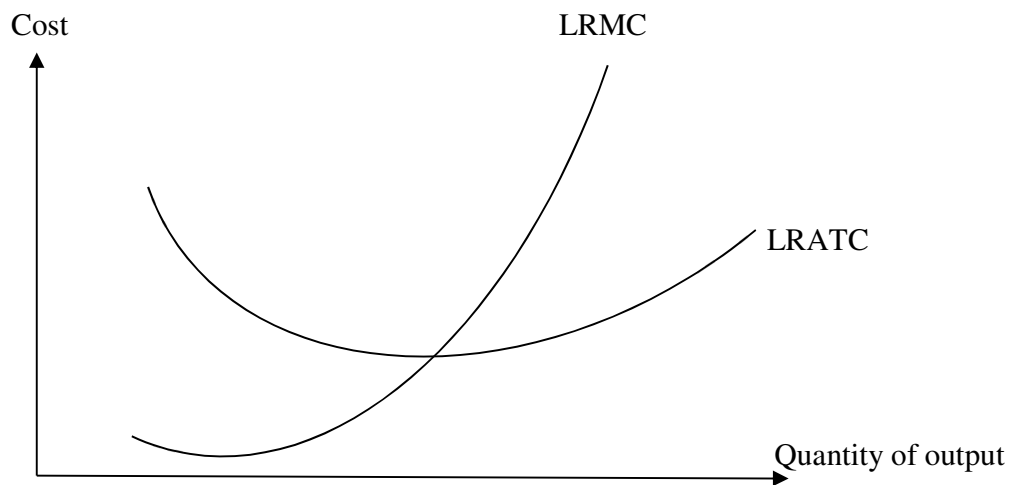


If there is constant returns to scale, there is no change in the efficiency with increasing production. The additional cost of producing one more unit of output is the same as the average cost of production. Thus the long run marginal cost curve is a horizontal line and is the same as the long run average cost curve. This is shown in Panel (b) of Figure 7.6.

However, with diseconomies of scale occurs, the long run average total cost curve is upward sloping. The production is increasingly inefficient, the additional cost of one more unit of output will be higher than the average cost of production and this will pull up the average cost of production. Thus the long run marginal cost curve will also be upward sloping and is above the long run average cost curve. This is shown in Panel (c) of Figure 7.6.

The relationship between long run marginal cost and the long run average total cost is shown in Figure 7.7

Figure 7.7: Relationship Between Long Run Marginal and Average Total Cost Curves



The relationship between long run marginal cost and the long run average total cost is the same as that of the short run. If the marginal cost is lower than the average total cost, it will pull down the average total cost. If the marginal cost is higher than the average total cost, it will pull up the average total cost. Thus the long run marginal cost curve intersects the long run average total cost curve from below at the minimum point of long run average total cost curve. This is also the minimum efficient scale in Figure 7.7.

4.5 Relationship Between Short Run and Long Run Cost Curves

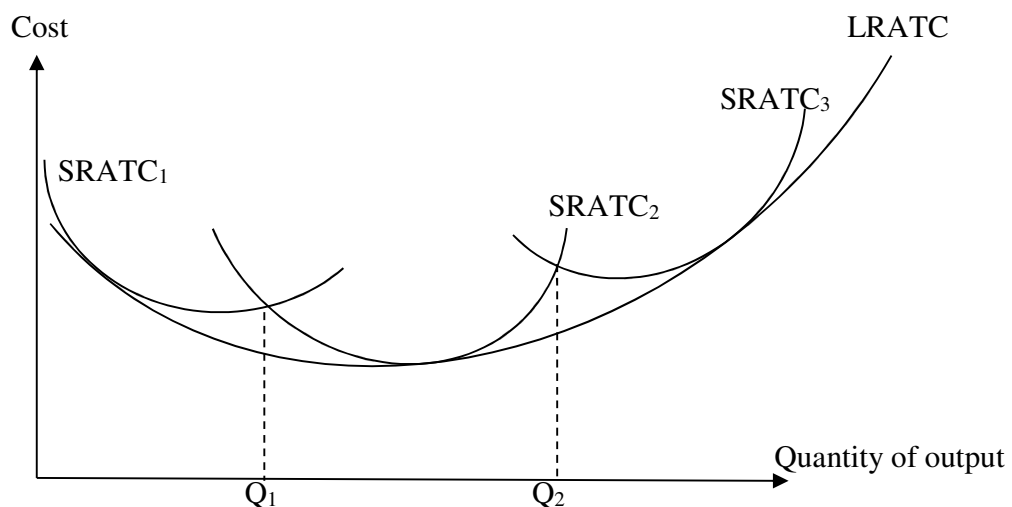
The long run is a planning concept. It allows the firm to expand from a small capacity to a large capacity if there is an increase in demand for its product. On the other hand, if there is a decrease in the demand for its product the long run allows the firm to downsize from a large capacity to a small capacity.

Once the optimal size is established, the firm will have a fixed number of machines and a fixed space of production, and the production period becomes short run. Actual production always occurs in the short run. Hence long run average cost curve allows the firm to determine the best capacity to operate and the minimize the average total cost of

production. It is not cost effective to operate a large firm with unused capacity if the firm's demand is small. Likewise there will be stress on resources if a small capacity firm is over-utilized to produce in a large scale.

Consider three possible plant sizes, a small factory which has one set of machines, a medium factory which has two sets of machine and a large factory which has three sets of machine. Their short run average total cost curves, denoted by $SRATC_1$, $SRATC_2$ and $SRATC_3$, is shown in Figure 7.8.

Figure 7.8: derivation of Long Run Average Total Cost Curve



To maximize profit, the firm needs to adopt the least cost method to produce the given output level. For any output level below Q_1 , the least cost method to produce the output is to use the small factory with one set of machine under $SRATC_1$. For output level between Q_1 and Q_2 , the least cost method to produce the output is to use the medium factory with two sets of machine under $SRATC_2$. For any output level above Q_3 , the least cost method to produce the output is to use the large factory with three sets of machine under $SRATC_3$.

The long run average cost curve is the envelope of all the short run cost curves. It is not the lowest point of all the short run average total cost curves. Rather, it combines the tangency point of all the short run average total cost curves that corresponds to the lowest average total cost to produce each output level. This is known as an envelope.

Hence in the long run the firm will move from one size to another to obtain the size that can produce a given output at the lowest average total cost. Thus the long run average total cost curve is also known as the planning curve.

5. Marginal Revenue, Marginal Cost and Profit Maximizing Output

Since the objective of the firm is to maximize profit, it is important for the firm to make decision on the output and the price to ensure that the profit maximizing output is reached. In the event that loss is incurred and the firm choose to produce, then the firm should produce at the loss minimizing output. We can use the concept of marginal revenue and marginal cost to establish the optimal output which allows the firm to maximize profit or minimize loss.

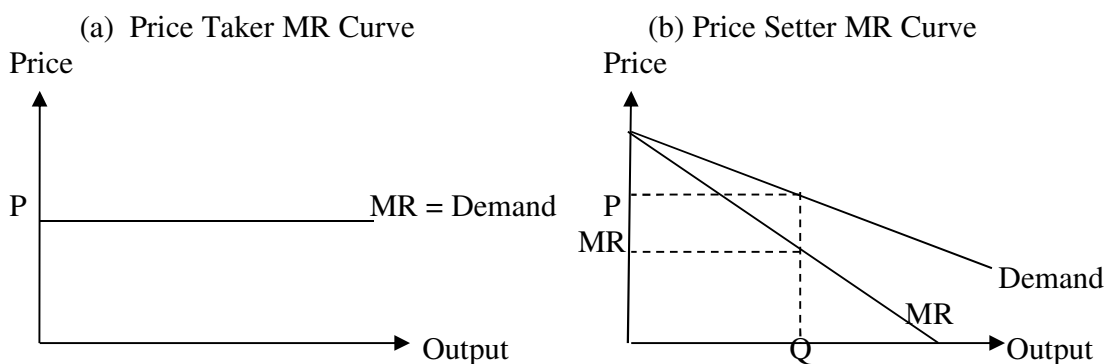
5.1 Marginal Revenue

In the earlier section at We have defined total revenue as price multiply by quantity and marginal revenue is the change in total revenue when output increases by one unit. Thus we have

$$\text{Marginal Revenue} = \frac{\text{Change in Total Revenue}}{\text{Change in Output}}$$

If the producer did not have power to control the market price and can only sell the product at a given price, the producer is known as a price taker. In this case the marginal revenue will be constant equals to the market price, which is also the demand curve for the firm's product. The marginal revenue curve is a horizontal line as shown in Panel (a) of Figure 7.9.

Figure 7.9: Marginal Revenue Curves



If the producer has the power to control the market price, it can choose to sell the product at the price range defined by the market demand curve, where consumers are willing and able to pay for the product. However, if the producer set a high price, there will be a smaller quantity demanded. If the producer wishes to sell more, he must set a lower price. The producer is known as a price setter. In this case the marginal revenue will be lower than the market price for any output Q , and the MR curve is downward sloping and always below the demand curve, as shown in Panel (b) of Figure 7.9.

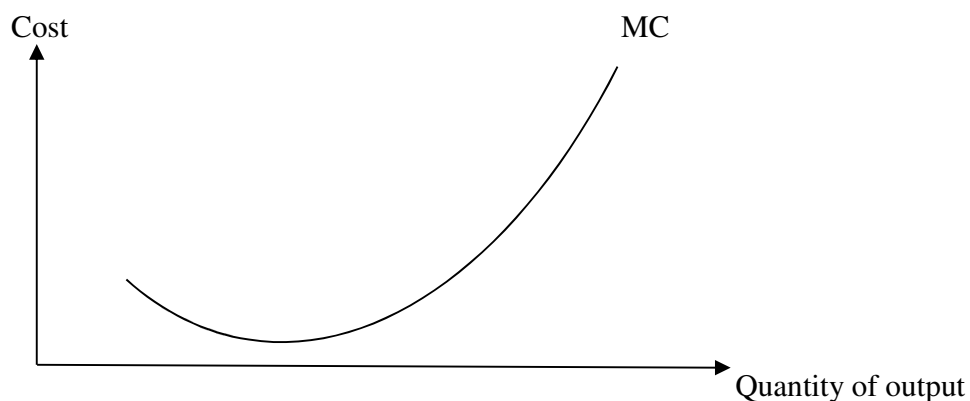
5.2 Marginal Cost

Marginal cost is the change in total cost when the firm produces one more unit of output. Thus we have

$$\text{Marginal Cost} = \frac{\text{Change in Total Cost}}{\text{Change in Output}}$$

Marginal cost tend to decrease initially as output increases and eventually increases as output increases. A typical marginal cost curve is shown in Figure 7.10.

Figure 7.10: Marginal Cost Curve



Since the decreasing marginal cost indicates increasing efficiency of resources employed by the firm, the firm will produce at the upward sloping portion of the marginal cost curves after it fully exhausts the benefits of the efficiency of resources.

5.3 Determination of Optimal Output

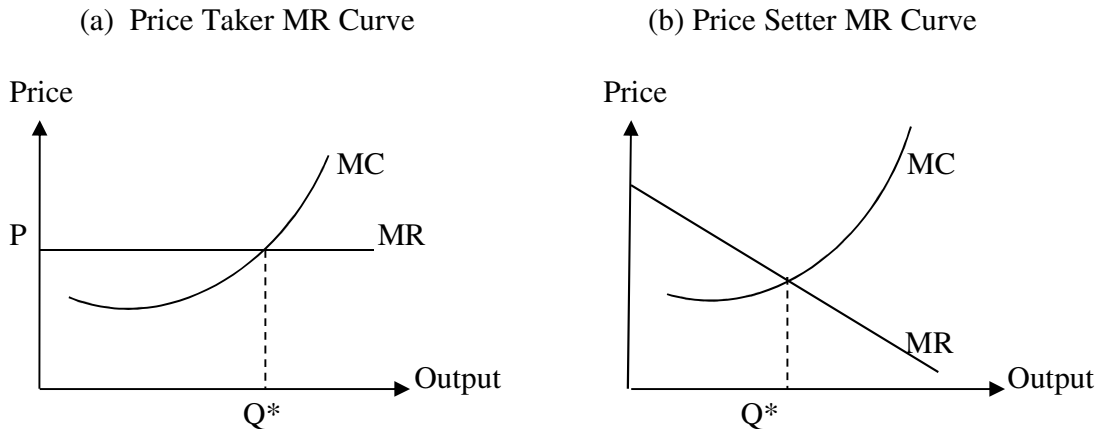
Comparing the marginal revenue and the marginal cost as output changes, we can establish the optimal output. If the marginal revenue exceeds the marginal cost, the firm's profit can increase by increasing output. On the other hand, if the marginal revenue is less than the marginal cost, the firm's profit can increase or loss can decrease by decreasing output. Hence the optimal output is for the firm to produce up to the output where marginal revenue equals marginal cost.

Although the marginal cost curve tends to be an U-shaped curve, there are two types of marginal revenue curve. As discussed in Section 5.1, if the firm is a price taker, the firm can only charge the same price and earn the same marginal revenue for all its output. The marginal revenue curve will be a horizontal line at the market price. This is shown in Figure 7.11 Panel (a) and we will discuss this type of firm in Session 8 under perfect competition.

Another type of marginal revenue curve is downward sloping when the firm is a price setter. In this case, the firm has some power to set the price but it will have to charge a

lower price and earn lower marginal revenue to sell more. Hence the marginal revenue curve is downward sloping. This is shown in Figure 7.11 Panel (b). This will be discussed in Session 9 (Monopoly) and Session 10 (Monopolistic Competition)

Figure 7.11: Optimal Output



When the firm is producing at the optimal output, the firm may be maximizing profit or minimizing loss. The firm needs to compare the price with average total cost at the optimal output. If the price is higher than the average total cost, the firm is making profit and is maximizing profit. If the price is lower than average total cost, the firm is incurring losses but is minimizing losses at this output level. There will be special circumstance that the firm may prefer to shut down (close down temporary) instead of producing when it is incurring losses. We will discuss this in Session 8.

6 Illustration Questions

(a) In a manufacturing plant producing aircraft parts, the operation of complex machinery requires three workers to a single machine. Due to a sudden spike in demand, the plant manager is under pressure to increase production and he tries to increase the number of workers, without increasing the number of machines. The productivity of his workers was observed to have decreased.

- (i) Explain the relevant economic theory behind this process.
- (ii) Suggest possible ways of increasing productivity of the workers in both the short and long run.

Answers

(i) The Law of Diminishing Marginal Returns is the main economic theory being discussed here. Diminishing returns occur in the short run when more and more variable inputs (workers) are continuously added to an unchanging amount of fixed inputs (machines) resulting in a loss of efficiency.

(ii) To increase productivity of the workers in the short run, the plant manager can add in a third shift (assuming production is not already at full capacity) to make full use of the fixed machine resources.

To increase productivity of the workers in the long run, bear in mind that all factors are now variable, the plant manager can increase the number of machines to match the increased number of workers or increase their productivity by upgrading the skills of the workers.

(b) A T shirts producer employs workers to work on sewing machines to produce T-shirt. The following table shows the total product of T-shirt when different quantities of labour are used with a fixed amount of sewing machines.

Labour	Total Product	Average Product	Marginal Product
1	10		
2	28		
3	45		
4	52		
5	55		

(i) Compute the average product and marginal product of the various quantities of labour. Comment on the changes of average and marginal product and describe their relationship as labour increases.

(ii) Explain whether the information in (i) support the law of diminishing returns.

Answers

(i) The completed table is shown below (½ marks for each entry, 5 marks in total)

Labour	Total Product	Average Product	Marginal Product
1	10	10	10
2	28	14	18
3	45	15	17
4	52	13	7
5	55	11	3

As labour increases, both marginal and average product initially increases but eventually decreases. The relationship between average product and marginal product is that when

marginal product is higher than average product, average product is increasing. But when marginal product is lower than average product, average product is decreasing.

(ii) The law of diminishing returns states that when more and more of the variable input (labour) is used together with the fixed input (capital), the marginal product of the variable input will eventually decline. The information in (i) supports the law of diminishing returns as the marginal product eventually decreases with more labour being used.

7 Discussion Questions

Question 1

1. The law of diminishing returns _____.
- (A) sets in because all workers are equally productive.
 - (B) applies only in the short run.
 - (C) explains why increased production results in diseconomies of scale.
 - (D) holds even when there are no fixed factors.

Question 2

Which is a fixed cost for Uncle Hock, the chicken rice hawker?

- (A) Rent paid for his hawker stall.
- (B) Wages paid to shop assistants (labour).
- (C) Payments to suppliers that sell Uncle Hock chicken.
- (D) Water bill paid to Singapore Power, which increases as he prepares and sells more chicken rice.

Question 3

In the short run,

- (A) capital is variable and labour is fixed.
- (B) there is at least one fixed factor.
- (C) there is no fixed factors.
- (D) there is no variable factor.

Question 4

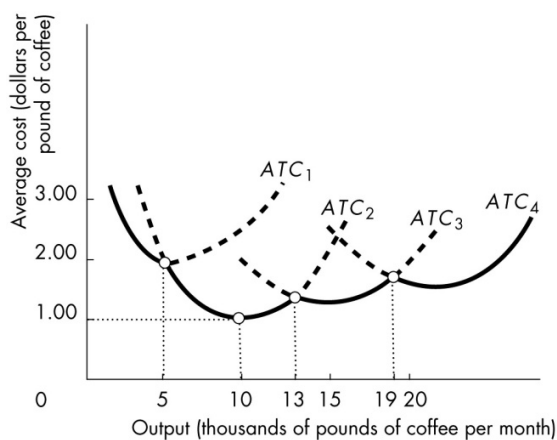
The table below shows the short-run product schedule for Virginia's Tee-Shirts. The worker for whom the law of diminishing returns initially occurs is the _____ worker.

Labour (workers)	Total product (shirts)
0	0
1	50
2	120
3	180
4	220
5	250

- (A) 5th
- (B) 4th
- (C) 3rd
- (D) 2nd

Question 5

In the figure below, economies of scale are present up to an output level of _____



- (A) 5,000 pounds of coffee.
- (B) 10,000 pounds of coffee.
- (C) 13,000 pounds of coffee.
- (D) 15,000 pounds of coffee.

Question 6

In a manufacturing plant producing aircraft parts, the operation of complex machinery requires three workers to a single machine. Due to a sudden spike in demand, the plant manager is under pressure to increase production and he tries to increase the number of workers, without increasing the number of machines. The productivity of his workers was observed to have decreased. Explain the relevant economic theory behind this process and suggest possible ways of increasing productivity of the workers in both the short and long run.

Question 7

Reed Ltd is involved in the production of Good X480M. The following total cost data was gathered for this product:

Quantity of X480M Produced (Units)	Total Cost (\$)
0	1,200
1	1,600
2	1,800
3	2,400
4	3,600
5	6,000

- (a) State clearly the Total Fixed Cost for Reed Ltd.
- (b) Calculate the marginal cost for Reed Ltd for all levels of production.

MICROECONOMICS

SESSION 8

PERFECT COMPETITION

At the end of the session, students should be able to:

1. Define perfect competition
 2. Explain how firms make their supply decisions and why they sometimes shut down temporarily and lay off workers
 3. Explain how the price and output level in an industry are determined and why firms enter or leave the industry
 4. Predict the effects of a change in demand
 5. Explain why perfect competition will tend to lead to efficient outcomes
-

1. Introduction

The market structure is a description of the behaviour of buyers and sellers in that market. The descriptions include the number of buyers and sellers in the market, the nature of the product, the ability to set price, the ease or difficulty in gaining entry or making exit from the market and the implication on efficiency. From Session 8 to Session 11, we introduce four market structures known as perfect competition, monopoly, monopolistic competition and oligopoly.

In this session, we focus on perfect competition which is being used as the baseline market structure for comparison with the others. We begin with the characteristics of perfect competition, followed by a discussion of decision making by firms in the short run. Next we discuss the long run decisions on remaining in the industry or exit from the industry. Then we predict the effects of a change in demand on perfectly competitive firms. Finally we analyze the efficiency issues of perfect competition. The main implication of perfect competition is that it is efficient. There is both productive and allocative efficiency and the social welfare is maximized.

2. Perfect Competition

Perfect competition is a market structure where competition is extreme such that the firms in this market has no power at all in determining price and have to take the price as given. Bear in mind that the term perfect does not imply that this is the best market structure. It means that competition is maximized such that all firms are price takers and there is no long term profit to be made.

2.1 Assumptions of Perfect Competition

A perfectly competitive market is one in which both buyers and sellers believe that their own buying or selling decisions have no effect on the market price. It is built with the following assumptions:

- (1) A large number of buyers and sellers. So each seller has only a very small market share and each buyer only purchase a very small quantity of the total output provided by each seller. The implication of this assumption is that no single buyer or seller has the ability to influence the market price.
- (2) Homogeneous product. Each firm sells exactly the same product. It makes no difference whether the consumer purchase from one firm or the other. The implication of this assumption is that consumers will tend to buy the product from the firm that charges the lower price and no one will buy from the firm that charges the higher price.
- (3) Perfect information. All buyers and sellers have all the information regarding the price, quantity and quality for the product. Thus established firms have no advantages over new firms.
- (4) Free entry and exit for firms. There is no obstacle to prevent new firms to enter the industry to compete with existing firms. It is also very easy for existing firms to leave the industry. The free movement of firms also implies perfect mobility of factors. All the factors of production can move from one use to another use without any restrictions. The implication of this assumption is that in the long run, profit will induce new firms to enter the market while losses will prompt existing firms to leave the market such that all existing firms only break even

2.2 Characteristics of Perfectly Competitive Firm

Due to the 4 assumptions of a perfectly competitive market, all firms are price takers in the market. The industry demand and supply forces determine the equilibrium price and all firms take this price as given. All firms and customers are price takers and that there will be a single price in the market.

A firm cannot charge a higher price than the market equilibrium price. This is because consumers are well informed with perfect information. Thus customers will know that the other firms are selling the same product at a lower price and hence no one will buy from the firm that charges a higher price. Each firm's output is identical and hence a perfect substitute to the other firm's output.

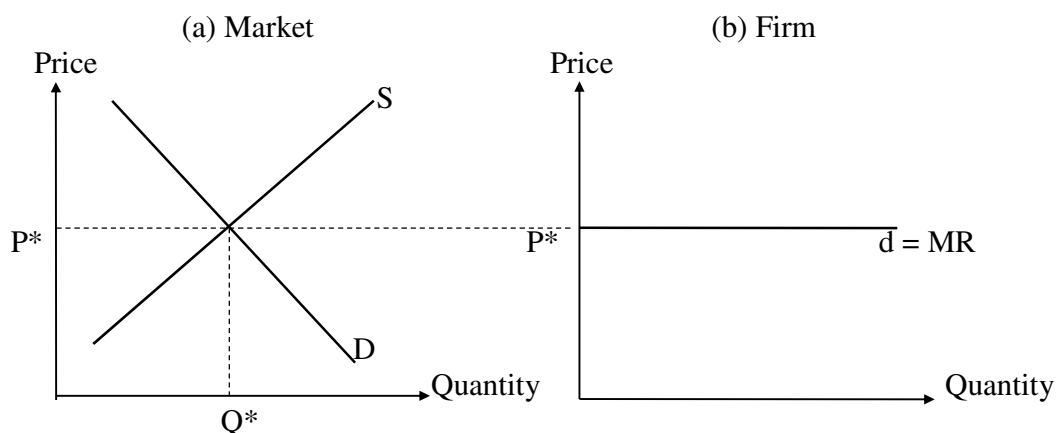
On the other hand, a firm will also not charge a lower price than the market equilibrium level. This is because the firm produces a small quantity and has no problem selling all its output at the current market price. Thus there is no incentive to lower the price.

Since a perfectly competitive firm cannot charge a higher price and will not want to lower its price, all customers in perfect competition will only need to pay the market equilibrium price for each unit they purchased from any firm in the market. Thus each firm has a horizontal demand curve. The demand curve is also the average revenue curve and marginal revenue curve which is equal to the market equilibrium price.

With many customers in the industry and each firm only has a very small market share, the firms can sell whatever quantity they wish. Likewise the customers are also able to buy whatever quantity they wish. No single customer and single firm is able to influence the market price.

The market price is determined jointly by all the buyers and the sellers in the market, as shown in Figure 8.1 panel (a). All the buyers form the downward sloping market demand curve, while all the sellers form the upward sloping market supply curve. The market forces will give rise to the equilibrium price. Once this price is established, all firms will have to take this price as given to them. Thus there is only one single price in the market and each firm can only sell all its output at this price. Each competitive firm has a horizontal demand curve, as shown in Figure 8.1 panel (b).

Figure 8.1: Perfectly Competitive Market and Firm



In Figure 8.1, the market demand curve is downward sloping and market supply curve is upward sloping, following the law of demand and supply. The equilibrium price P^* is determined by the intersection of demand and supply curve. Once this price is determined, each firm charge the same price P^* per unit for all quantities of their product. Since the firm can sell whatever quantity they wish at that price, the demand is a horizontal line, which is perfectly elastic.

The firm will have no incentive to charge a price lower than P^* since it can sell all it wishes at price P^* . It cannot charge a price higher than P^* since the customers can purchases from the other firms. Thus there is only a single price. Since the price is fixed, for every unit that the firm sells, it will earn an additional revenue equals to the price. The additional revenue from selling one more unit of output is the marginal revenue (MR). Thus for a

perfectly competitive firm, the firm's demand curve is also its marginal revenue curve which is the same as the market equilibrium price.

3 Short Run Equilibrium for Perfect Competition

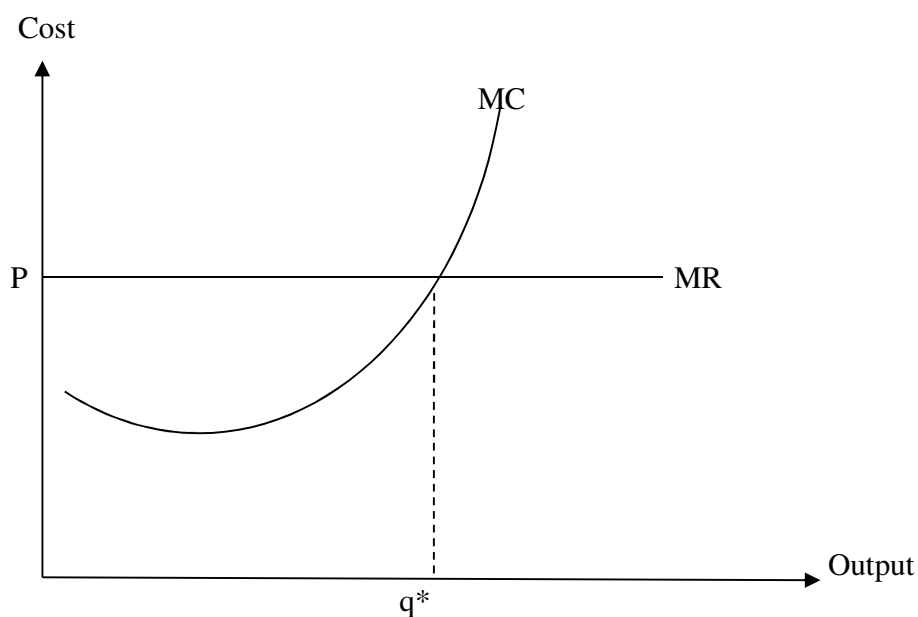
In the short run, a perfectly competitive firm will have to decide based on the given market price, should produce or shut down. If it chose to produce, then the firm will have obtain the resources to initiate the production. Since price is determined by market forces and each firm is a price taker, each firm will have to decide on the quantity of output produced in the short run and sell all its output at this price. The optimal output is one that maximizes the firms profit or minimizes its loss.

3.1 Optimal output

For every additional unit of output that the perfectly competitive firm sells in the market, the additional revenue earned is the marginal revenue (MR) is the same as the market equilibrium price. For every additional unit of output that the perfectly competitive firm produces, it will incur an additional cost which is the marginal cost (MC).

If MR is greater than MC, the firm will earn more profit by producing more output. If MR is less than MC, the firm will earn more profit by producing less output. Thus the optimum output is given by the level where marginal revenue equals marginal cost. This is shown in the output q^* in Figure 8.2

Figure 8.2: Optimal Output of a Perfectly Competitive Firm



In general, firm uses the marginal condition ($MC = MR$) to find the best output and then use average condition to check whether the price can cover the average cost. But in perfect competition, price equals marginal revenue (MR) and the firm's demand curve is also the marginal revenue curve. Hence the optimal output condition becomes $MC = P$. However, the firm making be making an economic profit, break even or incurring a loss, depending on the difference between the market price and the average total cost at this optimal output. Thus in the short run there are three possible situations.

A numerical example of optimal output is given by Table 8.1. Assume that the market equilibrium price is \$10 and the firm sells all its output at this price. The optimal output using $MR = MC$ condition is 6 units of output. At this output, the total cost is \$36 and the total revenue is $6 \times \$10 = \60 . Hence the maximum profit is $\$60 - \$36 = \$24$.

Table 8.1: Optimal Output for Perfect Competitive Firm

Output	TFC	TVC	TC	MC	MR	TR	Profit
0	10	0	10	-	-	0	-10
1	10	6	16	6	10	10	-6
2	10	10	20	4	10	20	0
3	10	12	22	2	10	30	8
4	10	13	23	1	10	40	17
5	10	16	26	3	10	50	24
6	10	26	36	10	10	60	24
7	10	38	48	12	10	70	22
8	10	51	61	15	10	80	19
9	10	71	81	20	10	90	9
10	10	96	106	25	10	100	-6

Another method to establish the optimal output is compute the profit for all the output level and establish the one that maximizes the profit. Using this method, there are two possible output level, namely 5 units and 6 units where the profits are both \$24.

Diagrammatically, we can construct the total revenue curve and the total cost curve to determine the optimal output as well as compute the profit or loss. Consider the short run situation where there is both fixed cost and variable cost and total cost is the sum of total fixed cost and the total variable cost. The total cost curve is upward sloping, consisting of an initial concave portion and then a subsequent convex portion. The total revenue curve.

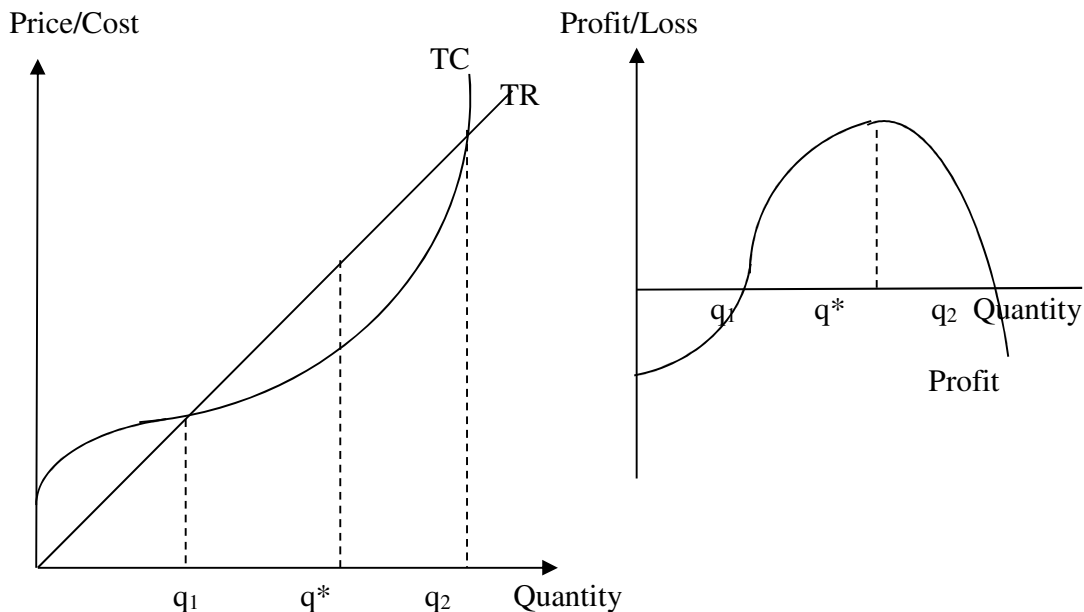
Since a perfectly competition firms is a price taker, for every unit the firm sells the marginal revenue is constant which is equal to the price. The total revenue is the product of price and quantity and the total revenue curve will be an upward sloping straight line with the slope equals to the price. Putting both the total revenue curve and the total cost curve together, we can analyze the profit and loss situations of the firm as output increases.

Refer to Figure 8.3 Panel (a). At output equals zero, the total revenue is zero while total cost is total fixed cost. Thus the firm will incur a loss equals to the total fixed cost. As

output increases, the loss becomes smaller until the firm breaks even at output q_1 . Positive profit occurs from output q_1 onwards. It increases and then decreases and eventually the firm breaks even again at output q_2 . Output larger than q_2 will result in loss again since total cost is higher than total revenue. The vertical distance between total revenue and total cost is the profit or loss which is reflected at Panel (b) of Figure 8.3.

Figure 8.3(a): Total Revenue and Total cost

Figure 8.3(b): Profit and Loss



The maximum profit occurs at the output q^* , between output q_1 and q_2 , where total revenue exceeds total cost and the vertical distance between total revenue curve and total cost curve is the largest. Geometrically, at q^* , the slope of the total cost curve is the same as the slope of the total revenue curve. Since the slope of total cost is marginal cost and the slope of total revenue is marginal revenue, this output also fulfils the condition of $MR = MC$.

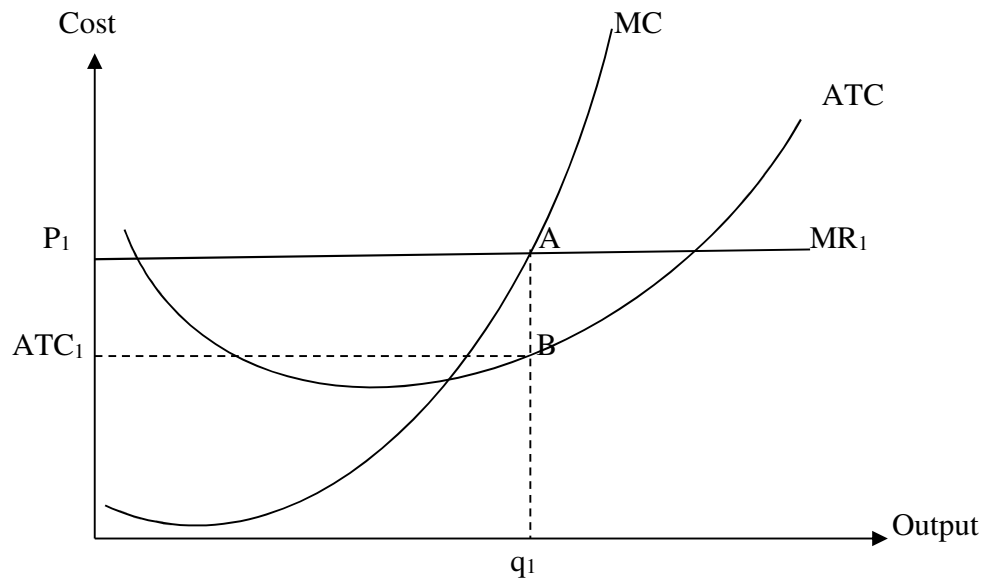
3.2 Firm's Short Run Equilibrium

Although a perfectly competitive firm's optimal output is at the level where $MR = MC$, the firm may be maximizing its profit or minimizing its loss at this output or break even. It all depend on whether at the optimal output the price is higher, equal or less than the short run average total cost. Thus in the short run, at the output level where $MR = MC$, there are three possible outcome. The firm will make profits if price exceeds Average total cost (ATC). The firm will break even if price = ATC and the firm will incur losses if price is less than ATC.

(a) Positive economic profit

Figure 8.4 shows a perfectly competitive firm making positive economic profit. The optimal output is given by the point A where MR intersects MC. The optimal output is q_1 . At this output, the firm is making profit since the price is higher than the average total cost. The maximum profit is represented by the area bounded by P_1 , A, B and ATC_1 .

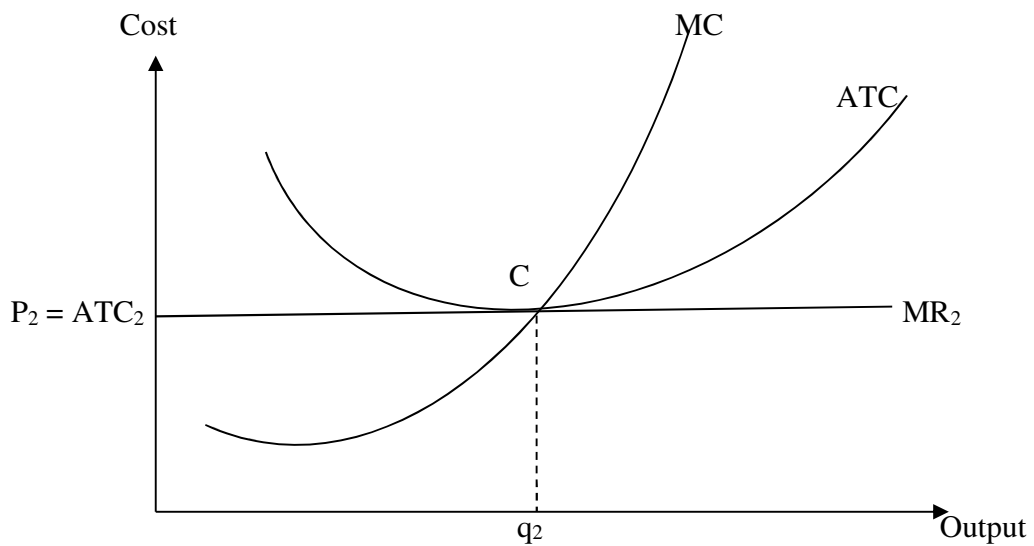
Figure 8.4: Profit Making Perfectly Competitive Firm



(b) Break even or normal profit

Figure 8.5 shows a perfectly competitive firm making positive economic profit.

Figure 8.5: Perfectly Competitive Firm Making Normal Profit

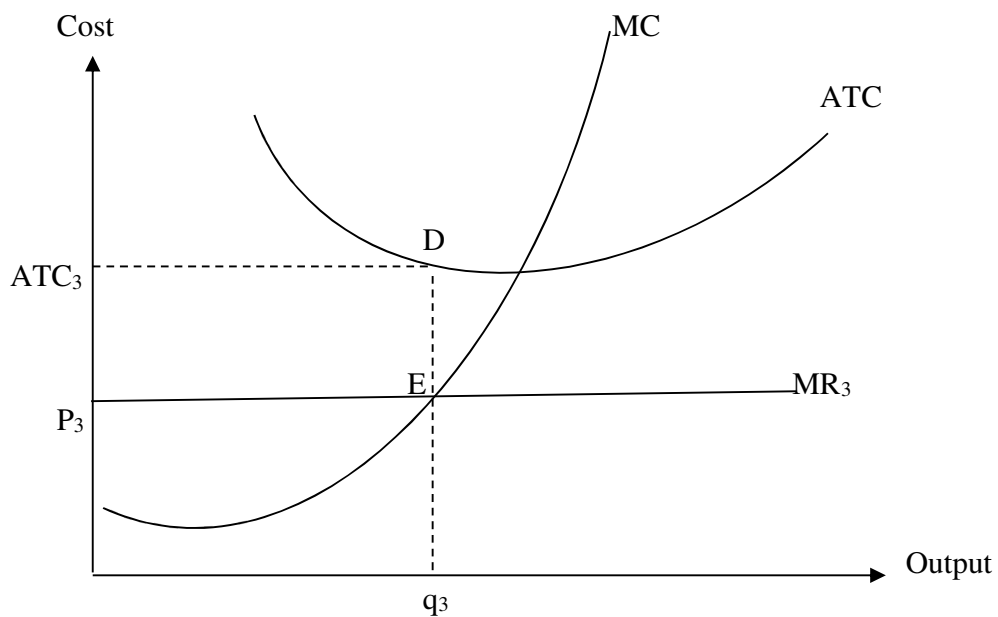


The optimal output is given by the point where MR intersects MC. This is shown in point C of Figure 8.4 and the optimal output is q_1 . At this output, the firm breaks even because the price is the same as the average total cost.

(c) Negative economic profit or loss

Figure 8.6 shows a perfectly competitive firm making positive economic profit.

Figure 8.6: Loss Incurring Perfectly Competitive Firm



The MR curve is below the ATC curve at the optimal output level where $MR = MC$. This is shown at point E where the optimal output is q_3 . At this output the firm is incurring a loss since the price is less than the average total cost. The loss is equal to the area bounded by ATC_3 , P_3 , E and D.

In a loss incurring situation in the short run, the firm has the option of operating at a loss or shut down (temporary close down) and only resume operation when the market situation is better. The firm will have to decide which option minimizes the loss.

3.3 Shut Down Condition of Perfectly Competitive Firm

In the short run, a loss incurring perfectly competitive firm has to decide whether to continue to operate at a loss or to shut down. Note that shut down means temporary closed the firm waiting for better time to operate. This is different from exit the industry which means closed down the firm permanently.

The loss incurring firm will choose the best option, which is the option that minimizes the loss. Since the firm already purchased the capital, whether the firm operate or shut down the fixed cost is already incurred. Assume that there is no resale value for the capital.

If the firm were to shut down, there will be no output produced and the firm will not require any variable inputs. Thus the total variable cost is zero and the total cost is just its total fixed cost. In addition, since the firm did not produce any output, the total revenue is also zero. using the formula profit = total revenue minus total cost, the firm's loss is equivalent to its fixed cost.

$$\text{Profit} = \text{TR} - (\text{TFC} + \text{TVC}) = 0 - (\text{TFC} + 0) = -\text{TFC}$$

If the firm were to operate, it will need to employ the variable resources and the total variable cost will be positive. Thus total cost will be the sum of total fixed cost and total variable cost. When the firm sells its output, the firm will earn positive total revenue. However, the total revenue will be less than the total cost since the firm is incurring a loss.

$$\text{Profit} = \text{TR} - (\text{TFC} + \text{TVC}) = -\text{TFC} + (\text{TR} - \text{TVC})$$

Compare the two situations, the loss will be smaller if total revenue is larger than total variable cost. This is because if the total revenue is larger than the total variable cost, the firm will not only cover all its variable cost but also has some balance to cover part of its fixed cost. Although the firm is still incurring a loss, the loss will be less than the entire total fixed cost.

In contrast, if the total revenue is smaller than the total variable cost, the firm will lose part of its variable costs and also all its fixed cost. Thus the loss will be larger than the entire total fixed cost and it will be better for the firm to shut down.

If the total revenue is the same as the total variable cost, there will be no different whether the firm shut down or operate as the loss will be the same. This is known as the shut down condition of the firm in the short run. It can also be expressed as price equals average variable cost.

$$\text{Shut Down Condition: } \text{TR} < \text{TVC} \text{ or } P < \text{AVC}$$

The shut down point is defined at the output level where the AVC is at its minimum. Any price lower than this point, the firm will shut down. Any price higher than this point, the firm will operate at a loss in the short run and produces at the optimal output where $\text{MR} = \text{MC}$

3.4 Perfect Competition and Supply Curve

From Sections 3.2 and 3.3, we can conclude that in the short run, a perfectly competitive firm either produces at the output level where $MR = MC$, or it does not produce at all if the price is below the average variable cost. Using this information, we can derive the supply curve of a perfectly competitive firm as shown in Figure 8.7(a) and (b).

Figure 8.7(a): Marginal and Average Variable Cost Curves

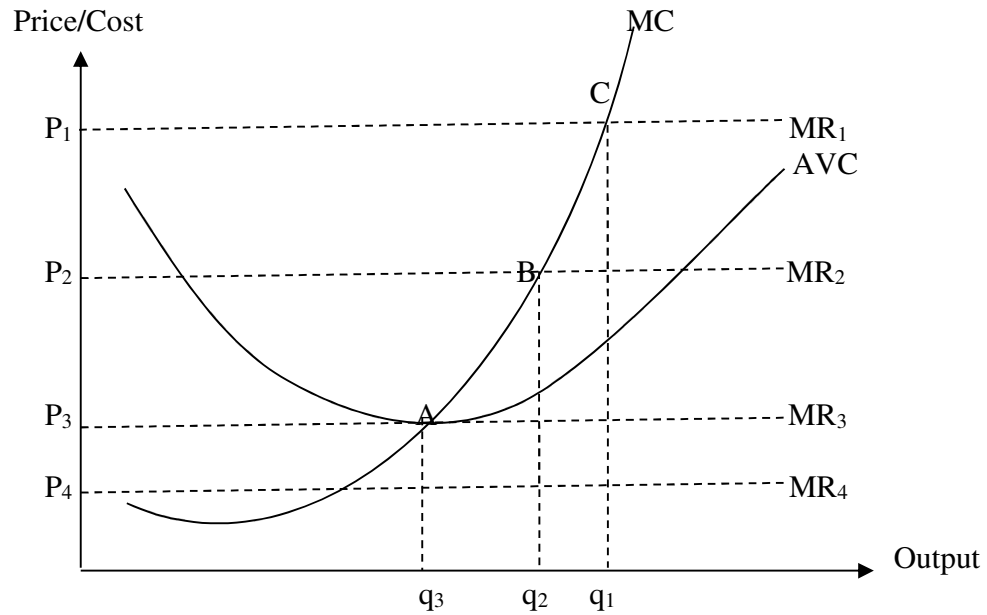
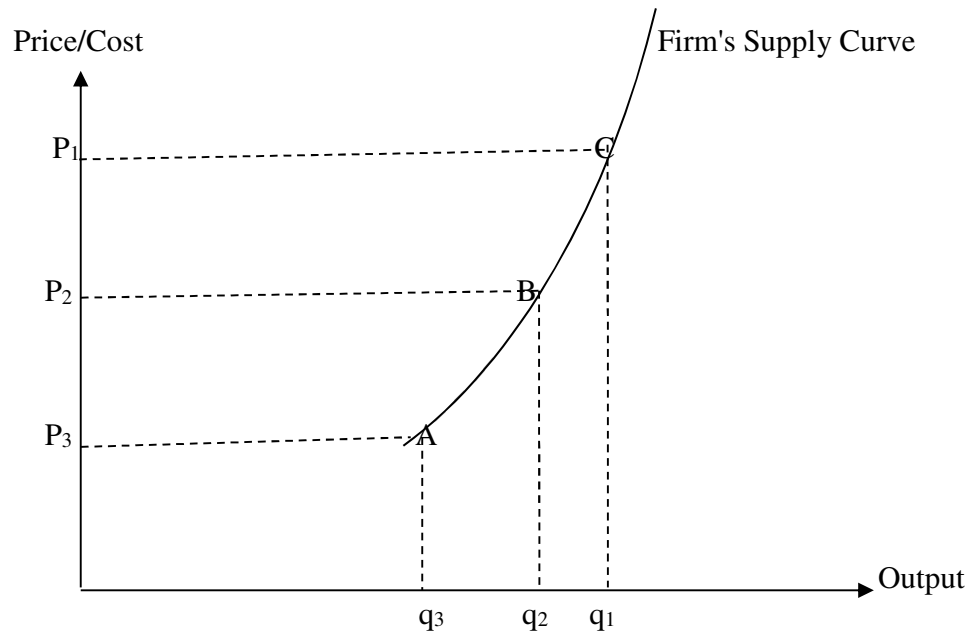


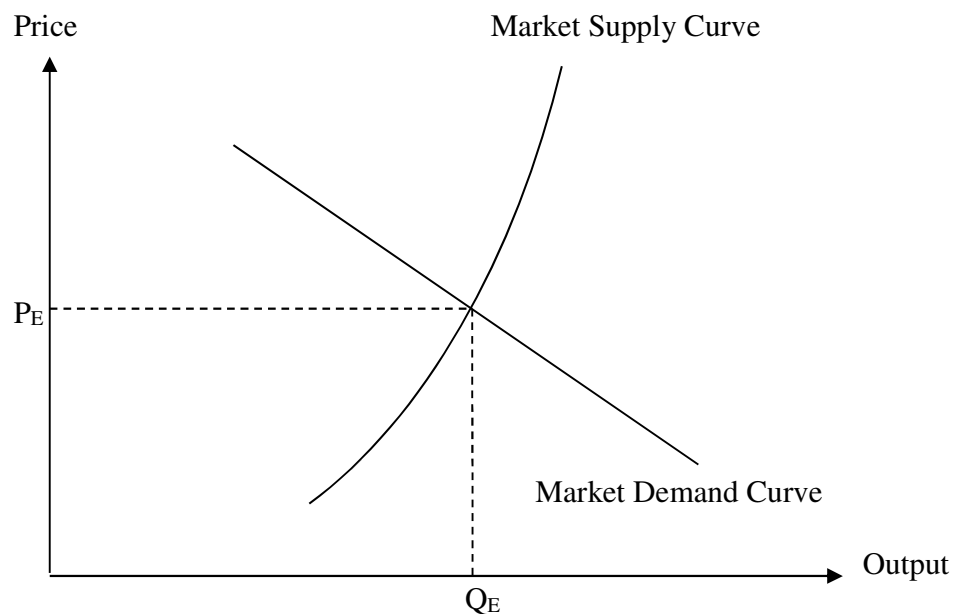
Figure 8.7(b): Competitive Firm's Supply Curve



In Figure 8.7(a), the minimum average variable cost is at point A corresponds to price P_2 . This is also the shut down point. Thus a perfectly competitive firm will only produce from this point onwards. At market price P_1 the optimal output is $MR_1 = MC$ at output Q_1 . At market price P_2 the optimal output is $MR_2 = MC$ at output Q_2 . At market price P_3 which is the shut down point, the optimal output is $MR_3 = MC$ at output Q_3 . At any price below P_3 , such as P_4 , the firm will shut down and will not produce any output at all.

Plotting price and quantity produced, we have the upward sloping supply curve as shown in Figure 8.7(b). The supply curve is actually the portion of the MC curve above the AVC curve. If we sum up all the individual firm's supply curve horizontally, we will derive the industry or market supply which is also upward sloping. This market supply curve, together with the downward sloping demand curve, will form the perfectly competitive market diagram, as shown in Figure 8.8. The equilibrium price will be established at the intersection point of the market demand and supply curves, and all firms will take this price as given.

Figure 8.8: Perfectly Competitive Market



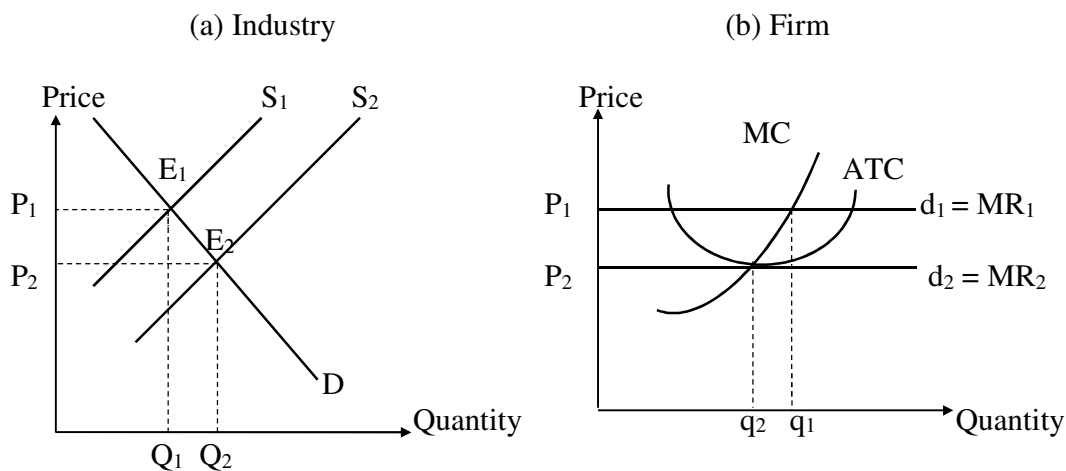
4 Long Run Equilibrium in Perfect Competition

In the long run, all factors of production are variable. If the firms are making economic profit in the short run, this will attract more new firms to enter the industry. If the firms are incurring losses, some firms that are more pessimistic will leave the industry. Thus in the long run there will be movement in and out of the industry such that eventually the market will be stabilized when all existing firms break even and earn zero economic profit. Firms may also adjust their plant size such that they reach the most efficient scale.

4.1 Adjustment From Short Run Profit Situation

In the short run, if existing competitive firms are making positive economic profit, this will attract new firms to enter the industry. Since there is free entry and exit, it is easy for new firms to gain entry into the industry and compete with the existing firms. With more new firms, the market supply increase. This is shown in a rightward shift of the supply curve in Panel (a) of Figure 8.9. This shift will push down the equilibrium price and increasing the equilibrium quantity in the market.

Figure 8.9: Long Run Adjustment of Profit Making Firm



From the firm's point, when market price reduces, the firm's MR curve also shift downwards. It will intersect the MC curve at a lower output level, and the gap between price and average total cost becomes smaller. Thus the profit of the existing firms will reduce. New firms will continue to enter the industry so long there is profit to make. They will only stop entering the industry when all existing firms are making normal profit. The process is described in Figure 8.9 panel (b).

Initially the market is at equilibrium at E_1 with price P_1 . The firm will produce at the output level where $MR = MC$ which is q_1 . At this output, since price is higher than average total cost, the firm is making a positive economic profit.

In the long run, new firms are attracted by the profit to enter the industry. This will increase the industry supply and decrease the price until the new equilibrium price at P_2 where all firms produce a lower output q_2 and break even.

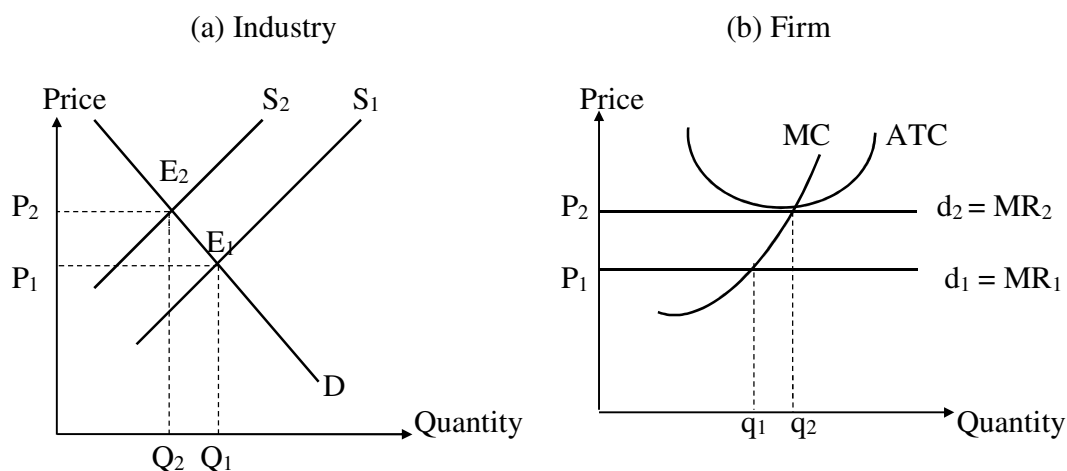
4.2 Adjustment From Short Run Loss Situation

In the short run if existing firms are making losses, then the industry becomes unattractive and firms may contemplating exiting the industry in the long run.

Firms may have different level of pessimism when encounter losses. Those firms that are more pessimistic may exit at the first sign of losses. Firms that are more optimistic may decide to ensure for a longer period of time, hoping that market condition will improve. This give rises to some firms leave while other firms stay in the industry.

With some firms leaving the industry, the industry supply will decrease. This will shift the supply curve to the left, as shown in Panel (a) of Figure 8.10. This will push up the market price and reducing the market equilibrium quantity.

Figure 8.10: Long Run Adjustment of Loss Incurring Firm



At the firm's level, when market price increases, the marginal revenue also increase and the firm will produce more output. Then gap between the market price and average total cost becomes smaller, hence the loss of existing firms also reduces. More existing firms will continue to leave the industry so long there is loss incurred until the price rise enough for those who remain to cover all their costs. The exit of firms will only cease when all existing firms are making normal profit. Thus in the long run all competitive firm can only make normal profit. The process is described in Figure 8.10 Panel (b).

Initially the market is at equilibrium at E_1 with price P_1 . The firm will produce at the output level where $MR = MC$ which is q_1 . At this output, since price is lower than average total cost, the firm is incurring a loss.

In the long run, some firms that cannot withstand the loss further will leave the industry. This will reduce industry supply until the new equilibrium price at P_2 where all firms produce a higher output q_2 and break even.

In conclusion, in the long run, due to the free entry and exit of firms, profit induces new firms while loss results in exiting of existing firms. Price will adjust until it equals to average total cost and all firms earn a zero economic profit. In addition, firms will adjust their plant size until they reach the minimum long run average cost at equilibrium.

4.3 Effect of Changes in Demand

The market equilibrium is affected by any change in the demand and supply conditions. It is important to analyze the changes in the market equilibrium and their impacts on the firm.

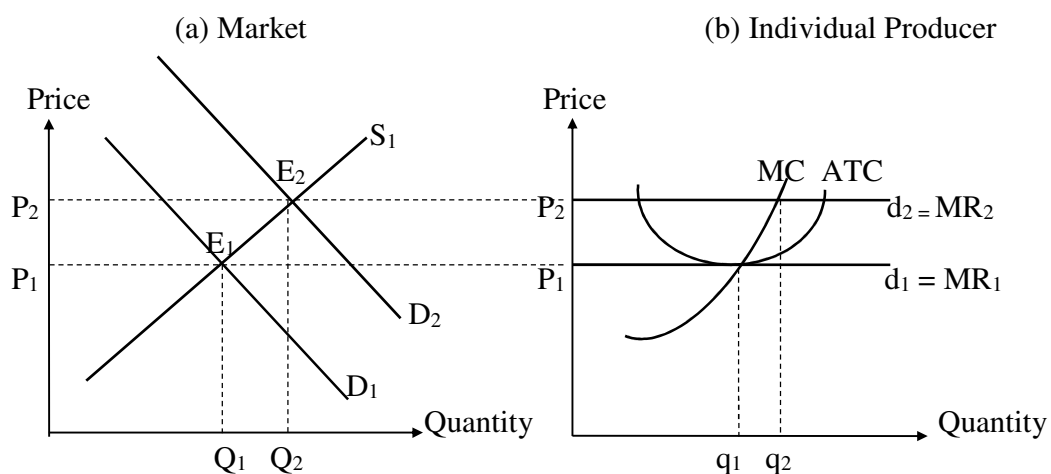
Consider a perfectly competitive market with a large number of small sellers producing an identical product and there is no entry or exit barriers. There is also a large number of buyers and no one has any control over the price. Assume initially all the producers are earning a normal profit.

If there is an increase in the market demand for the product due to a change in consumer preference, we can analyze the effect with a suitable market and a representative firm diagrams. Specifically, we need to analyze the effects on the market price and quantity of the product, the output and the profit or loss of the firm in the short run and also the long run equilibrium triggered by entry and exit of firms.

In the short run, we can draw an industry diagram consisting of a downward sloping demand curve and an upward sloping supply curve to establish the equilibrium price. There should also be a corresponding representative firm diagram showing a horizontal firm's demand curve at the equilibrium price, together with a U-shaped MC curve and a U-shaped ATC curve with MC curve intersecting ATC curve at its minimum point from below. Since we assume all the firms are making normal profit initially, at the initial equilibrium, the optimal output is at the level where $P_1 = MC$ and ATC lowest point touches the firm's demand curve at this point.

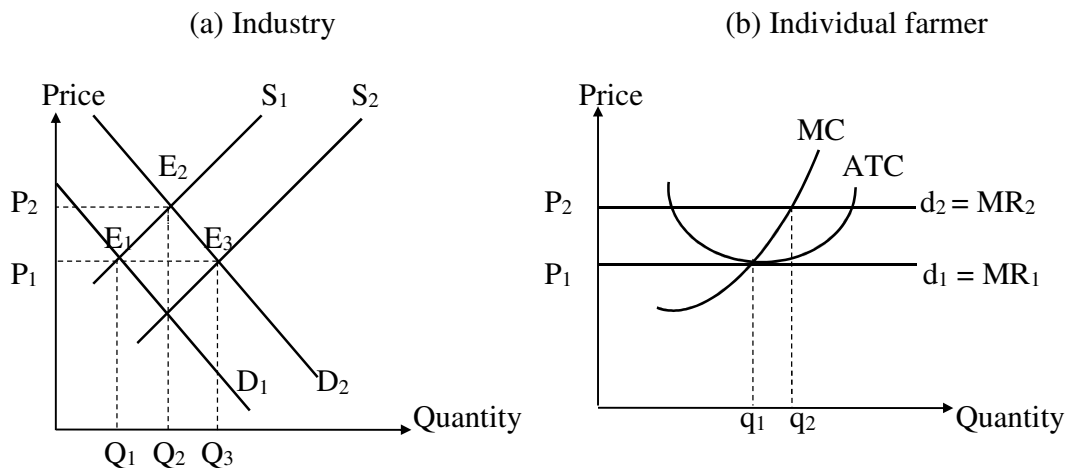
In the short run, with a stronger demand for the product, the industry demand curve shifts right, the market price and quantity of output increases as shown in Panel (a) of Figure 8.11. The firm will produce more output and earns an economic profit, as shown in Panel (b) of Figure 8.11.

Figure 8.11: Short Run Effect of Demand Changes



In the long run, more firms will enter the market, industry supply increases, market price decreases until the original price P_1 and market quantity increases further to Q_3 . This is shown in Panel (a) of Figure 8.12. Although there are more firms in the market, each firm will produce a smaller output and eventually all firms will earn a normal profit, as shown in Panel (b) of Figure 8.12.

Figure 8.12: Long Run Effect of Demand Changes



5. Perfect Competition and Efficiency

In the long run, a perfectly competitive firm is earning a normal profit. The firm also has the flexibility of adjusting the scale of operation such that it will minimize its average total cost of production. This will result in efficiency outcome for perfect competition. From the society point of view, we can also conclude that perfect competition maximizes social welfare.

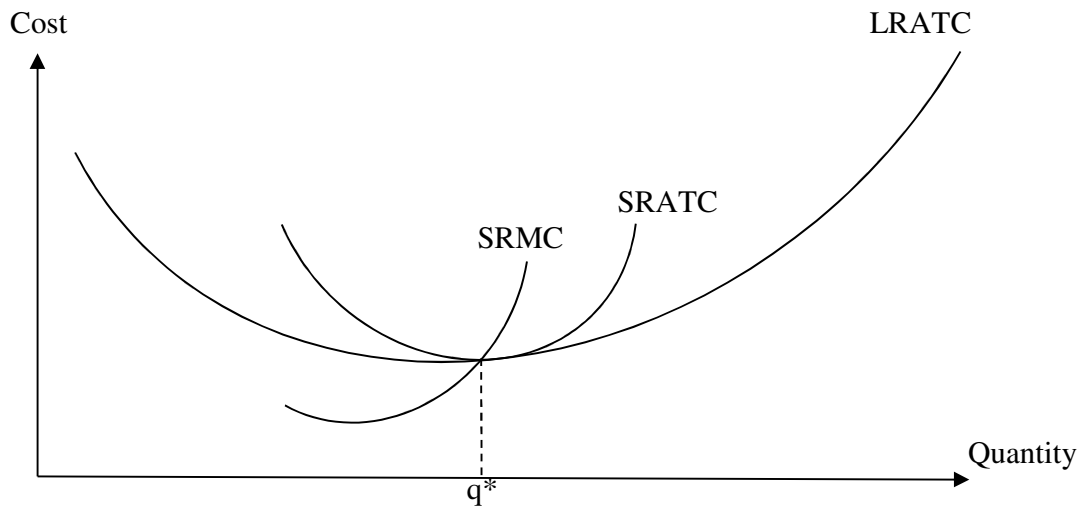
5.1 Productive and Allocative Efficiency

In perfect competition, resources are used efficiently and outputs are produced using the most cost effective method. Thus the firm is able to produce the output with the lowest average total cost of production. This is known as productive efficiency.

In addition, the optimal output is determined at the quantity where marginal revenue equals marginal cost, $MR = MC$. Since in perfect competition, price is fixed and is the same as the marginal revenue, at the optimal output the price is also equals to the marginal cost. Since marginal cost is the lowest price that producers are willing to produce the product, it is also the lowest price that consumers are able to secure the product. Thus the largest amount of resources are allocated to the product. The products are in turn allocated to the largest amount of consumers who are willing to pay the market price. This is known as allocative efficiency.

Thus in the long run, a perfectly competitive firm is both productive and allocative efficiency. This is shown in Figure 8.13. The perfectly competitive firm will produce at the output level q^* . It is the lowest average total cost in the short run and also the long run.

Figure 8.13: Long Run Efficiency of Perfect Competition



5.2 Consumer Surplus and Producer Surplus

The concept of consumer surplus and producer surplus, discussed in Section 3, are important to analyze the welfare of a society. If the market is efficient, using the market system to allocate resources will also maximize the welfare of the society by maximizing the sum of producer and consumer surplus. This implies that resources are utilized and output produced and distributed in such a way that no one can be made better off without making someone less worse off.

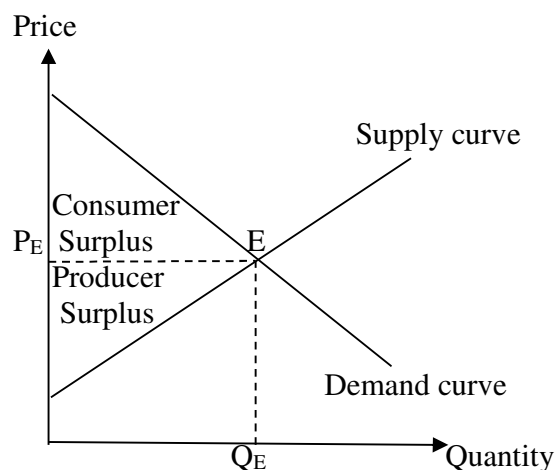
Recall that consumer surplus is the amount a buyer is willing to pay for a good minus the amount the buyer actually pays for it. It measures the benefits to buyers of participating in a market. For all consumers, there is a maximum price that each would pay for a product. Each consumer's maximum price is called his willingness to pay or the reservation price, and it measures how much that buyers values the good. Buyer will be eager to buy at a price less than his willingness to pay and will refuse to buy at a price more than his willingness to pay. So long as the price, determined by the market system, is lower than the price that the consumers are willing to pay, there will be extra welfare enjoyed by the consumer when he buy this product at the market price. This extra welfare is called the consumer surplus. If the market price is higher than the reservation price, the consumers will refuse the buy the product.

Producer surplus is the amount a seller is paid minus the cost of production. It measures the benefit to sellers of participating in a market. Producers will be willing to produce and

supply a product if the price received exceeds the cost of supply. The producer must cover his cost in the business and hence the price that allow him to cover his cost is the lowest price a producer must receive for his effort, cost is a measure of his willingness to sell. Each producer will be eager to supply at a price higher than his cost and will refuse to supply at a price less than his cost. So long as the price, determined by the market system, is higher than the price that the cost incurred by producer, there will be extra welfare enjoyed by the producer when he produced and sell this product at the market price. This extra welfare is called the producer surplus.

Consumer surplus is closely related to the demand curve for a product. The demand curve illustrates the willingness of consumers to pay for a certain quantity of a product. Thus the area below the demand curve and above the price is the consumer surplus. Since the supply curve reflects seller costs, it can be used to measure producer surplus. The area below the price and above the supply curve measures the producer surplus in a market. Both the consumer surplus and producer surplus is shown in Figure 8.14.

Figure 8.14: Consumer Surplus and Producer Surplus



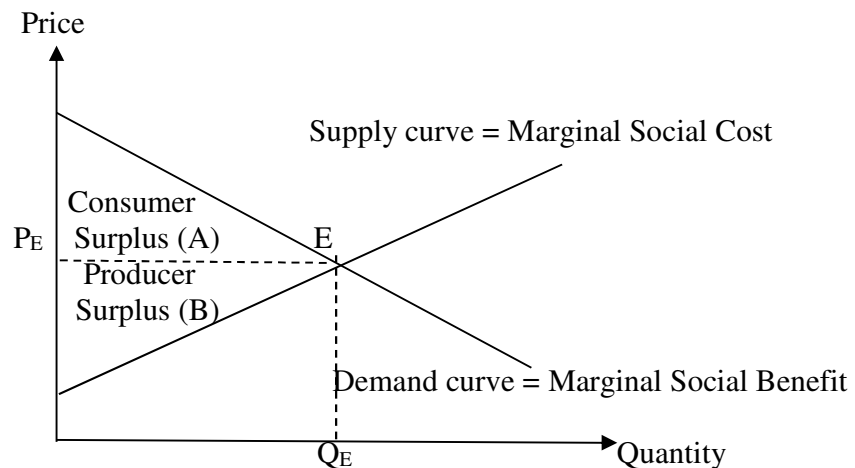
5.3 Market Efficiency and Social Efficiency

Consumer surplus and producer surplus are the basic tools that economists use to study the welfare of buyers and sellers in a market. We are interested to find out whether changes in allocation of resources can increase welfare of people in an economy. If an allocation of resources maximizes total surplus, the allocation exhibits efficiency. An allocation is not efficient if a good is not produced by the lowest cost sellers or if a good is not consumed by the highest value buyers.

Consider the market of a product. Assume that the benefits received by the society arises only from the consumers that consume the product while the cost incurred by the society arises only from the producers that produce the product. There is no external benefit besides consumers private marginal benefits, and there is no external cost besides

producers private marginal cost. The demand curve is therefore the marginal social benefit (MSB) curve while the supply curve is the marginal social cost curve (MSC). The society will maximize its welfare at the output level where marginal social benefit equals marginal social cost.

Figure 8.15: Welfare of a Society Under Perfect Competition



When a perfectly competitive market reaches the equilibrium of supply and demand, the total surplus is maximized. The market allocates the supply of goods to the buyers with highest value and allocate the demand for goods to sellers who with least cost, thus maximizes the sum of consumer surplus (A) and producer surplus (B), as shown in Figure 8.15. The welfare of society = A + B. It is the maximum of welfare for the product. Any other quantity different from Q_E will result in deadweight loss arises from over production or under production.

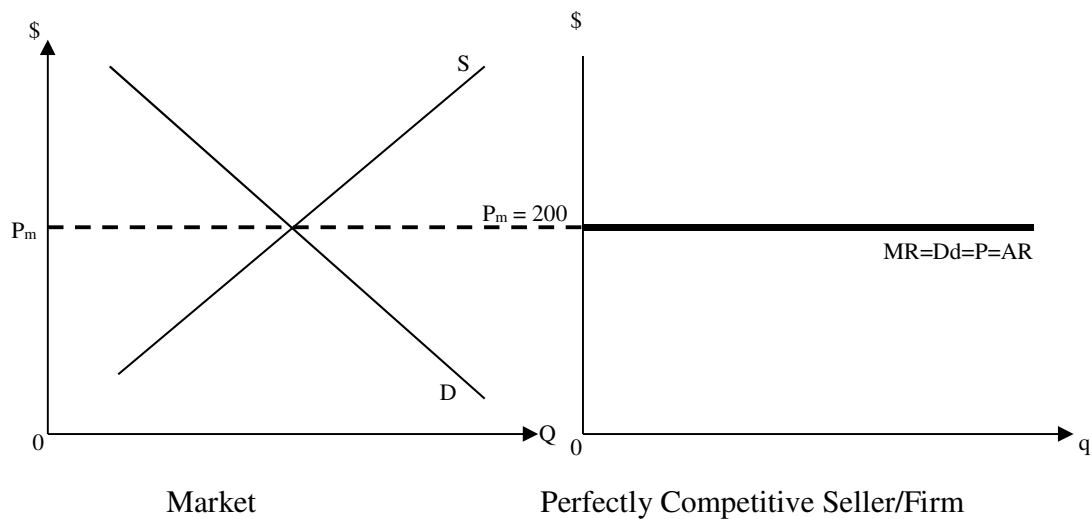
If there is external benefit or external cost, the supply curve will not be the same as the marginal social cost, and the demand curve will not be the same as the marginal social benefit. The market equilibrium outcome will not maximize the welfare of the society. This will be discussed in Session 12 under externality.

6 Illustration Questions

Consider a hypothetical perfectly competitive market where producers are selling an identical children's toy called Zomble popularised in a TV show. If the market price of a Zomble is \$200, derive the demand curve for a single seller's Zomble from the demand and supply of Zombles in the market. Other producers in the market are all selling Zombles at \$200 per toy, explain if there will be any incentive for this particular seller to sell his Zombles at \$180?

Answer:

The demand curve for an individual producer in a perfectly competitive market is perfectly elastic due to the fact that all producers are considered price takers, accepting the market price determined by market demand and market supply.



There should be no incentive for this seller to sell his Zomble below the market price of \$200. In a perfectly competitive market, each producer can produce and sell as much as he wants and the market will be able to absorb everything as each producer is considered to be very small relative to the entire market. Since all his production can be sold at the market price, there will be no incentive for the producer to lower price to attract higher levels of quantity demanded.

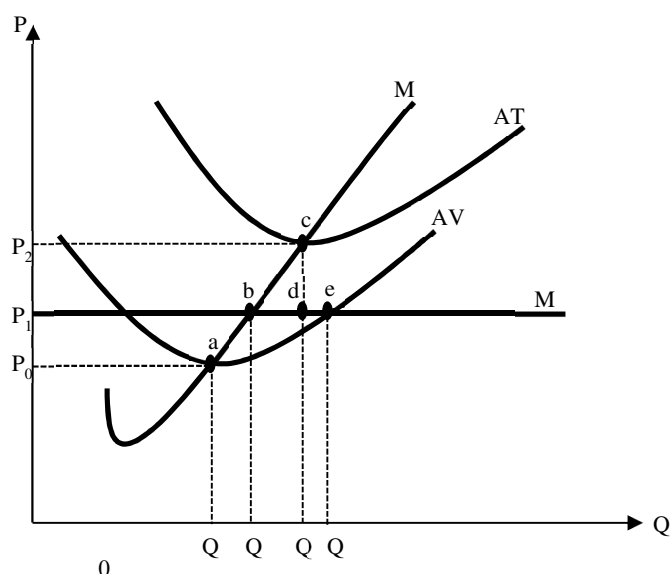
7 Discussion Questions

Question 1

Refer to Figure 1. Suppose the prevailing price is P_l and the perfectly competitive firm is currently producing its loss-minimising quantity. In long-run equilibrium,

- (A) there will be more firms in the industry and total industry output increases.
- (B) there will be more firms in the industry and total industry output remains constant.
- (C) there will be fewer firms in the industry and total industry output decreases.
- (D) there will be fewer firms in the industry but total industry output increases.

Figure 1



Question 2

Which of the following is **NOT** a characteristic of a Perfect Competitive Market?

- (A) There are many buyers and sellers in the market.
- (B) Firms can freely enter or exit the market.
- (C) Firms can earn positive profit in the long run.
- (D) The firms sell homogeneous goods.

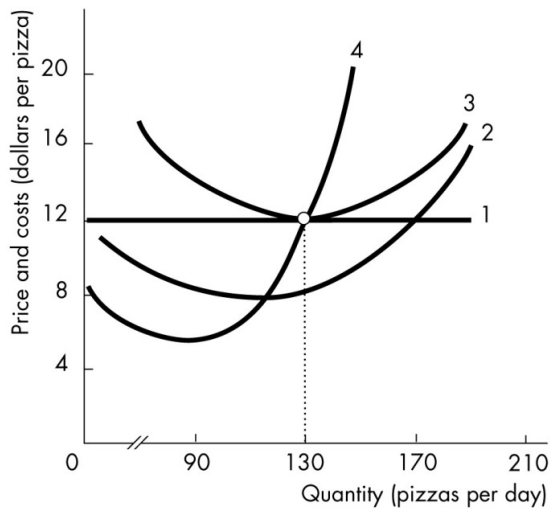
Question 3

Suppose a perfectly competitive firm has marginal costs of \$8 when producing 550 units of output. In order for this to be a point of profit maximization,

- (A) total revenues must exceed total costs.
- (B) price must be less than \$8.
- (C) price must be more than \$8.
- (D) price must be equal to \$8

Question 4

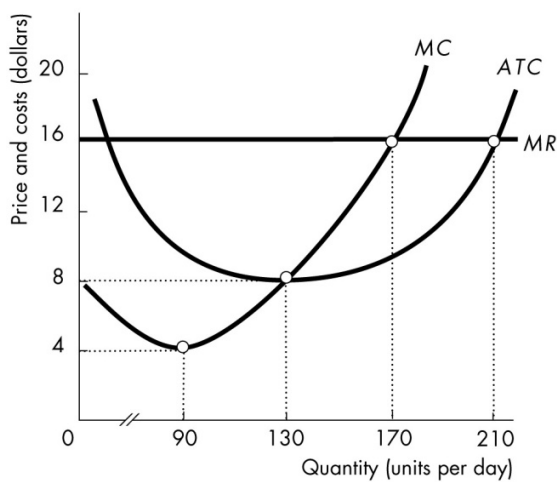
The figure below shows the cost curves of a perfectly competitive firm. The line represented by the "2" is the



- (A) average fixed cost.
- (B) average variable cost.
- (C) total cost.
- (D) average total cost.

Question 5

The figure below shows the marginal revenue and costs of a perfectly competitive firm. The firm's profit is maximized when the firm produces



- (A) 90 units of output.
- (B) 130 units of output.
- (C) 170 units of output.
- (D) 210 units of output.

Question 6

Reed Ltd is involved in the production of Good X480M with the following total cost:

Quantity of X480M Produced (Units)	Total Cost (\$)
0	1,200
1	1,600
2	1,800
3	2,400
4	3,600
5	6,000

Assume Reed Ltd exists in a competitive market and the current market price is \$1,000 per unit for Good X480M, how many units of Good X480M should Reed Ltd produce? Calculate the amount of profit or loss at this particular level of output.

Question 7

YOGINI Yoga is one of many Yoga studios in Singapore, each teaching the same yoga lessons. There are no barriers to entry.

- (a) What market structure does YOGINI Yoga belong in?
- (b) Assume that YOGINI Yoga is currently at Long-run Equilibrium, and charges \$20 per Yoga Lesson, selling 20 lessons per month. Draw the industry and firm diagrams for YOGINI Yoga which shows this long-run equilibrium. Assume there are 200 Yoga Studios in Singapore.
- (c) Now assume that that Two Directions (a popular boyband) decide to take up Yoga, and post pictures of their Yoga poses on their Instagram account. Yoga demand in Singapore then increases by a huge amount. Redraw your industry and firm diagrams from 4(a)(ii) and show the new short-run equilibrium.
- (d) Redraw your industry and firm diagrams from 4(a)(iii). Now draw industry and firm diagrams that show the new long-run equilibrium. Explain what happens to YOGINI Yoga's profits, quantity of Yoga lessons it sells, market price and market quantity of Yoga lessons, and number of Yoga firms in the industry.

MICROECONOMICS

SESSION 9

MONOPOLY

At the end of the session, students should be able to:

1. Explain how a monopoly arises and distinguish between a single-price monopolist and a price-discriminating monopolist
 2. Explain how a single-price monopoly determines its output and price
 3. Compare the performance and efficiency of a single-price monopoly with a perfect competitive market structure
 4. Explain how price discrimination increases profit
-

1. Introduction

In this session, we analyze another type of market structure known as monopoly. This is the opposite of perfect competition, where there is no competition at all. We begin with a discussion of how monopoly arises and distinguish between two types of pricing strategies, single price and price discrimination. Next we discuss how a single-price monopolist determines its optimal output and set its price. Then we compare the efficiency between perfect competition and single-price monopoly to verify that monopoly is inefficient. Finally we analyze the types and behaviour of price discrimination in monopolist.

2. Characteristics of Monopoly

A monopolist is the only supplier of a product in the market and the product has no close substitutes. The reason why only one firm exists in the market is due to extensive barriers of entry which make new firms difficult to enter the industry. Even in the long run new firms are not allowed to enter the industry. Hence unlike perfect competition there is usually no need to distinguish between the short run and the long run in monopoly. A monopolist that makes profit in the short run will continue to make profit in the long run, while a loss incurring monopolist will exit the industry in the long run.

Since there is only one firm in the industry, customers who want to buy the product in the market can only get it from this firm. Thus the firm's demand curve is also the market's demand curve. Hence there is no distinction between the market demand curve and the firm's demand curve as they are the same.

Unlike perfect competition in which the firm is a price taker, a monopolist has the ability to influence the market price and is a price setter. A monopolist has a large amount of market power. It can influence the market, in particular the market price, by changing the

quantity of its output produced. By reducing its quantity supplied, it can increase the market price and force consumers to pay a higher price.

2.1 Barriers to Entry

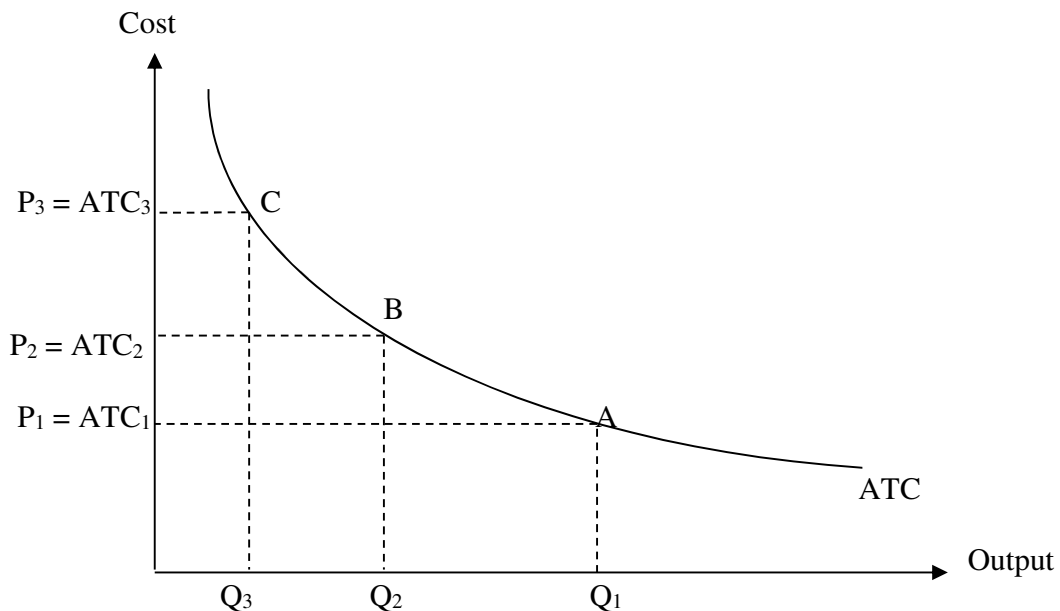
For a monopoly to exist there must be substantial barriers to entry of new firms. Barriers to entry refers to legal or natural obstacles that prevent new firms from entering an industry. In the presence of barriers to entry, if in the short run the monopolist makes an economic profit, it can continue to make this profit in the long run.

The barriers to entry could be due to the following reasons:

(a) Economies of scale: The larger the output, the lower the average total cost of production such that the industry can only be efficiently supported by one producer. This is known as natural monopoly. In a natural monopoly, the long run average total cost curve is downward sloping throughout, as shown in Figure 9.1.

In a natural monopoly, the incumbent firm has a large customer base and produce a large quantity Q_1 with a low average total cost ATC_1 . Thus the incumbent firm can charge a price P_1 and still break even. However, for a new comer with a smaller customer base, the new firm may only produce a small output Q_3 which has a higher average total cost ATC_3 . Thus the new firm must charge a price P_3 just to break even. The incumbent can charge any price higher than P_1 and lower than P_3 to drive the new firm out of the market.

Figure 9.1: A Natural Monopoly



Hence the first firm that enters the industry has the ability to capture the entire market with large scale production with lower average total cost. Any new firm that enters the industry bound to start with a small scale of production that results in higher average total cost, thus unable to compete with the incumbent firm. Hence there is only one firm in the entire market eventually. The scale and cost advantage of the incumbent firm makes it difficult for new firms to enter the market.

It is important to note that competition may create inefficiency in a natural monopoly. Refer to Figure 9.1 and assume that the market demands a quantity Q_1 . If there is only one firm in the market, the firm can produce the required output Q_1 at a low average total cost ATC_1 and the price can be as low as P_1 . If $Q_2 = \frac{1}{2}Q_1$, two firms can produce an amount Q_2 each to meet the market demand but the average total cost increases to ATC_2 and the price must be at least at P_2 . If $Q_3 = \frac{1}{4}Q_1$, four firms can produce an amount Q_3 each to meet the market demand but the average total cost will increase to ATC_3 and the price must be at least at P_3 . Hence the larger the number of firms, the more inefficient each firm will be and consumers may be worse off as they will need to pay a higher price for the product.

(b) Economies of Scope

Besides the economies of scale in producing a product in large scale to reduce the average total cost, a firm may also use its resources and brand to produce other similar or related products that can tag on its existing resources to make better use of its resources.

For example, a producer of 3-in-1 coffee can also use the resources such as manpower and machines to produce 3-in-1 tea, 3-in-1 cereals and a variety of other products. It can also use its distributional to distribute the products and using the same marketing methods such as advertising to advertise the variety of products it produces. This will reduce the average total cost of producing the variety of products, making it difficult for newcomers to compete.

(c) Product Differentiation and Brand Loyalty

Besides the cost advantage, the first firm that enter the market may also be able to cultivate customer's loyalty such that consumers will prefer its product rather than the newcomer's unknown product. This is especially if the first firm can differentiate its product from its competitors and establish a strong brand for its product such that consumers will prefer the establish brand to cheaper substitutes.

(d) Control of key inputs or distribution channel: To produce products, resources are needed and some resources could be scarce. If a firm controls the supply of important resources needed to produce a product, it may become a monopoly because other firms may not be able to obtain the resource to produce the same product. Likewise if a firm

controls the distribution channel of the product, such as the wholesale centre or the retail outlets, it can prevent other firms from accessing the products.

(e) Legal protection: Most of the monopolists are created due to legal protection. This could be in the form licences granted by the government in order to produce the product or service. If the government only grants one licence in the entire country, then there will only one legal seller of the product in the entire market. Another type of legal protection is the patent and copyright. If a firm has the patent of a certain technology to produce a product or the copyright of a product, other firms will not be able to copy the technology or violate the copyright to produce the same product.

2.2 Demand Curve and Marginal Revenue Curve

Although the monopolist has the ability to set price, it is unable to set any price it desires as consumers must still be willing and able to pay for the product. The firm is still subjected to the law of demand when selling its product. There are two types of price setting strategies for a monopolist. It can set a single price to all its customers for all the units or it can practice price discrimination where different customers or different quantities are charged different unit price. We will analyze the single price monopolist in this section and will discuss price discrimination in Section 5.

A single price monopolist is one that charge the same price to all its customers, regardless of the quantity purchased by the customers. Thus if the monopolist sets a high price, less consumers will buy its product. If the monopolist sets a low price, more customers will buy its product. This implies that a monopolist's demand curve is downward sloping. In contrast, a perfectly competitive firm's demand curve is horizontal and the firm can sell all its product at the current market price which is determined by the market demand and supply curve.

Consider a single price monopolist which initially sells a small quantity of its output at a high price, if the monopolist wishes to sell more output, it will have to lower the price, not just for the additional output but also the previous output.

For example, assume that a monopolist is selling 3 units of output at \$6 per unit, earning a total revenue of $3 \times 6 = \$18$. If the monopolist wishes to sell 4 units of output, it will have to lower the price to \$5 per unit. This \$5 applies to not just the additional unit (the 4th unit) but also the previous 3 units. So the new total revenue is $5 \times 4 = \$20$. The additional revenue from selling one more unit, which is the marginal revenue, is only \$2 even though the firm sells one more unit at \$5.

Although the 4th unit allows the monopolist to earn an additional revenue of \$5 which is equal to the price, the monopolist will have to earn less revenue from the first 3 units which it must also sell at \$5 instead of \$6 previously. Thus the marginal revenue is \$5 from the 4th unit minus \$3 from the first 3 units, which is \$2 and less than the price.

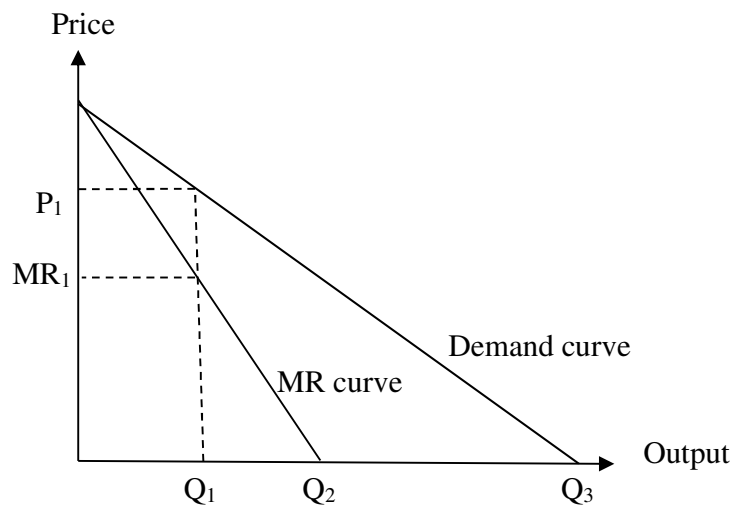
Table 9.1 shows the price, quantity, total revenue and marginal revenue of a single price monopolist. To sell a larger quantity, the monopolist needs to lower the price for all its customers. Thus the monopolist's demand curve is downward sloping and the marginal revenue is always less than the price.

Table 9.1: A Single-Price Monopolist Price and Marginal Revenue

Quantity	Price	Total Revenue	Marginal Revenue
0	10	0	-
1	9	9	9
2	8	16	7
3	7	21	5
4	6	24	3
5	5	25	1
6	4	24	-1

Figure 9.2 shows the demand curve and the marginal revenue curve of a single price monopolist. Both are downward sloping but the marginal revenue curve lies below the demand curve since price is higher than marginal revenue. For example, at the output Q_1 , the price given by the demand curve is P_1 while the MR given by the MR curve is MR_1 which is lower than P_1 .

Figure 9.2: Demand Curve and Marginal revenue Curve



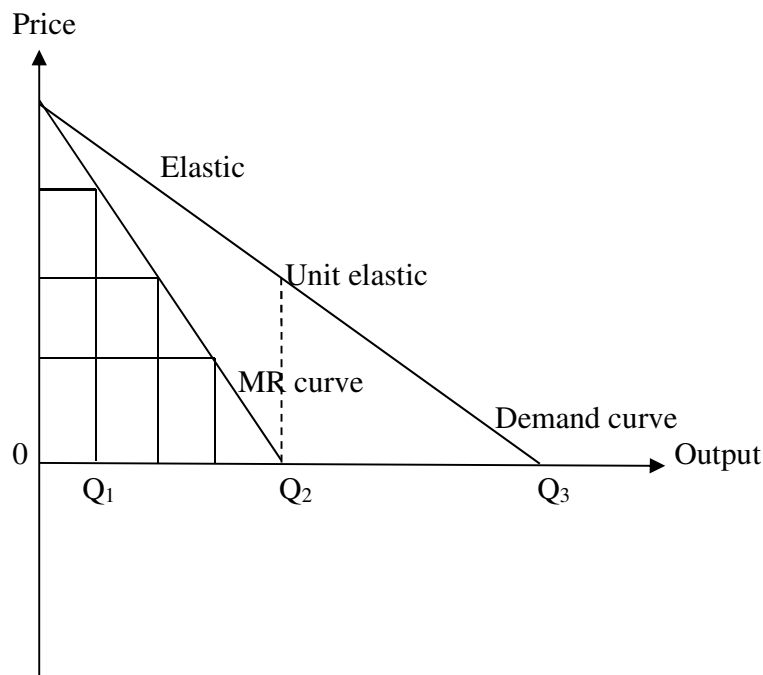
In general, if both the demand curve and marginal revenue curve are straight lines, the marginal revenue curve will share the same Y-intercept and has twice the slope of the demand curve. Thus the X-intercept of the demand curve, Q_3 , will be twice the X-intercept of the MR curve Q_2 . Hence if the demand curve is defined by the equation $P = a - bQ$ where a and b are any positive numbers, then the marginal revenue equation will be given

by the equation $MR = a - 2bQ$. For example if the demand equation is given by $P = 10 - 2Q$, then the marginal revenue function will be given by $MR = 10 - 4Q$.

2.3 Marginal Revenue and Elasticity

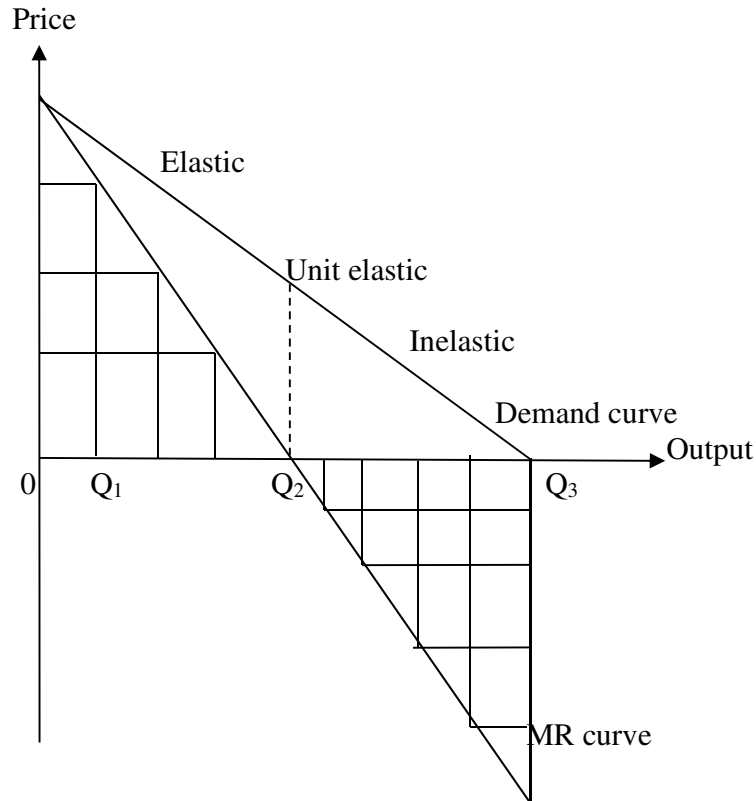
There is an important relationship between marginal revenue and the price elasticity of demand. Consider a linear demand curve and recall that the portion above the midpoint is elastic in demand while the portion below the demand curve is inelastic in demand. Along the elastic demand region, any price decreases will result in a larger than proportional increases in quantity demanded and results in a higher total revenue. However, the total revenue increases at a decreasing rate as quantity increases until it reaches a maximum at the midpoint of the demand curve where the demand is unit elastic. In this region, the positive effect on total revenue due to larger quantity exceeds the negative effect on total revenue due to lower price. Thus the marginal revenue is positive, say at quantity Q_1 . However, as the elasticity decreases, the marginal revenue decreases as quantity increases and eventually reaches zero at the quantity Q_2 where the demand curve is at its midpoint and the demand is unit elastic. This is shown in Figure 9.3.

Figure 9.3: Elastic Demand and Positive Marginal Revenue



Beyond the midpoint, the demand curve enters the inelastic region. In this region, any price decreases will result in a smaller than proportional increases in quantity demanded and results in a lower total revenue. However, the total revenue decreases until it reaches zero at the X-intercept of the demand curve at Q_3 . In this region, marginal revenue is negative and decreasing as quantity increases. This is shown in Figure 9.4.

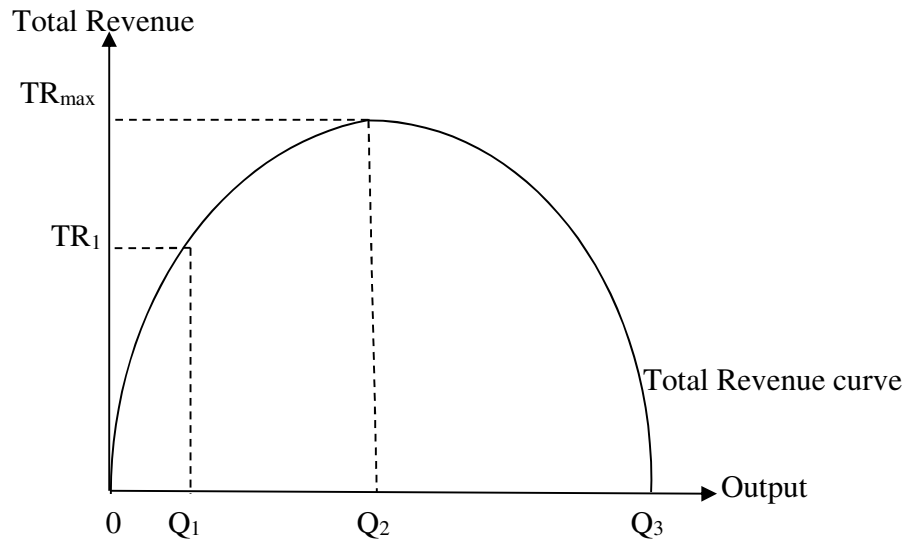
Figure 9.4: Inelastic Demand and Negative Marginal Revenue



For the quantity from 0 to Q_1 , the marginal revenue is the area of the rectangular bar. For each increasing unit, the area of the rectangular bar decreases until the marginal revenue is zero at Q_2 . For any quantity larger than Q_2 , the MR curve is below the X-axis. The area of the rectangular again measures the marginal revenue for each additional unit but it represents a negative value. Summing up all the individual marginal value for each additional unit, we will obtain the total revenue.

Refer to Figure 9.5. Initially at the elastic portion of the demand curve, as quantity increases with price decreases, total revenue increases since the marginal revenue is positive. Thus starting from 0 to Q_1 and Q_2 , total revenue increases. However, it increases at a decreasing rate since the marginal revenue is decreasing. The total revenue reaches the maximum at the quantity where demand is unit elastic and marginal revenue equals zero. Eventually as quantity increases with price decreases, total revenue decreases when the demand is inelastic and marginal revenue is negative until total revenue becomes zero. The total revenue curve is thus an "n-shaped curve" with increasing portion corresponds to the elastic portion of the demand curve, reaches its maximum point at the unit elastic demand and then has a decreasing portion corresponds to the inelastic portion of the demand curve.

Figure 9.5: Total Revenue Curve



3 Determination of Price and Output Under Monopoly

The objective of a monopolist is to maximize profit. Similar to a perfectly competitive firm, the monopolist will have to determine the optimal output using the marginal analysis. An additional unit of output will bring the additional revenue (marginal revenue) to the monopolist but it also incurs additional cost (marginal cost) to the monopolist since more resources are needed.

3.1 Numerical Example of Optimal Output for Monopoly

A numerical example of optimal output is given by Table 9.2. Assume that the monopolist is setting a single price and has to reduce the price to sell more output.

Table 9.2: Optimal Output for Single Price Monopolist

Output	Price	TC	MC	TR	MR	Profit
0	10	10	-	0	-	-10
1	9	16	6	9	9	-7
2	8	20	4	16	7	-4
3	7	22	2	21	5	-1
4	6	23	1	24	3	1
5	5	26	3	25	1	-1
6	4	36	10	24	-1	-12
7	3	48	12	21	-3	-27
8	2	61	15	16	-5	-45
9	1	81	20	9	-7	-72

If MR exceeds MC, the monopolist will earn more profit by producing one more unit of output. Applying the optimal output of $MR = MC$, we are unable to find the output level since the

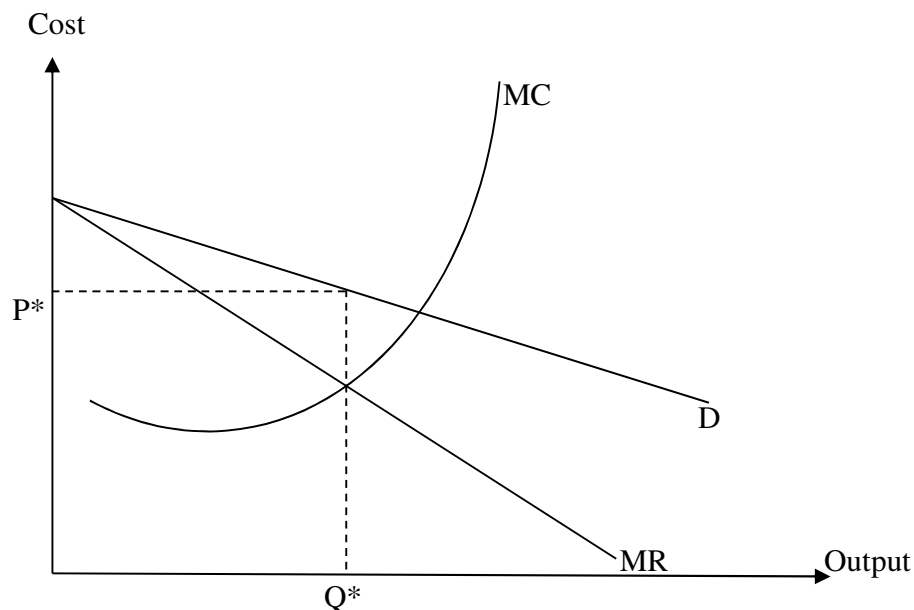
output are not continuous. In this case we will choose the output level where MR is still higher than MC but by the smallest magnitude. This corresponds to 4 units of output. At this output level, the total cost is \$23 and the total revenue is \$6 X 4 units = \$24. Hence the maximum profit is \$1.

Another method to establish the optimal output is compute the profit for all the output level and establish the one that maximizes the profit. This is shown in the profit column in Table 9.2. Using this method, the optimal output level is again 4 units.

3.2 Diagrammatic Approach of Optimal Output for Monopoly

For continuous output, we can use a downward sloping demand curve and MR curve and a U-shaped MC curve, as shown in Figure 9.6. The optimal output is Q^* which fulfil the condition of $MR = MC$. To clear all the output, the monopolist will need to charge the price P^* based on the demand curve. Profit will increase with higher output for any output less than Q^* since MR exceeds MC. However, profit will increase with lower output for any output more than Q^* since MR is less than MC.

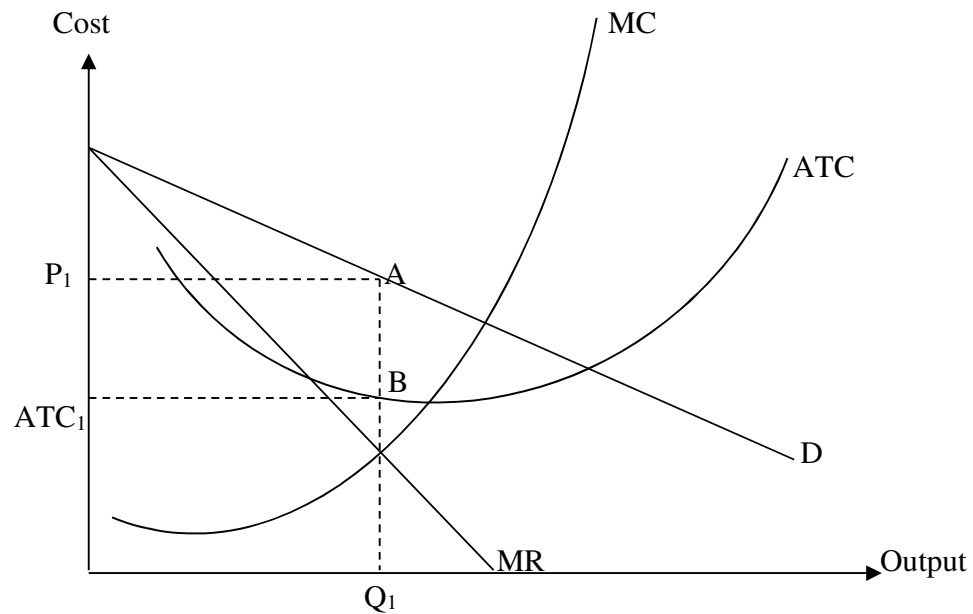
Figure 9.6: Optimal Output of a Single Price Monopolist



The optimal output for a monopolist is at the level where MR equals MC. But at this output level, the monopolist may be making profit or incurring loss. It all depends on whether the price is higher or lower than the average total cost at the optimal output. Just because a firm is a monopolist will not guarantee that it always make a profit. If the price is higher than average total cost, the monopolist will be making a profit. This is shown in Figure 9.7 where the monopolist produces at $MR = MC$ at Q_1 . From the demand curve, the monopolist

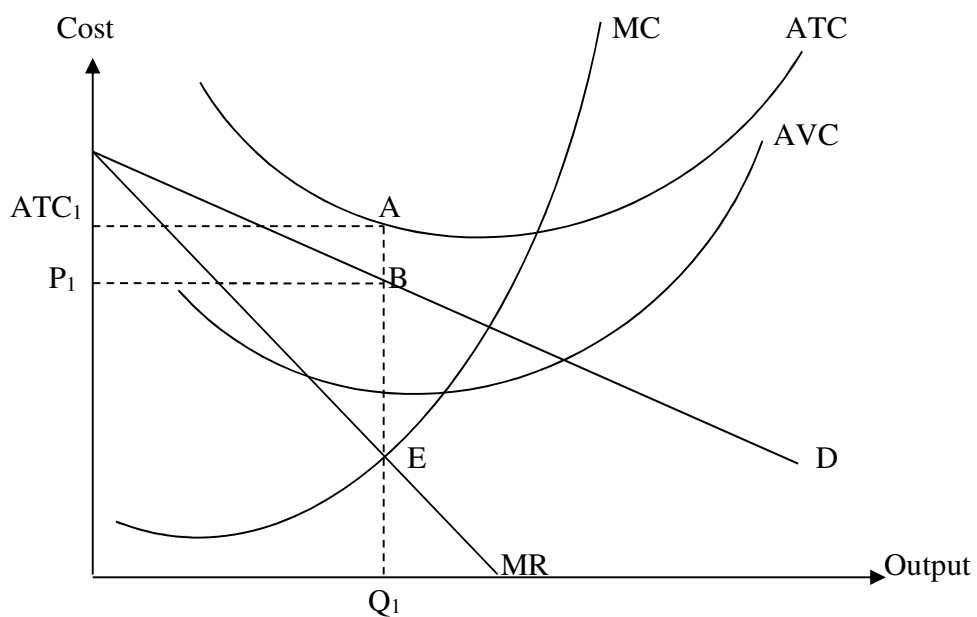
will set the price at P_1 . The amount of profit earned is $(P_1 - AC_1) \times Q_1$. Since there is no barriers to entry, the monopolist will make this profit in the long run.

Figure 9.7: Profit Making Single Priced Monopolist



The monopolist will incur losses if its price is lower than the average total cost at the optimal output. This is shown in Figure 9.8.

Figure 9.8: Loss Incurring Single Priced Monopolist

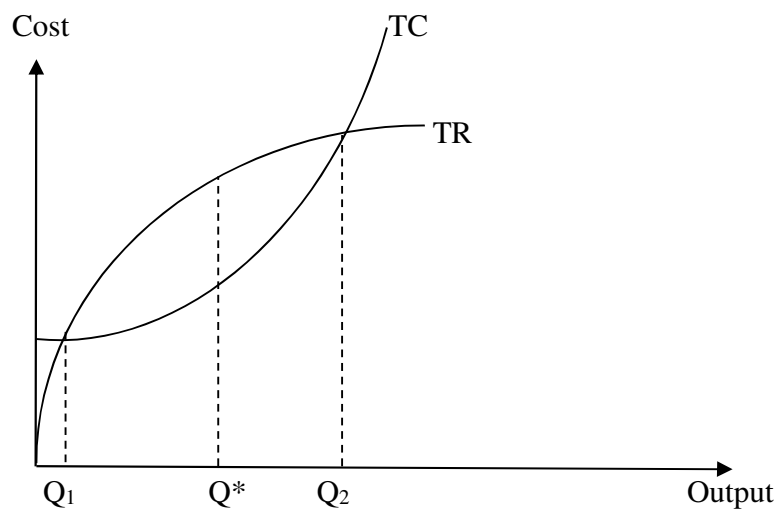


At the optimal output where $MR = MC$ at Q_1 , the price given by the demand curve is lower than the average total cost given by the ATC curve. Hence the monopolist is incurring a loss and the loss amount is equal to the area ATC_1ABP_1 .

However, the monopolist has the choice of shutting down in the short run. Since the monopolist chooses to operate, it must imply that the price P_1 is higher than the average variable cost at the optimal output. If the price is lower than the average variable cost at the optimal output, the monopolist will shut down in the short run, just like perfectly competitive firms. In the long run, a loss incurring monopolist will leave the industry.

We can also express the profit and loss situation using the total revenue and total cost diagram based on the formula $\text{Profit} = \text{Total Revenue} - \text{Total Cost}$. Since the optimal output is $MR = MC$ and MC is always positive, the optimal output must only involve positive MR . This implies that the monopolist will only operate at the elastic portion of the demand curve. The relevant TR curve is only the upward sloping portion of Figure 9.5. The TC curve is discussed in Figure 7.3 but we focus only on the concave portion where diminishing returns occur. Combining both portions, we have Figure 9.9 as follows:

Figure 9.9: Total Revenue and Total Cost of a Single Price Monopolist



The range of output where profit occurs is between Q_1 and Q_2 , and the optimal output is Q^* where the vertical distance between TR and TC is the largest. At the output, the slope of TR and TC is the same, which fulfils the condition of $MR = MC$.

4 Market Structure and Efficiency

It is widely believed that competition enhances efficiency but monopoly breeds inefficiency. Thus perfect competition is efficient but monopoly is inefficient. Recall that there are two types of efficiency: Productive and allocative efficiency.

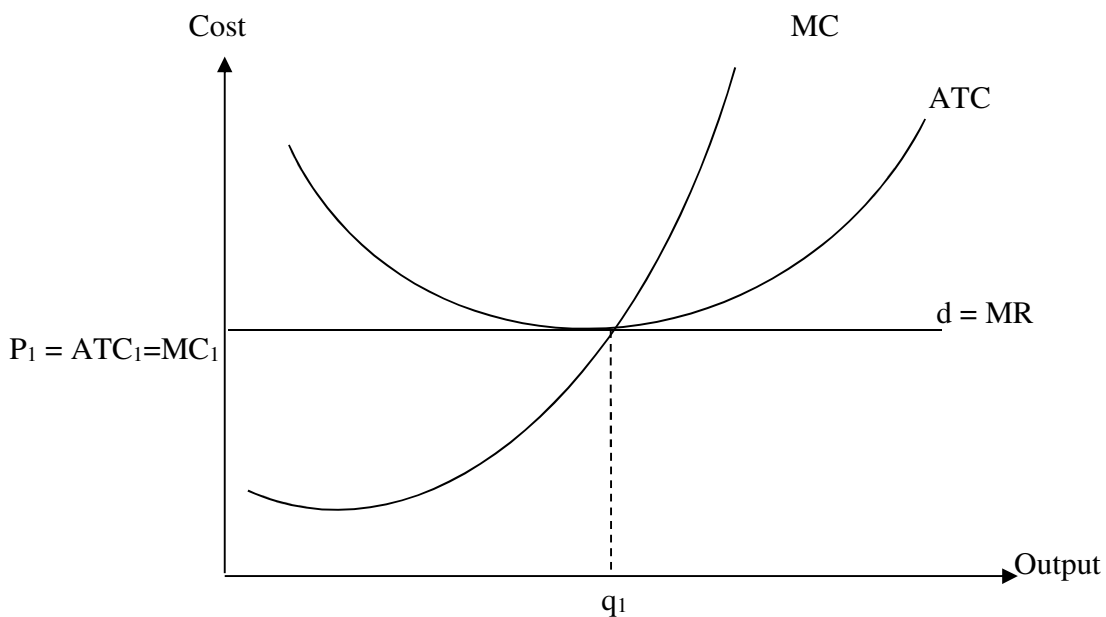
Productive efficiency refers to the situation where a firm uses the most efficient method to produce its output. This means the firm can produce the maximum amount of output with a given amount of inputs. It is generally reflected at producing at the lowest point of the long run average total cost curve.

Allocative efficiency refers to the situation where the output are being produced and distributed to the consumers in such a way that that maximizes their satisfaction when consuming the product. This requires the utilizing resources in production and charging a price such that it maximizes the welfare of the society. It is generally reflected at the output level where price equals marginal cost.

4.1 Perfect Competition and Efficiency

In perfect competition, the industry demand and supply forces determine the price and quantity and every firm takes this price as given and produce at the output level where price equals marginal cost. All the firms' output adds up to form the market output supplied and the demand for all the firm's output add up to form the market output demanded. Thus perfect competition always ensure that the market produce at the point where industry demand curve intersects the industry supply curve.

Figure 9.10: Perfect Competition and Efficiency



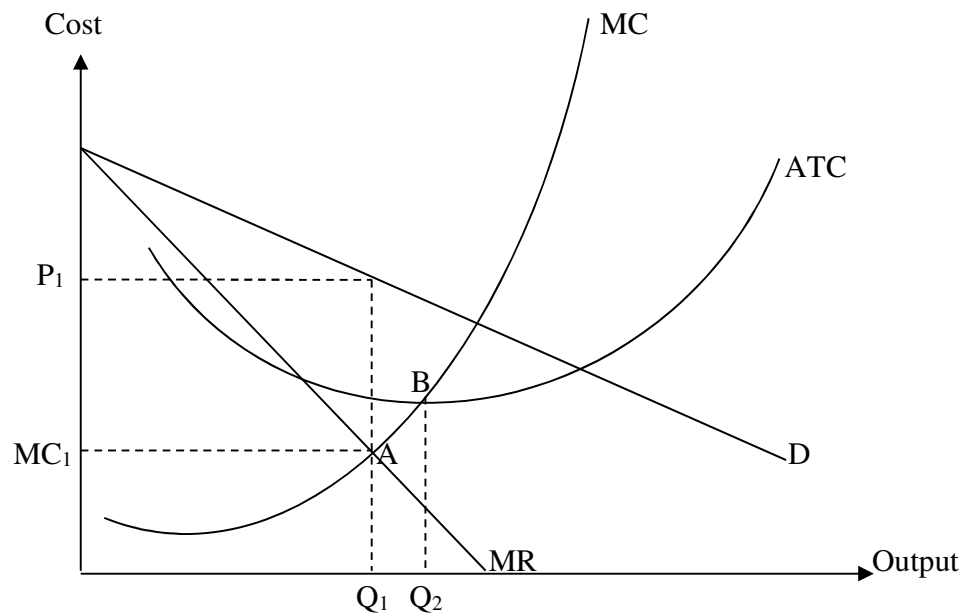
In the long run, all firms break even. Thus at the optimal output level where $MR = MC$, which is $P = MC$ implies that $MB = MC$, the condition $P = ATC$ is also fulfilled. There is productive efficiency because the firms produce at the lowest point of average total cost, which is q_1 where the MC curve intersects the ATC curve.. There is allocative efficiency because at the optimal output, price equals marginal cost. This is shown in Figure 9.10.

4.2 Monopoly and Inefficiency

Under perfect competition, there is efficiency and the welfare of the society will be maximized. But when competition is imperfect, there will be inefficiency and deadweight loss will occur. When competition is imperfect, resources will not be used in the most efficient manner. There will be productive inefficiency as well as allocative inefficiency. This is shown in the case of a single price monopolist.

In a single price monopolist, the demand curve is always above the marginal revenue curve. The monopolist will produce at the output level where marginal revenue equals marginal cost and charge a price at this output level based on the demand curve. Consider a single price monopolist making profit in the long run. This is shown in Figure 9.11.

Figure 9.11: Single Price Monopolist and Inefficiency



In Figure 9.11, the optimal output of a monopolist is at the level where MR equals MC which is Q_1 . At this output level, there is productive inefficiency since the monopolist did not produce at the lowest point of average total cost curve which is at output Q_2 . There is allocative inefficiency since at the output level the price (P_1) is higher than the marginal cost (MC_1). Consumers pay a much higher price and get fewer outputs due to the market power of a monopolist. The excess of price over marginal cost is a measure of monopoly power which breeds inefficiency.

However, a monopoly may have the advantage over perfect competition if it is a natural monopoly. The monopolist will have a large customer base and produce at a large output with lower average cost. The monopolist can thus afford to charge a lower price which benefits the consumers. Also the possibility of long term profit may induce the monopolist to implement research and development effort to introduce new and better products which benefit the society.

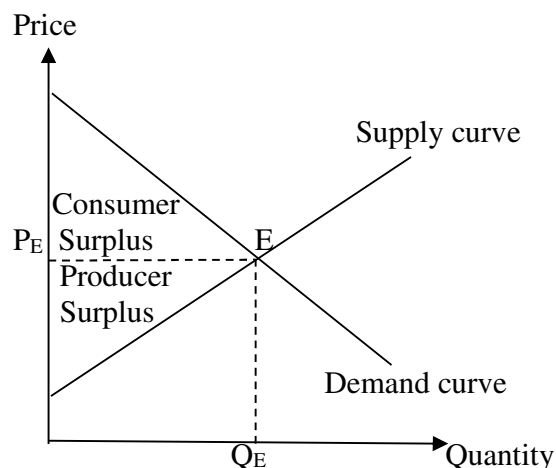
To conclude, when a firm has a huge amount of market power, it need not be a bad thing to the consumers. This is especially true if the huge market power arises from the ability of the firm in exploiting economies of scale to enhance its efficiency. Breaking up a large efficient firm into many small inefficient firms may result in productive inefficiency that increases the cost of production and price paid by consumers. It is only when the firm abuses its market power to exploit consumers by charging a higher price that the government may have intervene.

4.3 Monopoly and Social Welfare

We have mentioned in the earlier section that perfect competition is both productive and allocative efficient, while a single-priced monopolist is both productive and allocative inefficient. From the society point of view, we can also conclude that perfect competition maximizes social welfare while monopolist creates deadweight loss and is socially inefficient. The concept of consumer surplus and producer surplus are important to analyze the welfare of a society. If the market is efficient, using the market system to allocate resources will also maximize the welfare of the society by maximizing the sum of producer surplus and consumer surplus.

Consumer surplus is the amount a buyer is willing to pay for a good minus the amount the buyer actually pays for it. The area below the demand curve and above the price is the consumer surplus. Producer surplus is the amount a seller is paid minus the cost of production. It measures the benefit to sellers of participating in a market. The area below the price and above the supply curve measures the producer surplus in a market. At the market equilibrium price P_E and quantity Q_E , the producer surplus and consumer surplus is shown in Figure 9.12.

Figure 9.12: Consumer Surplus and Producer Surplus



Consumer surplus and producer surplus are the basic tools that economists use to study the welfare of buyers and sellers in a market. We are interested to find out whether changes

in allocation of resources can increase welfare of people in an economy. If an allocation of resources maximizes total surplus, the allocation exhibits efficiency. An allocation is not efficient if a good is not produced by the lowest cost sellers or if a good is not consumed by the highest value buyers.

Consider the market of a product. Assume that the benefits received by the society arises from the consumers that consume the product while the cost incurred by the society arises from the producers that produce the product. The demand curve, which measures the marginal private benefit (MPB), is also the marginal social benefit (MSB) curve. The supply curve, which measures the marginal private cost, is also the marginal social cost curve (MSC). The society will maximize its welfare at the output level where marginal social benefit equals marginal social cost. If the marginal social benefit exceeds the marginal social cost, the society will desire a larger quantity of output. In contrast, if the marginal social cost exceeds the marginal social benefit, the society will prefer a smaller quantity of output.

Figure 9.13: Welfare of a Society Under Perfect Competition

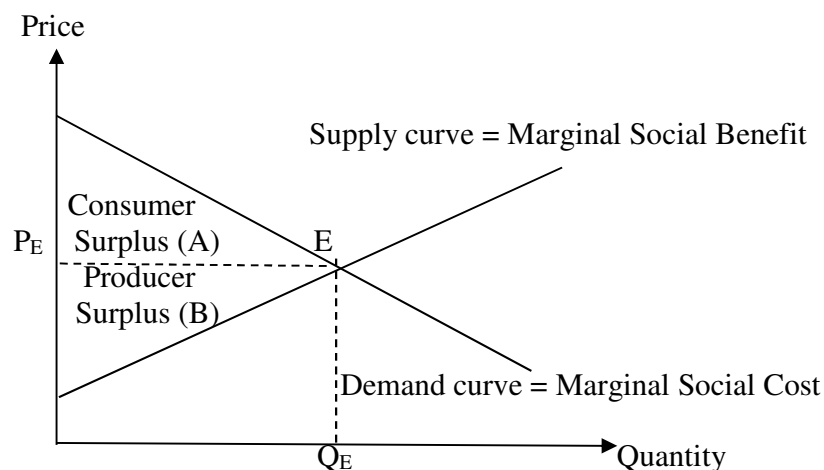
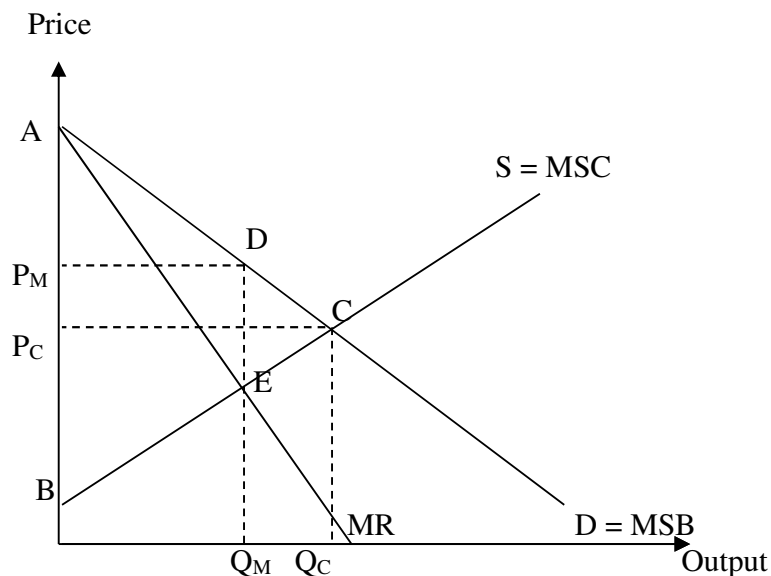


Figure 9.13 shows the situation where the market is perfectly competitive. Under perfect competition, the market equilibrium outcome will prevail. The market allocates the supply of goods to the buyers with highest value and allocates the demand for goods to sellers who with least cost. The market equilibrium occurs at the intersection of market supply and market demand. This market equilibrium output coincides with the social optimal quantity where marginal social benefit equals marginal social cost. Thus perfect competition maximizes the welfare of the society, represented by the sum of consumer surplus (A) and producer surplus (B). The social welfare is equal to the area $A + B$.

If this market were to become a monopoly, the social welfare will be different. We consider a single priced monopolist where the optimal output is where $MR = MC$. The MR curve is given by a downward sloping straight line below the demand curve, while the MC curve is the supply curve. Figure 9.14 shows the social welfare under monopoly.

Figure 9.14: Social Welfare under Monopoly



The producer surplus is given by the area P_MDEB , while the consumer surplus is given by the area ADP_M . The social welfare is given by the sum of producer and consumer surplus which is the area $ADEB$.

The monopolist results in a higher producer surplus and a lower consumer surplus. This is because some of the consumer surplus are redistributed to producer surplus due to the market power. However, overall there is a net welfare loss due to the deadweight loss represented by the area CDE . The presence of deadweight loss is another evidence that monopolist is inefficient while perfect competition is efficient.

4.4 Comparing between Perfect Competition and Monopoly

In a perfectly competitive market, the price and quantity are determined by the demand and supply curves. The long run equilibrium price and quantity are obtained from the intersection point of the market demand and supply curve. This is shown in Figure 9.15. The price under perfect competition is P_C and the quantity is Q_C .

In contrast, a profit making single priced monopolist optimizes at the output level where $MR = MC$. Since the MC curve is the same as the market supply curve and the MR curve is always below the market demand curve, this output level will be less than the market equilibrium output under perfect competition. With a downward sloping demand curve, the monopolist will also charge a higher price than perfect competition. This is shown in Figure 9.15. The price under monopoly is P_M and the quantity under monopoly is Q_M .

Figure 9.15: Price and Output under Perfect Competition and Monopoly

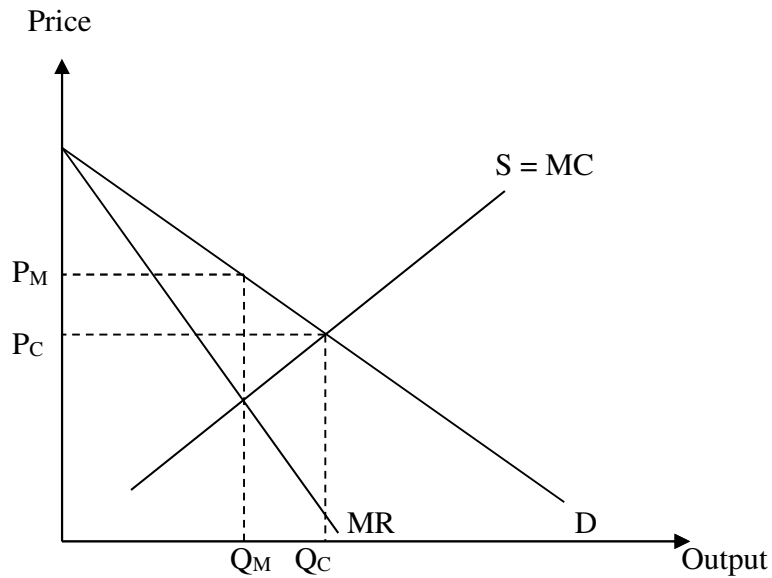


Table 9.3 summarizes the comparison among perfect competition and a single priced monopoly. The differences can be expressed in terms of number of sellers, nature of products, barriers to entry, long run profit, firm's demand curve, relationship between price and marginal revenue, optimal output and efficiency.

Table 9.3: Comparison between Perfect Competition and Monopoly

	Perfect Competition	Monopoly
Number of Sellers	Many	One
Nature of Products	Identical	No close substitutes
Barriers to entry	None	Substantial
Long run profit	Normal	Can be positive
Firm's Demand Curve	Horizontal	Downward slopping
Relationship between price and marginal revenue	Price equals marginal revenue	Price is larger than marginal revenue
Optimal output	$P = MC$	$MR = MC$
Productive Efficiency	Efficient	Inefficient
Allocative Efficiency	Efficient	Inefficient
Social Welfare	Maximized	Deadweight Loss

5 Price Discrimination

Although a single price monopolist maximizes its profit if price exceeds average total cost at the output level where $MR = MC$, its profit can be higher if it practices price

discrimination. This is because different consumers tend to have different willingness to pay and price discrimination can convert the consumer surplus to producer profit.

Price discrimination means the monopolists either charge different prices to different customers for the same product produced with the same cost, or charge different prices to different quantity of output purchased by the customers where the cost is the same. It is important to establish that if the cost of supplying the good is different to different consumers, then the producer charge different prices to different consumers is not considered as price discrimination.

5.1 Conditions of Price Discrimination

To practise price discrimination, the firm must have some market power in setting the price. In addition, the following conditions must be fulfilled:

- (a) Distinct markets for different customers

The sellers must be able to separate consumers from different markets so as to practise discrimination in the prices to the customers.

- (b) Different demand elasticities in distinct market

The consumers from different markets must have different price elasticity of demand for the product. The market with more elastic demand will be charged a lower price while the market with more inelastic demand will be charged a higher price.

- (c) No resale of the product

If resale of the product is possible, then consumers may buy the product at the low price market and then sell the product at the high price market and capture the price differential as the profit. This is known as arbitrage. For the price discrimination to occur, it must not be possible for resale to occur.

5.2 Types of Price Discrimination

There are three types of price discrimination, discussed as follows:

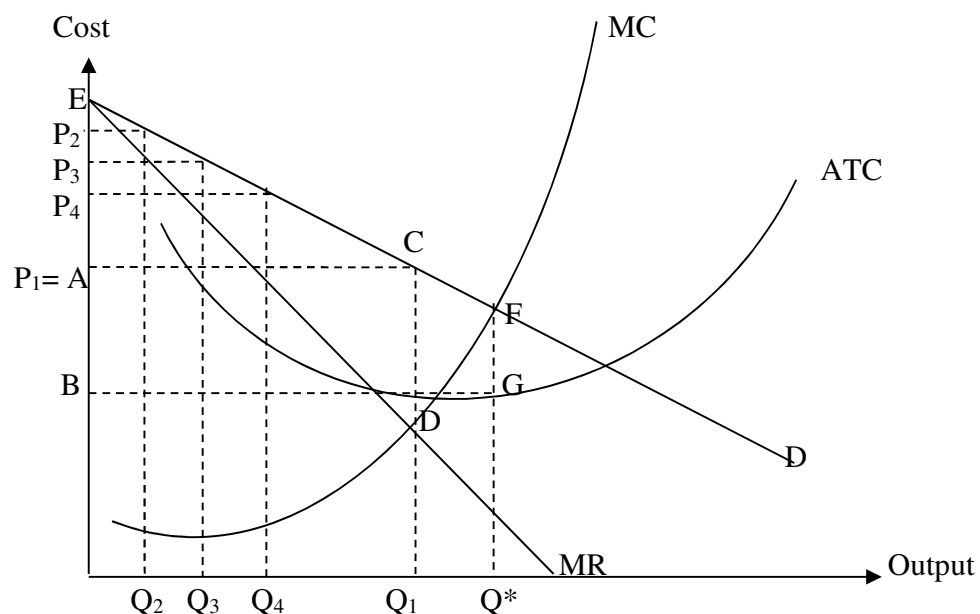
- (a) First-degree price discrimination occurs where the firm charges each consumer the maximum price which is the same as the willingness to pay or the reservation price he or she is prepared to pay for each unit. This is also known as perfect price discrimination.
- (b) Second-degree price discrimination occurs where the firm charges customers different prices according to the quantity they purchase. This is also called batch price discrimination.

(c) Third-degree price discrimination occurs where consumers are grouped into different markets and a separate price is charged in each market.

5.3 Consumer Surplus, Price Discrimination and Profit

Consider a monopolist that practice single pricing. At the optimal output $MR = MC$, the price is given by the demand curve and the maximum profit is given by the price less average total cost multiply by output. This is represented by the area of triangle ABCD, shown in Figure 9.16.

Figure 9.16: Single Priced Monopolist and Price Discrimination



However, based on the demand curve which shows willingness to pay, there are customers who are willing to pay a price higher than A for output less than Q_1 . Instead of charging the same price P_1 to all customers for all quantities up to Q_1 , if the monopolist can charge different price for different quantities, the monopolist is able to convert the consumer surplus into economic profit.

For example, if the monopolist can charge a price P_2 for the output up to Q_2 , and then a lower price P_3 for output up to Q_3 , and then a even lower price P_4 up to output Q_4 , its profit can increase by the areas of the rectangles bounded by the new prices and their respective quantities. In the extreme cases of every unit charges different price, the entire area of triangle EAC can be added to become profit of the monopolist.

Moreover, if price discrimination is allowed, the monopolist will not stop at the output Q_1 . For output more than Q_1 , so long as the price is higher than the marginal cost, it is profitable for the monopolist to produce more. Thus the monopolist will continue to produce until

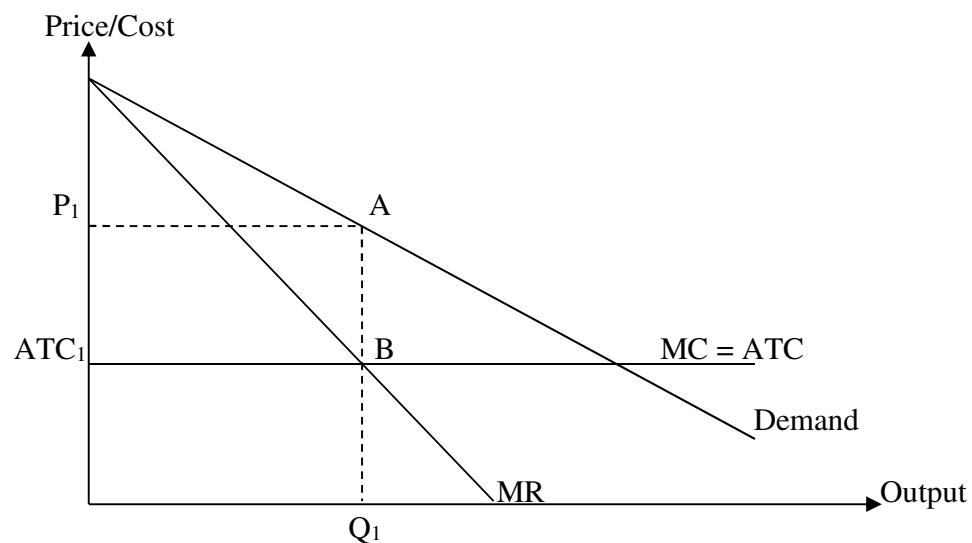
the output Q^* where the demand curve intersects the MC curve. The additional profit is given by the area CDFG.

5.4 Profit Maximizing with Perfect Price Discrimination

In practice, the second-degree and the third degree price discriminations are more common since the reservation prices of consumers are usually not known to the producers. But if perfect price discrimination can be practiced, the firm can earn more profit than charging a single price.

Consider a monopolist who practice single price. For simplicity, assume that the marginal cost is a constant and equals to the average total cost at ATC_1 , as shown in Figure 9.17. The optimal output is Q_1 where $MR = MC$. From the demand curve, the monopolist will set the price at P_1 . The amount of profit earned is $(P_1 - ATC_1) \times Q_1$. This is shown by the rectangle bounded by P_1ATC_1BA .

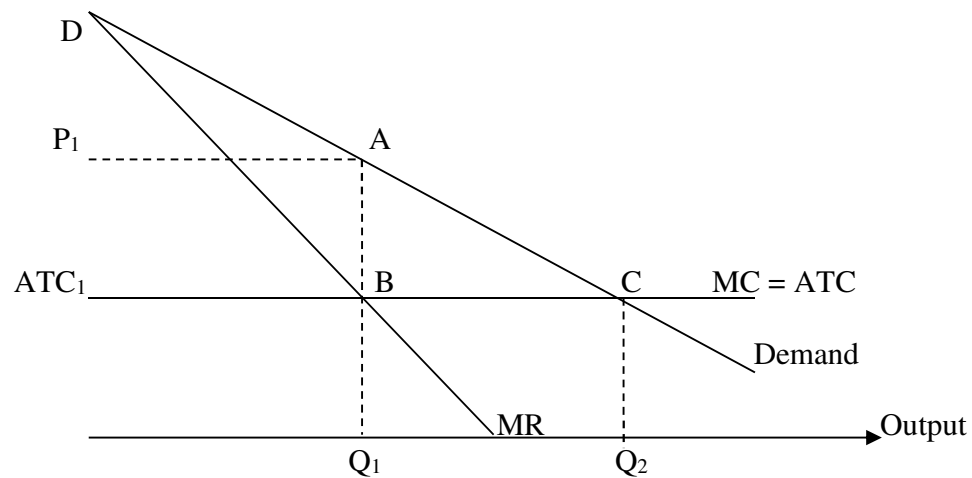
Figure 9.17: Profit Under Single Price Monopolist



If the monopolist were to practice perfect price discrimination, then the MR curve will be the same as the demand curve and the optimal output will be the Q_2 where MC curve intersects the demand curve, as shown in Figure 9.18. The total profit in the perfect price discrimination is $DA TC_1 C$. This is higher than the profit under single price by the triangle DP_1A and ABC .

Figure 9.18: Profit Under Perfect Price Discriminating Monopolist

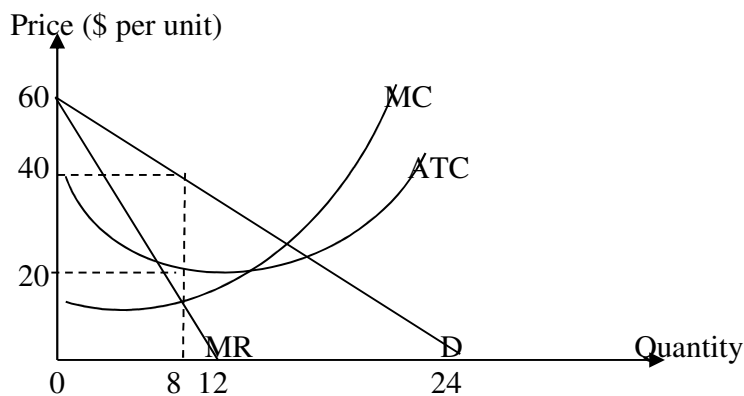
Price/Cost



If a monopolist practices perfect price discrimination, it will produce at the same output as perfect competition and hence the outcome is efficient. The only difference is under perfect competition the social welfare is shared between buyers and sellers but under monopoly all social welfare belongs to the monopolist.

6 Illustration Questions

Consider a single-priced, profit maximizing monopolist with the following diagram.



- Determine the optimal output and the price of the monopolist.
- Compute the profit or loss and the consumer surplus for the monopolist
- Is the monopolist productive and allocative efficient? Explain.

Suggested answers:

- The optimal output is given by $MR = MC$ which is 8 units.

The price is given by the demand curve at 8 units, which is \$40.

(b) Profit = $(P - ATC) \times \text{Output} = (\$40 - \$20) \times 8 = \160

Consumer surplus = $(1/2) \times 20 \times 8 = \80

(c) Since the monopolist did not produce at the lowest ATC, it is productive inefficient. Since it produces at an output level where price exceeds marginal cost, it is allocatively inefficient.

7 Discussion Questions

Question 1

Compared to perfect competition, the consumer surplus in a monopoly _____.

- (A) is unchanged because price and output are the same.
- (B) is eliminated.
- (C) is higher because price is higher and output is the same.
- (D) is lower because price is higher and output is lower.

Question 2

Compared to a perfectly competitive market, a simple monopoly market will have _____.

- (A) higher price and lower output
- (B) lower price and higher output
- (C) lower price and lower output
- (D) higher price and higher output

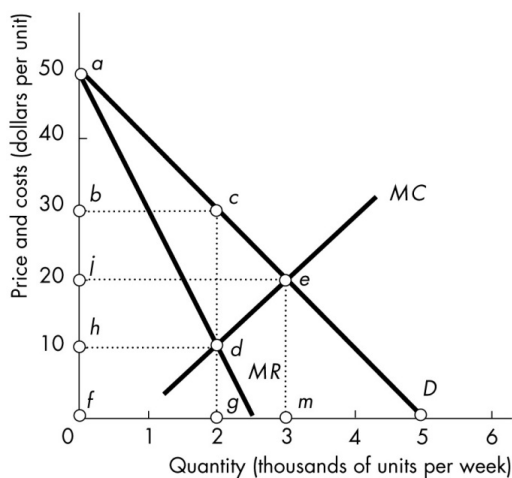
Question 3

A monopolist's output price is \$10 and the firm is producing 80 units with a marginal cost of \$11. The monopolist should

- (A) lower its price.
- (B) decrease production.
- (C) keep its price unchanged.
- (D) increase production.

Question 4

In the figure below, a single-price monopolist charges a price of _____, resulting in total revenue equal to area _____.



- (A) \$10; *hbcd*
- (B) \$20; *fjem*
- (C) \$10; *fbcg*
- (D) \$30; *fbcg*

Question 5

For a single-price monopolist to sell one more unit of a good, it must

- (A) lower the price on just the last unit sold.
- (B) lower the price on all units sold.
- (C) raise the price on just the last unit sold.
- (D) raise the price on all units sold.

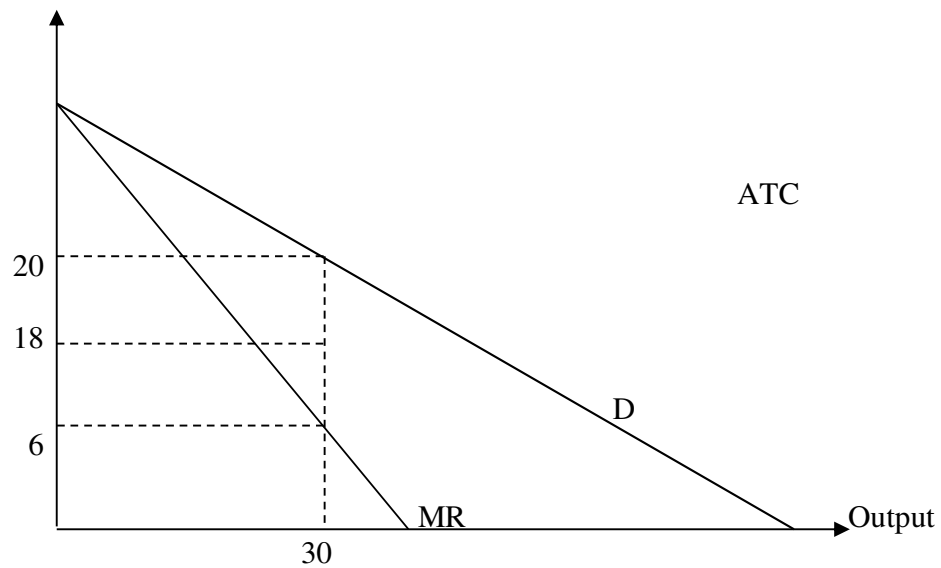
Question 6

A monopolist diagram comprises a downward sloping demand (D) and Marginal revenue (MR) curves together with U-shaped average total cost (ATC) and marginal cost (MC) curves is shown below.

- (a) Determine the optimal output for the monopolist.
- (b) What is the price at the optimal output?
- (c) Calculate the profit or loss for the monopolist at the optimal output.

Cost (\$)

MC



Question 7

TICKfit is a new fitness centre in Singapore, the only one of its kind, with no close substitutes. Analysts call it a monopoly. TICKfit knows what each customer is willing to pay, and is able to perfectly price discriminate.

- Draw a diagram which shows TICKfit's profit-maximising output, assuming it makes positive economic profit.
- Is TICKfit allocatively efficient? Why?

MICROECONOMICS

SESSION 10

MONOPOLISTIC COMPETITION

At the end of the session, students should be able to:

1. Define and identify an industry characterized by monopolistic competition
 2. Explain how output and price are determined in a monopolistically competitive industry
 3. Compare between monopolistic competition and perfect competition
 4. Explain why advertising costs are high in a monopolistically competitive industry
-

1. Introduction

In this session, we begin with an introduction to the framework of monopolistic competition, which is very similar to perfect competition except for the nature of the product. Next, we analyse the optimal output, short run equilibrium and long run equilibrium under monopolistic competition. Then we make a comparison between monopolistic competition and perfect competition. Finally, we analyze the effects of advertising in monopolistic competition.

2. Behaviour of Monopolistic Competitive Firm

Monopolistic competition refers to a market structure where there is competition but firms have some monopoly power. Firms in monopolistic competition shares many characteristics as perfect competition except for the nature of the product. While perfectly competitive firms sell identical product, monopolistic competitive firms sell differentiated products, which give the firms some monopoly power and provides them with the ability to set price.

2.1 Characteristics of Monopolistic Competition

Monopolistic competition has the following characteristics:

- (a) Large number of buyers and sellers - This implies that there were be keen competition among the sellers for customers.
- (b) Differentiated products - This means the firms are selling close substitute products but not identical. Thus there is no need for the firms to charge the same price. Those that

charge a higher price will still retain some customers due to the unique features of their products.

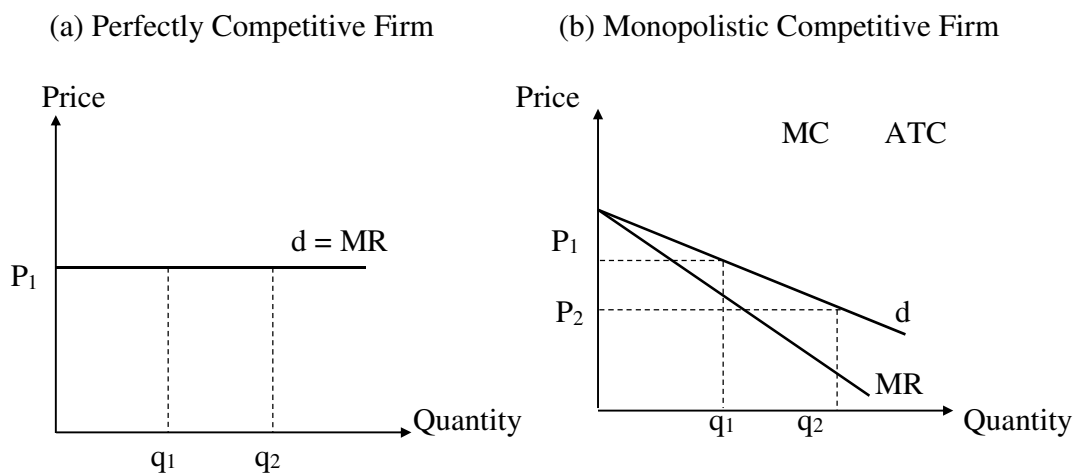
(c) Free entry and exist of firms - This implies that profit will induce new firms to enter while losses will prompt existing firms to leave the industry. One important implication of this assumption is that all firms will earn zero economic profit in the long run.

The most common example cited for monopolistic competition is the retail sector. For example, the sales of food, clothing and shoes. In these retailing sectors, there are many buyers and sellers and it is easy to enter the industry as well as exit from the industry. Most importantly is the retailers sell differentiated product (different types of food, clothing and shoes). Consumers can buy from the sellers that cater to their particular preferences.

2.2 Product Differentiation

The most important characteristics for monopolistic competition and the one that distinguish it from perfect competition is the nature of product. In perfect competition, all firms sell the same product. Thus it makes no difference for consumers to buy the product from any firm and hence firms cannot charge higher price than the market equilibrium price. The firm that charges a higher price will lose all customers. The firm has a horizontal demand curve which is the same as the marginal revenue curve, as shown in Panel (a) of Figure 10.1. The other firms' output are perfect substitutes to the output of a representative firm. Hence the firm's demand curve is perfectly elastic.

Figure 10.1: Demand Curve for Firms in Perfect and Monopolistic Competition



In contrast, the monopolistic competitive firms sell differentiated products. Customers will buy from the firm that differentiates its product that cater to the preferences of the consumers. This means a firm that charges a higher price than its rivals will still have customers. Customers will be willing to pay a higher price for the product due to its

differentiation from the others. The other firm's output are close substitutes, not perfect substitutes to the product of a representative firm.

However, the market will still be governed by the law of demand. Because there are close substitutes available, a firm that charges a higher price will have lesser customers. This means the demand curve for a monopolistic competitive firm is downward sloping. The marginal revenue curve will be below the demand curve. This is shown in Panel (b) of Figure 10.1. Initially to sell a quantity q_1 the firm needs to set the price at P_1 . To sell a larger quantity q_2 the firm will have to reduce the price for all units to P_2 . Hence the MR is always less than the price and the MR curve is always below the demand curve.

2.3 Methods of Product Differentiation

There are many ways to conduct product differentiation. The common methods of product differentiation are as follows:

(a) Changing the external features of the product

One method of differentiating the product from the competitors is to change the external feature of the product, such as the size, shape, colour and weight of the product. For example, the introduction of multi-colour for lap top will attract consumers with preference of specific colours, while the smaller and lighter laptops cater to consumers who prefer one that enhance mobility.

(b) Improving the quality of the product

For products where performance matters, such as electric appliances, the quality of the product may be the priority concern of the consumers. The producer can differentiate the products by improving on the quality such that it is more powerful, equipped with additional functions, time and energy saving, more durable and less frequency of breaking down. For example, Japanese cars have the reputation of more durable and fuel efficient to differentiate from the continental cars.

(c) Service quality

Purchasing a product is an experience and hence the service quality is as important as the quality of the product. Firms that provide good sales and after-sales services will create a pleasant buying experience and tend to attract repeat customers.

(d) Advertising

Advertising may provide a signal of the product is of good quality and hence the producer is confident and willing to incur high cost to advertise it. Successful advertisement will create deep impression to the consumers and influence the preference or tastes of the customers. Consumers may select a particular brand of product with rigorous advertising based on perceived differences from the other brand. We will analyze the effects of advertising in Section 5.

(e) Price competition

Some consumers are very price conscious and are willing to purchase products with no frills if the price is attractive. Hence one method of product differentiation is to provide the bare essential elements in the product or service and charge a low price to attract price conscious customers. One example is firms selling no frill products, such as the budget airline which has no in-flight entertainment and meals but the lower fares are attractive to budget conscious travellers.

3. Short Run Equilibrium of Monopolistic Competition

In the short run, the firms in monopolistic competition compete with each other based on their methods of differentiation. If their methods of differentiation is well received by the customers, there will be strong demand for their products and they will be making economic profit. On the other hand, those firms with differentiation that is not valued by consumers will incur losses.

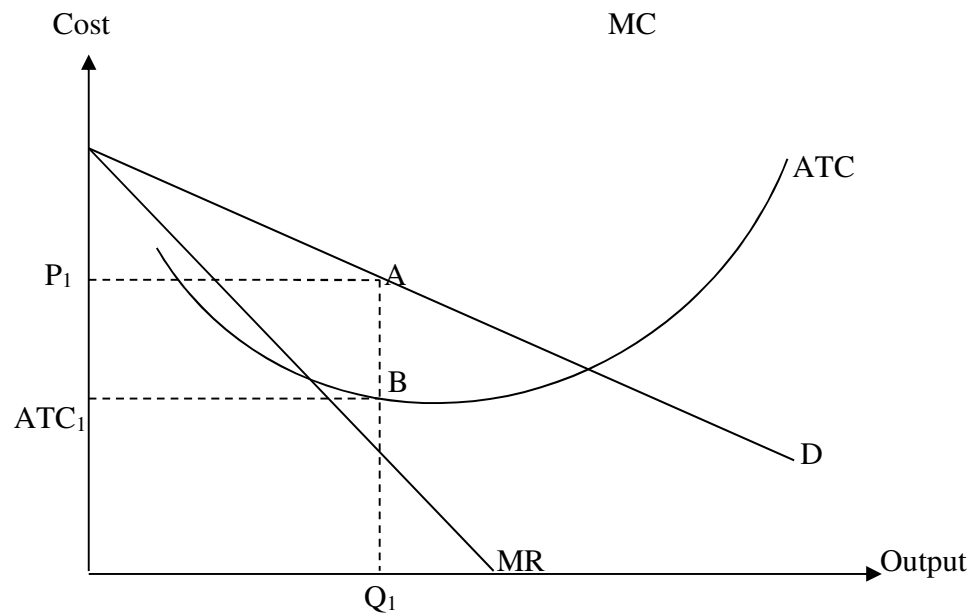
Similar to perfect competition and monopoly, the optimal output for monopolistic competition is at the level where MR equals MC. Profit will be higher with increasing output if MR exceeds MC but will be lower with increasing output if MC exceeds MR. But at this output level, the monopolistic competitive firm may be making profit or incurring loss. It depends on the value of price and average total cost at this output level.

3.1 Profit Making Monopolistic Competitive Firm

If the price is higher than average total cost, the monopolistic competitive firm will be making a profit. This is shown in Figure 10.1. Profit occurs when the product differentiation introduced by the firm is well received by the customers.

In Figure 10.1, the optimal output is Q_1 where $MR = MC$. From the demand curve, the monopolistic competitive firm will set the price at P_1 . The amount of profit earned is $(P_1 - AC_1) \times Q_1$. This is shown by the rectangle bounded by P_1 , A, B and ATC_1 . Note that at this output, price exceeds marginal cost. The excess of price over marginal cost is a measure of the market power due to product differentiation.

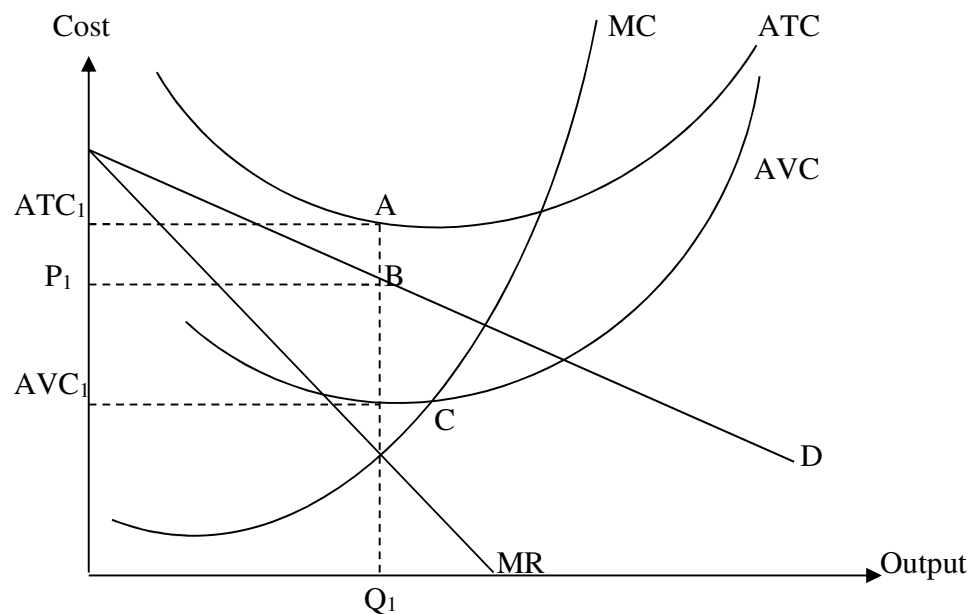
Figure 10.1: Profit Making Monopolistic Competitive Firm



3.2 Loss Incurring Monopolistic Competitive Firm

A monopolistic competitive firm will incur losses if its price is lower than the average total cost at its optimal output. This is shown in Figure 10.2

Figure 10.2: Loss Incurring Monopolistic Competitive Firm



In Figure 10.2, at the optimal output Q_1 where $MR = MC$, the monopolistic competitive firm is incurring a loss since price is P_1 is lower than average total cost ATC_1 . The amount of loss incurred is $(ATC_1 - P_1) \times Q_1$. This is shown by the rectangle bounded by P_1 , A, B and ATC_1 . Note that at the optimal output Q_1 , price exceeds average variable cost and the minimum average variable cost is at point C. Thus the firm continues to operate at a loss since the loss is smaller than the shut down situation.

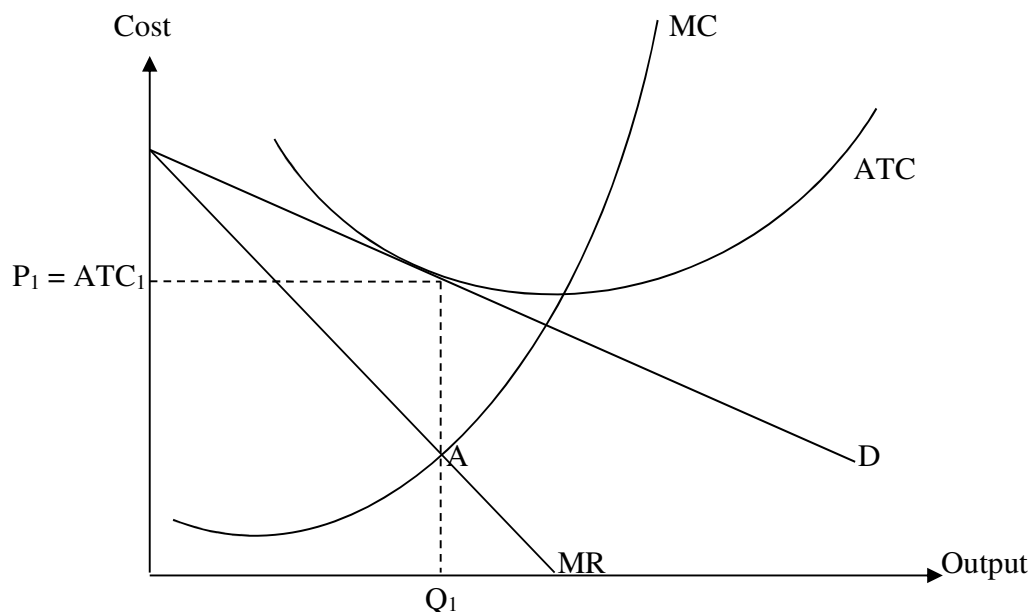
Just like the other market structures, in the short run, the firm will only operate at a loss if the price exceeds the average variable cost at the optimal output. Those firms that cannot cover their variable costs will shut down in the short run.

4 Long Run Equilibrium in Monopolistic Competition

In the long run, there is free entry and exit of firms in monopolistic competition. If existing firms are making profit, new firms will enter the market. If the existing firms are incurring losses, some firms will exit from the industry. The movements of firms will result in the long run that all firms will only earn a normal profit, just like the perfectly competitive firms.

In Figure 10.4, the optimal output of a monopolist is at the level where MR equals MC which is Q_1 . At this output level, the price P_1 given by the demand curve is equal to the average total cost ATC_1 given average total cost curve. So the firm is making a normal profit. This is the long run equilibrium for a monopolistic competitive firm.

Figure 10.4: Long Run Equilibrium of Monopolistic Competitive Firm



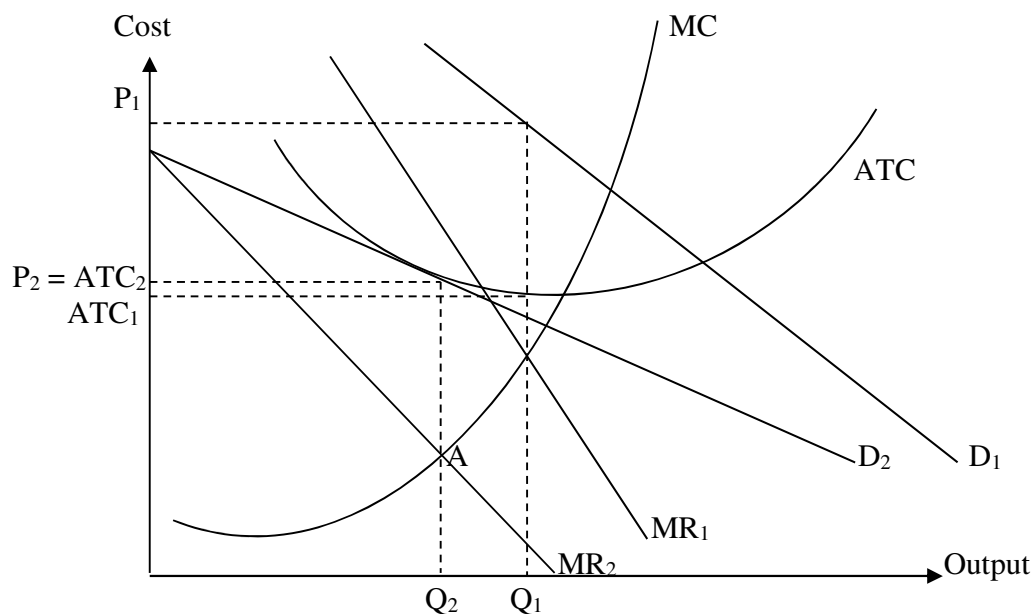
4.1 Adjustment from Profit

When the existing firms are earning positive economic profit, new firms will enter the industry since there is no barriers to entry. However, new firms will enter the industry with a slightly different product. This slightly different product will bound to attract some consumers from the existing firms.

There are two effects to the existing firms when new firms enter the industry. The first effect is that there will some customers attracted by the newly introduced differentiated product. Thus the existing firms will have lesser customers. The demand curve of the existing firm will shift to the left.

The second effect is that with the newly introduced differentiated product, there will be more substitutes to the existing firm's product. Thus the existing firm's demand curve becomes more elastic and is flatter.

Figure 10.5: Adjustment From Profit to Normal Profit



Refer to Figure 10.5 which shows the adjustment from a short run profit situation to a long run break even for a monopolistic competitive firm. Initially the demand curve is D_1 and MR curve is MR_1 . The firm is making a profit at the optimal output Q_1 since price P_1 exceeds average total cost ATC_1 .

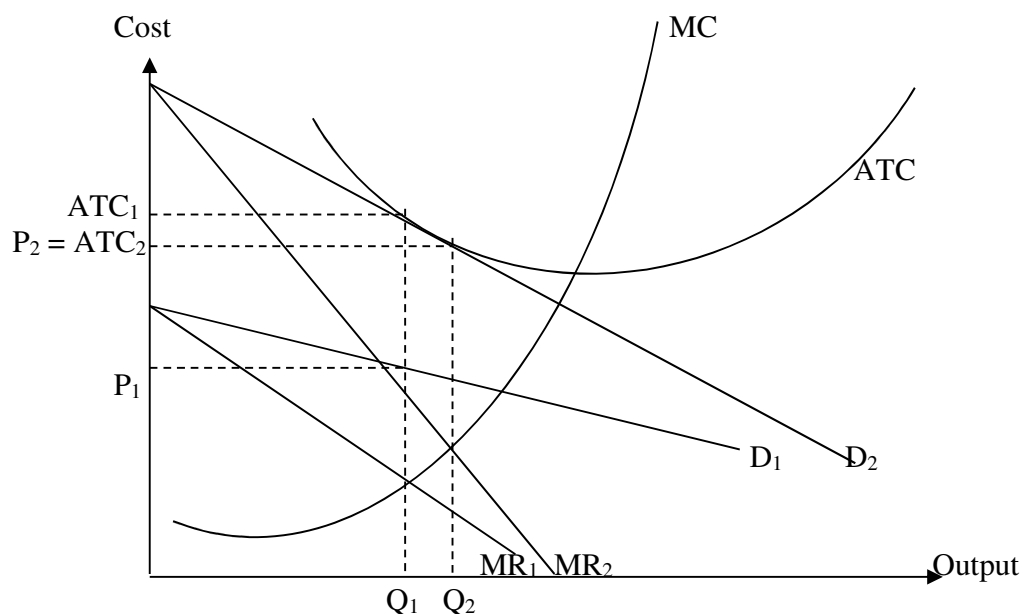
Eventually with new firms enter the industry, the demand curve will shift to the left and becoming flatter until it touches the ATC curve at the optimal output where $MR = MC$ at Q_2 . The firm is making a normal profit at the optimal output Q_2 since price P_3 is equal to average total cost ATC_2 .

4.2 Adjustment from Loss

If the existing firms are incurring losses, some firms which are more optimistic will remain in the industry but the other firms which are more pessimistic will leave the industry. When firms leave the industry, there are again two effects on the existing firm.

With firms leaving the industry, the existing firms will have more customers and hence the demand increases. With lesser choices available, there will be lesser substitutes to the existing firms' output, the demand for existing firms' products becomes more inelastic. Thus the demand curve of a typical existing firms will shift to the right and become steeper.

Figure 10.6: Loss to Normal Profit



Refer to Figure 10.6 which shows the adjustment from a short run loss situation to a long run break even for a monopolistic competitive firm. Initially the demand curve is D_1 and MR curve is MR_1 . The firm is incurring a loss at the optimal output Q_1 since the price P_1 is less than the average total cost ATC_1 .

Eventually with firms leave the industry, the demand curve for the existing firm will shift to the right and becoming steeper until it touches the ATC curve at the optimal output where $MR = MC$ at Q_2 . The firm is making a normal profit at the optimal output Q_2 since price P_2 is equal to average total cost ATC_2 .

4.3 Comparison Between Perfect Competition and Monopolistic Competition

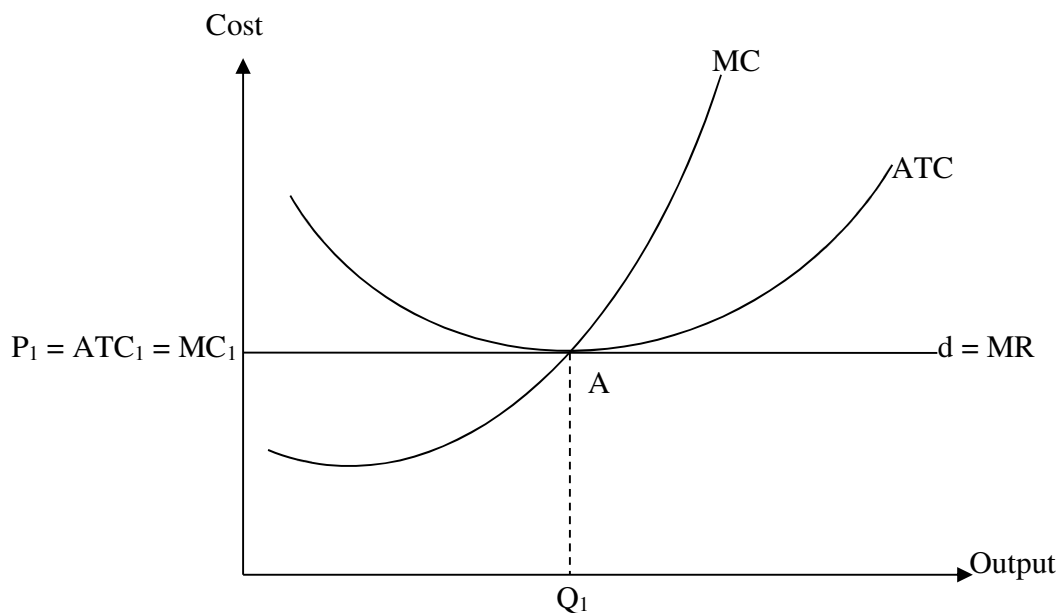
Comparing monopolistic competition with perfect competition, we can observe many similarities. Both market structures have a large number of firms, both have free entry and exit, and firms in both market structures can only earn normal profit in the long run. However, the long-run equilibria are different between monopolistic competition and perfect competition in two aspects: Excess capacity and Markup.

Excess capacity refers to the firm did not fully utilize its resources by producing at an output level before it reaches the lowest average total cost. The firm has some extra capacity to produce more output and reduce the average total cost of product but it did not utilize them for profit consideration.

Markup refers to the setting of price above the marginal cost of production. Marginal cost is the minimum price that a producer must receive to produce the output. Price exceeds marginal cost represents the market power of producer which in turn reduces consumption due to higher price and hence resulting in misallocation of resources.

Figure 10.7 shows the long-run equilibrium of perfect competition. At the long-run equilibrium output Q_1 , the firm produces at output level with the lowest average total cost at point A. Thus there is no excess capacity and the firm is productive efficient. At the optimal output Q_1 , the price P_1 is the same as the marginal cost MC_1 . Thus there is no markup and the firm is allocatively efficient.

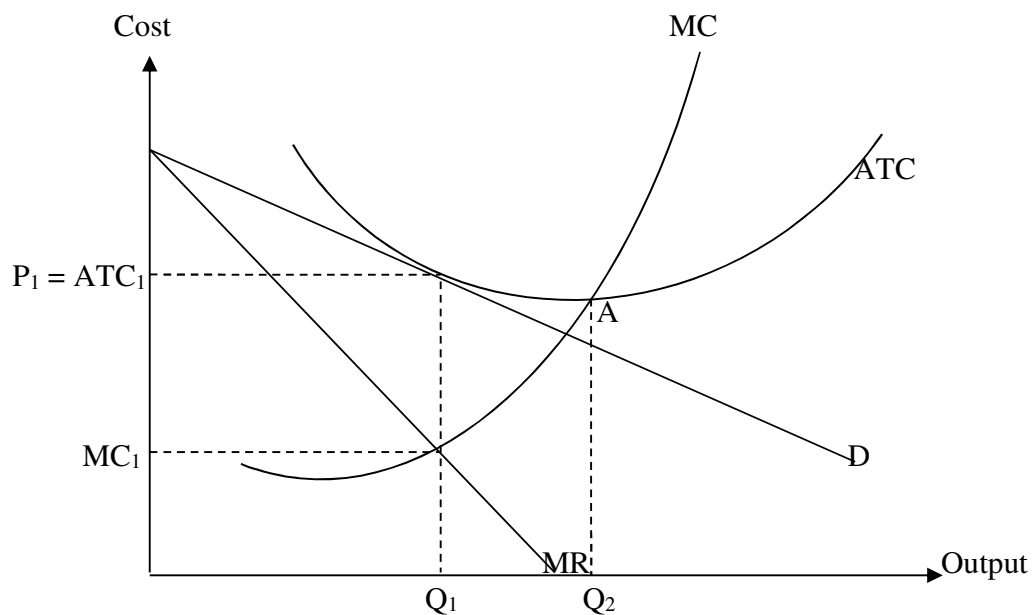
Figure 10.7: Perfect Competition: Long Run Equilibrium and Efficiency



In contrast, in the long run, a monopolistic competitive firm has both excess capacity and markup. Hence the firm is both production and allocative inefficient.

Figure 10.8 shows the long run equilibrium of a monopolistic competitive firm making normal profit. The firm is productive inefficient since the firm did not produce at the lowest point of average total cost curve which is at output Q_2 at point A. The excess capacity is given by $Q_2 - Q_1$. The firm is allocatively inefficient since at the output level the price (P_1) is higher than the marginal cost (MC_1). The mark up is given by $P_1 - MC_1$. Consumers pay a much higher price and get fewer outputs due to the market power of the monopolistic competitive firm in selling differentiated product.

Figure 10.8: Monopolistic Competition: Long Run Equilibrium and Inefficiency



4.4 Variety, Efficiency and Innovation

From efficiency, point of view, monopolistic competition is a both productive and allocative inefficient. However, a monopolistic competitive firm may have the advantage over perfect competition due to the product differentiation. The excess capacity and markup are due to product differentiation where a smaller quantity of a large variety of products will be produced. In contrast, under perfect competition a large quantity of an identical product will be produced and all consumers will buy the same product.

Since different consumers have different tastes preferences. Under monopolistic competition a variety of the same category of product is available and consumers value variety. Consumers can choose to buy the product which cater most to their preferences. However, variety is costly. Consumers may be willing to pay a higher price to get their preferred choice which means the society may be willing to tolerate some inefficiency in the production and allocation to exchange for variety.

Due to free entry and exit of firms in monopolistic competition, an attractive product differentiation will soon be emulated by other firms and any existing firm will only earn normal profit in the long run. To continue making economic profit, a monopolistically competitive firm will need to continuously differentiate itself from its competitors. This include product development via innovation.

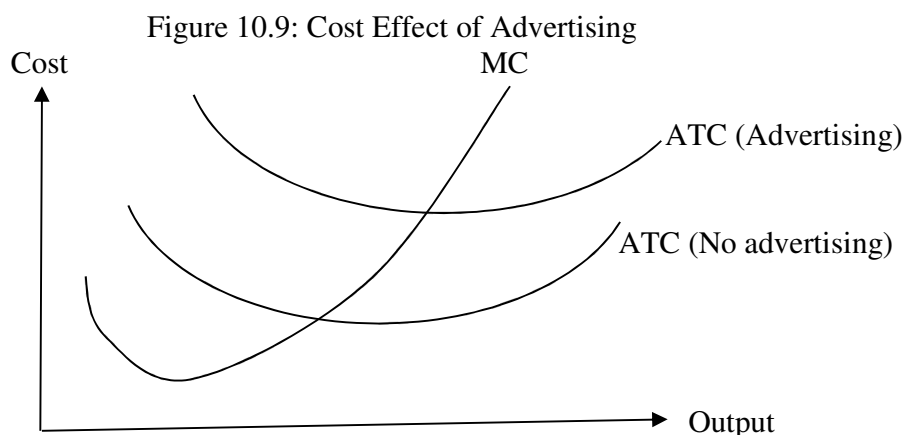
New product development will allow a firm to obtain a competitive edge over its rivals. This is especially when the new product is protected by a patent. However, patent has a validity period and the competitive advantage a firm has is only temporary. When other firms are able to copy the technology and produce similar product, the firm will have to introduce new product to sustain its competitiveness. Innovation is costly but it can increase revenue and profit of the firm. To maximize profits the firm will pursue product development until the marginal revenue from innovation equals the marginal cost of innovation.

5. Advertising and Monopolistic Competition

In perfect competition, all firms produce the same product and hence there is no incentive for any firm to advertise its products. In monopoly, there is only one firm in the market and there is no close substitutes to the product, there is also no incentive for the monopolist to advertise. But in monopolistic competition, firms can use advertisement as a method of production differentiation. Hence advertising is common among monopolistic competitive firms.

5.1 Cost Effect of Advertising

Advertising is a form of selling cost. When a firm advertise in newspaper or television programme, the cost incurred is regardless of the output that it can sell. Thus advertising expenditure is a fixed cost. Since average total cost is the sum of average fixed cost and average variable cost, with advertising the average total cost increases but not marginal cost. This is shown in Figure 10.9 where ATC curve shifts upwards with advertising.

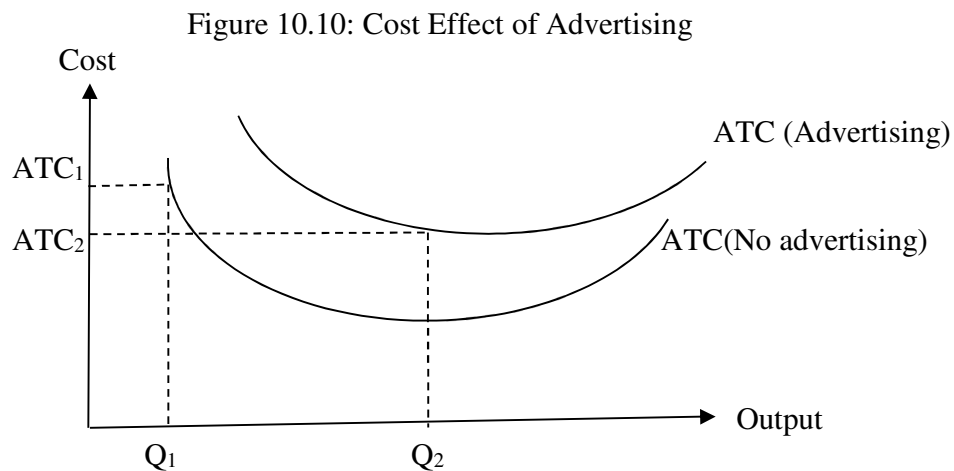


5.2 Quantity Effect of Advertising

The benefits of advertising lies in generating awareness of the product so that more customers are attracted to the product. This will results in two effects which benefit the producers.

One effect is advertising results in the firm having more consumers. This will increase the demand for its product, shifting the demand curve and MR curve to the right. In addition, to the extent that the advertisement influence the taste of consumers and attracts consumer's loyalty, it will also make the demand more inelastic. The firm will be able to charge a higher price, enjoys a higher markup and sell more products when demand increases.

The second effect is that a larger scale product may result in a lower average total cost of product, even though the average total cost curve has shifted upwards. This is elaborated in Figure 10.10.



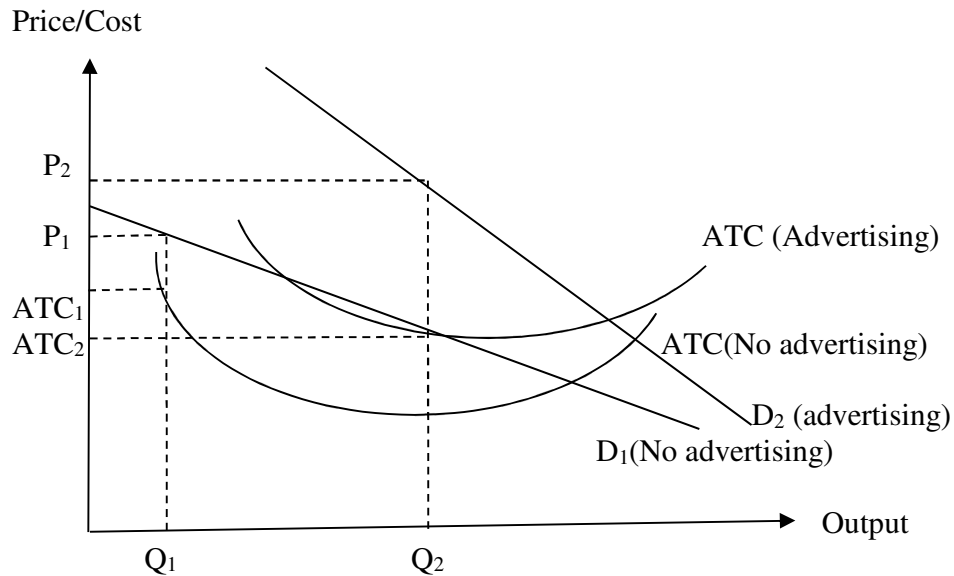
In Figure 10.10, initially the firm did not advertise and has a small market share at Q_1 . To produce Q_1 , the average total cost is ATC_1 . When the firm advertise, the ATC increases and the ATC curve shift upwards. But the larger number of customers will increase the market share of the firm, resulting in a larger quantity of output produced at Q_2 . This will reduce the average total cost of production to ATC_2 .

5.3 Total Effect of Advertising

Combining the effects on demand and cost, the total effects of advertising is profit enhancing if the demand effect exceeds the cost effect.

Refer to Figure 10.11. Without advertising, the average total cost is ATC_1 . The firm's demand curve is D_1 , the corresponding marginal revenue curve is MR_1 . At the optimal output Q_1 , the profit is $(P_1 - C_1) \times Q_1$.

Figure 10.11: Total Effect of Advertising



With advertising, the ATC increases and ATC curve shift up. But the greater and more inelastic demand at D_2 resulting in a larger quantity produced at Q_2 , allows the firm to charge a higher price P_2 and incur a lower average total cost ATC_2 . Hence the profit with advertising is $(P_2 - ATC_2) \times Q_2$, larger than the original profit without advertising.

Besides the direct effects of advertising, advertising also has an indirect signalling effect to enhance the benefits of the firms. A signal is an effort to inform another party of a specific message. Firms tend to use advertising to not just to notify the public but also to signal the quality of the products. The perception of customers is that if a firm is willing to incur high costs to advertise its products, the firm must be confident of the quality of its product. Hence the consumers will be more confident to try out the product.

However, just like any other differentiation method, the benefits of advertising is also short term. In the short run if a firm advertise and other the other firms did not, the firm that advertised will have a larger demand for its product and the demand is also more inelastic. Its mark up and profit will increase. But in the long run other firms will know that advertising is profits enhancing. They firms will also imitate the method to advertise their products. When all firms advertise, the original firm will have lower demand and more substitutes for its products. The original's firm's demand curve shifts left and become flatter until it breaks even in the long run.

6 Illustration Questions

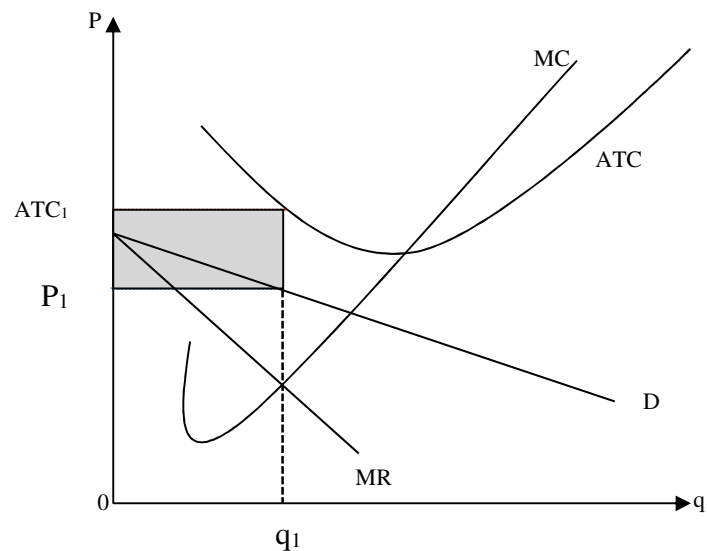
There are many small bakers in the bakery industry serving a large number of customers. Each of the baker produce slightly different bakery products and it is easy to set up a bakery store in the industry. However, there are too many bakers compete for too few customers and hence all bakers are incurring losses.

(a) What type of market structure fits the description of the bakery industry? Draw a diagram to illustrate the short run equilibrium of a bakery store in the industry

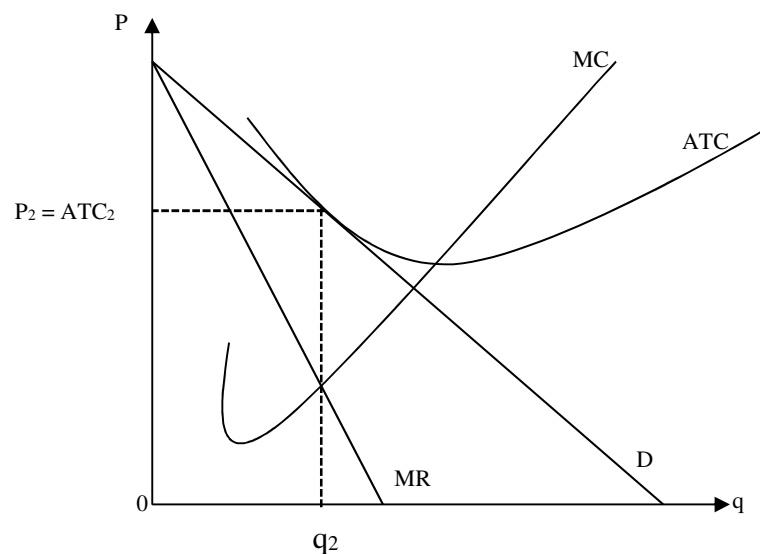
(b) What will happen to the price, output and profit of this store in the long run? Explain with a suitable diagram.

Answers:

(a) This type of market structure fits into monopolistic competition. Students should draw a diagram with downward sloping demand curve, downward sloping MR curve below the demand curve, together with a U-shaped ATC curve and a U-shaped MC curve with MC intersects the minimum point of ATC from below. At the optimal output where $MR = MC$, price must be lower than ATC (but higher than AVC) to indicate a loss. Refer to the diagram below



(b) Refer to the diagram below.



In the long run, there will be firms leaving the industry. This will lead to the more customers and less substitutes for the existing firms, resulting in their demand curve shifts right and also become steeper. The existing firm will be able to produce more output and charge a higher price. The process continues until all firms break even at the optimal output at equilibrium.

7 Discussion Questions

Question 1

Is a monopolistically competitive firm productively efficient?

- (A) No, because price is greater than marginal cost.
- (B) No, because it does not produce at minimum average total cost.
- (C) Yes, because it produces where marginal cost equals marginal revenue.
- (D) Yes, because price equals average total costs.

Question 2

If a monopolistic competitive firm produces at an output level where Marginal Revenue is higher than Marginal Cost, what should it do?

- (A) It should produce more.
- (B) It should raise its price.
- (C) It should produce less.
- (D) It should keep output the same.

Question 3

Monopolistic competitive firms have some market power because of

- (A) free entry and exit of firms in the industry
- (B) the firms have product differentiation.
- (C) the firms have a small market shares
- (D) the firms are interdependent.

Question 4

When comparing perfect competition and monopolistic competition, we find that

- (A) firms in monopolistic competition produce identical products just as do firms in perfect competition.
- (B) firms in monopolistic competition face barriers to entry, unlike firms in perfect competition.
- (C) advertising plays a large role in monopolistic competition, unlike in perfect competition.
- (D) firms in monopolistic competition are price takers just as is the case for firms in perfect competition.

Question 5

Monopolistic competition differs from monopoly because in monopolistic competition

- (A) there are many firms.
- (B) there are no close substitutes for each firm's product.
- (C) the firms compete only on price.
- (D) there are barriers to entry.

Question 6

The industry producing laptops has many producers producing a wide variety of laptops with many possible configurations. A particular laptop producer has discovered a new technology that enables the entire laptop to be collapsible into a small cube. Cubist – the new product – has garnered rave reviews and became an instant hit with the consumers.

- (a) Explain, with the help of a suitable diagram, the short-run equilibrium of this producer selling Cubist.
- (b) Using a new diagram, explain how this short run situation will evolve in the long-run.

Question 7

Discuss the effects of advertising to a monopolistic competitive firm. Under what situations it will not be attractive for the firm to advertise its products?

MICROECONOMICS

SESSION 11

OLIGOPOLY

At the end of the session, students should be able to:

1. Define and identify oligopoly
 2. Explain the Kinked Demand Curve Model
 3. Use game theory to explain how price and output are determined in oligopoly
 4. Define a prisoner's dilemma game
 5. Use game theory to explain other strategic decisions
-

1. Introduction

In this session, we begin with a definition to the market structure oligopoly, which means a few firm in the market with interdependency among the firms. Next, we introduce the kinked demand curve model based on the assumption that firms match each other in price cutting but not price increases. Then we introduce the concept of game theory to analyze strategic behaviour among firms in decision making. We also analyze one type of game, known as prisoner's dilemma game where the equilibrium leads to inferior outcomes for the players.

2. Oligopoly

In an oligopolistic environment, there are a few large firms in the industry such that the optimal position of one firm often depends on the decision made by the other firms. This has resulted in many models in the oligopoly. The common examples of oligopoly are the petrol market and the banking industry where there is usually more than one firm but not many firms in these markets.

2.1 Characteristics of Oligopoly

The characteristics of oligopoly are as follows:

- (1) A few large firms

There are only a few large firms in the oligopoly and thus each firm has a large market share. This means when one firm makes decision, the decision will not only affect its situation but also has an impact on the other firms. The number of firm is not specific, it can be two firms (known as duopoly) or several firms but not many firms.

(2) Standardized or Differentiated Product

The firms may be selling standardized or differentiated product or services. For example, in the banking industry, the service is quite standardized. A borrower is only concern about the lending rate and it usually does not matter which banks a borrower approach to borrow money. However, the banks may also provide differentiated services by having different criteria in granting loans and also efficiency in the services.

(3) Interdependency among the firms

The most important characteristics for oligopoly is the interdependency among the firms. Since each firm has a large market share, a firm's decision will inevitably affect the others since consumers will always search for the highest value in purchasing. For example, when one bank reduces its interest rate, consumers will likely switch to this bank and the other banks will be forced to respond by also lowering their interest rates so as not to lose sales. Likewise when one firm raises its price, it may increase the revenue of the other firms. It is this interdependency among the firms that create many outcomes in an oligopolistic environment.

2.2 Oligopolistic Models

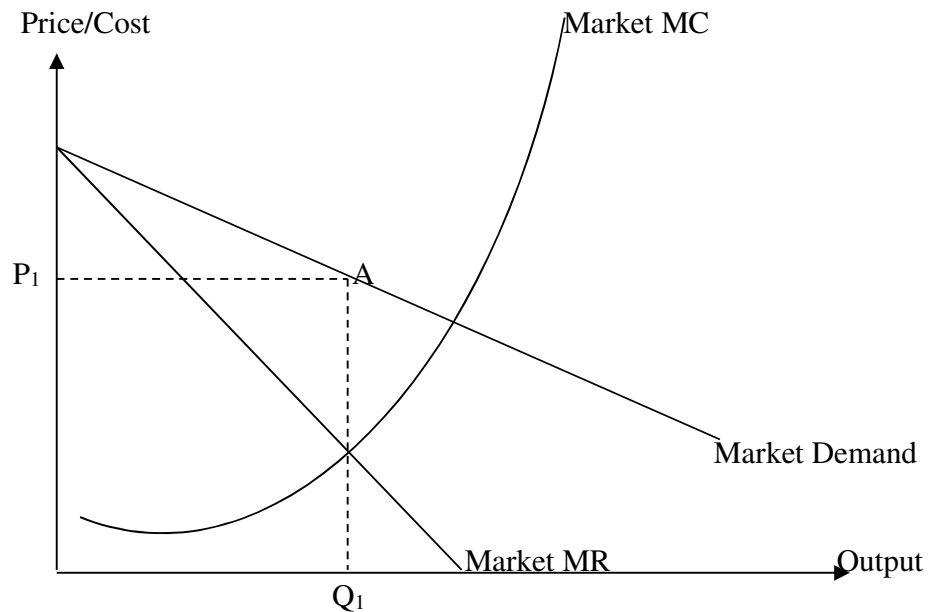
As mentioned in Section 2.1, there are many outcomes in oligopoly. For example, the few firms in the oligopoly can choose head to head competition and the outcome will be similar to perfect competition. Alternatively, the firms may agree to collude to reduce output and charge a higher price so that the outcome will be similar to monopoly.

Firms that engage in head to head competition will be engaged in a vicious circle of price cutting which benefits the consumers at the expense of the firms. Eventually the firms will discover that it is better to have a more orderly environment for competition and will work towards having more cooperation in the competition. This may take the form of a price-leadership model where one firm act as the leader to set the price and the other firms just follows.

The extreme case of cooperation will be a form of collusion where all the firms agreed to collude and behave like a monopolist. A formal collusion is known as a cartel where all the members agree to a certain quota of output in order to set the price at the optimal level. An example of a cartel is the Organisation of Petroleum Exporting Countries (OPEC). The OPEC comprises of the world major oil producers, mainly in the Middle east region such as Saudi Arabia, Kuwait and Qatar, which control about 60% of the world oil output. Periodically, the member countries will meet to decide on a quota output for each country. If OPEC reduces the quota output for each member country, the decrease in the world oil output will increase the world oil price, resulting in high revenue and profit for each member country.

In a cartel, all the firms' individual demand curves will form the market demand curve, all their marginal revenue curves will form the market MR curve and all their individual supply curve (MC curve) will form the market MC curve. The effect of a cartel in oligopoly is shown in Figure 11.1.

Figure 11.1: Cartel in Oligopoly



The profit maximizing output level for the market is Q_1 where the market MR curve intersects the market MC curve. The corresponding market price is P_1 . Thus all the firms must agree to a specific quota such that their aggregate output is Q_1 , and all the firms must agree to sell their product at P_1 . The problem with a cartel is the difficulty to sustain if the allocated quota for each member is below their maximum capacity. Individual members may be tempted to cheat by producing more than their allocated quota in order to earn more profit at the current price P_1 . But if all members were to produce more, the increase in supply will push down the market price and eventually all members will earn lower profit.

3 Kinked Demand Curve Model

There are many models in the oligopolistic environment. Depending on the assumptions of interdependency among the firms, there will be different outcomes for different models. In this course, we only discuss two oligopolistic models; the kinked demand curve model and the game theory model. We discuss the kinked demand curve model in Section 3 and the game theory model in Section 4.

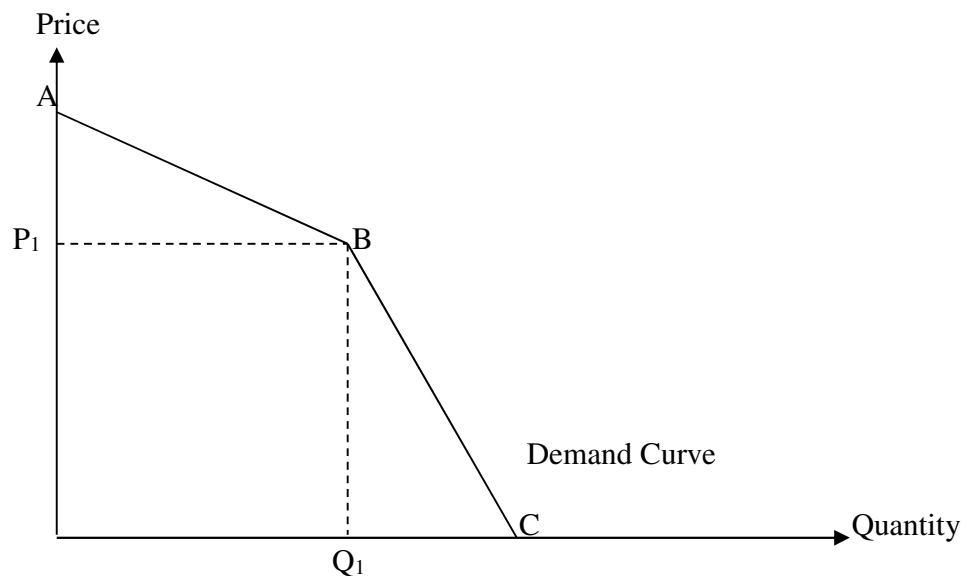
3.1 Assumptions of the Kinked Demand Curve Model

The assumption of the kinked demand curve model is that when one firm reduces its price, the other firms will follow. But when the firm increases its price, the other firms will not follow. This is because when one firm reduces its price, consumers will be attracted to this firm's product. The other firms will be losing customers to this firm and will earn a lower revenue and profit. Thus the other firms will have to reduce their own prices in order to retain consumers. But when this firm raise its price, its consumers will switch to the other firms. The other firms will encounter higher demand and can earn higher revenue and profit by retaining their original prices. This will give rise to the demand curve for the firm having two portions with different slope and a corner or kink in the centre, thus called the kinked demand curve.

3.2 Demand and MR Curves in the kinked Demand Curve Model

The assumptions of firm matches each other in price cutting but not price raising give rise to a kinked demand curve ABC for a typical firm, as shown in Figure 11.2.

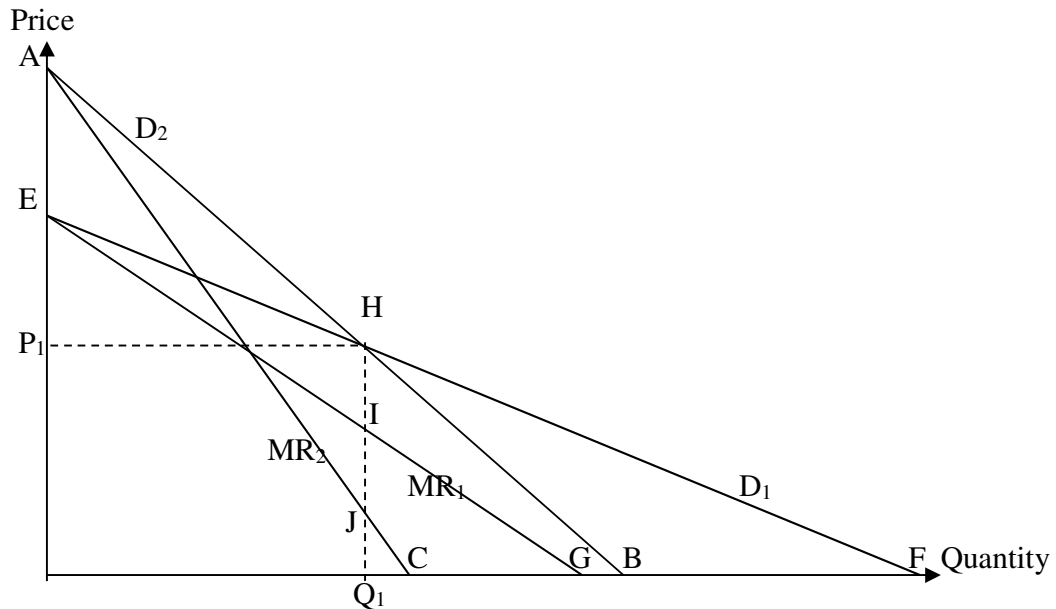
Figure 11.2: Kinked Demand Curve



Consider a firm in an oligopolistic environment fulfilling the assumptions of a kinked demand curve model. Assume that initially the price is P_1 and the quantity demanded for this firm output is Q_1 . If this firm raises its price, the other firms will not follow. The firm will encounter a large decrease in quantity demanded when price increases and its total revenue will decrease. Thus for the portion above P_1 the demand curve will be elastic. If this firm reduces its price, the other firms will follow. The firm will encounter only a small increase in quantity demanded when price decreases and its total revenue will decrease. Thus for the portion below P_1 the demand curve will be inelastic. There is a kink at point B that connects the two portions of the demand curve at price P_1 .

Recall that if the demand curve is linear, the MR curve is also linear, has the same Y-intercept but twice the slope of the demand curve. Figure 11.3 shows two demand curves with different slopes and their corresponding marginal revenue curves.

Figure 11.3: Two Demand and MR Curves



In Figure 11.3, consider two demand curves D_1 and D_2 , where D_1 is flatter or more elastic than D_2 . Their corresponding MR curves are MR_1 and MR_2 respectively. Assume that an oligopolistic firm is initially operating at point H, producing a quantity Q_1 and charges a price P_1 . We can view D_1 and MR_1 as the demand and marginal revenue curve for one firm, say Firm A, and D_2 and MR_2 as that for another firm, Firm B. A firm in the kinked demand curve model will have elements of both firms' demand and MR curves.

If this firm were to increase its price, the other firms will not match the price increase. Thus the firm will lose many customers and earn a lower total revenue. The demand will become elastic and the demand curve follows the flatter D_1 curve and the MR curve follows MR_1 . Thus for prices higher than P_1 , the relevant portion of the demand curve is EH and that of the MR curve is EI.

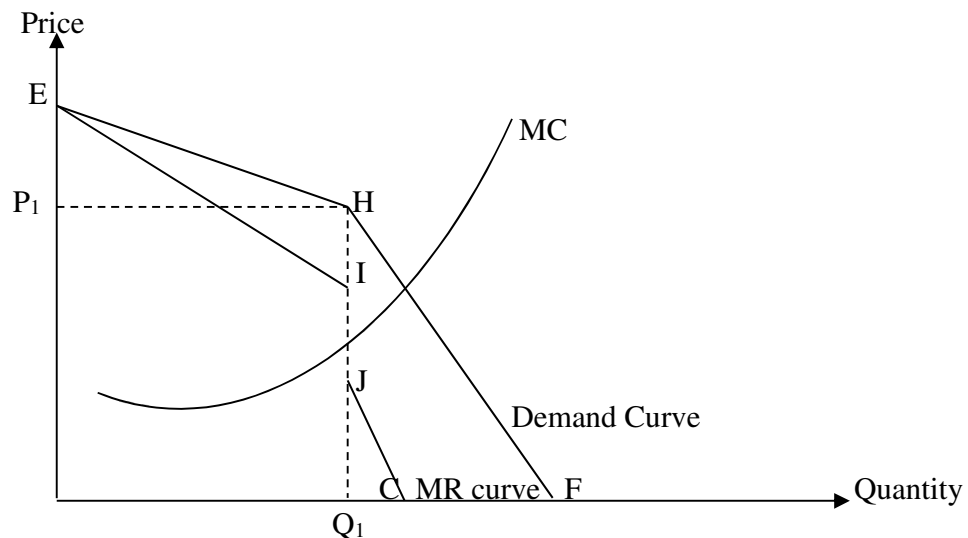
If this firm were to decrease its price, the other firms will match the price decreases. Thus the firm will not gain many customers and it will still earn a lower total revenue. The demand will become inelastic and the demand curve follows the steeper D_2 curve and the MR curve follows MR_2 . For prices lower than P_1 , the relevant portion of the demand curve for the oligopolistic firm is HB and that of the MR curve is JC.

We can combine the relevant portion of the demand curve and the MR curve to derive the kinked demand curve with a discontinuity or a gap in the MR curve. This will be discussed in Section 3.3

3.3 Derivation of the Kinked Demand Curve

Retaining the relevant portion of the demand curves and the marginal revenue curves, we have the corresponding to the kinked demand curve model as shown in Figure 11.4. There is a kink at the demand curve at point H and there is a gap IJ in the MR curve, as shown in Figure 11.4.

Figure 11.4: Kinked Demand Curve Model



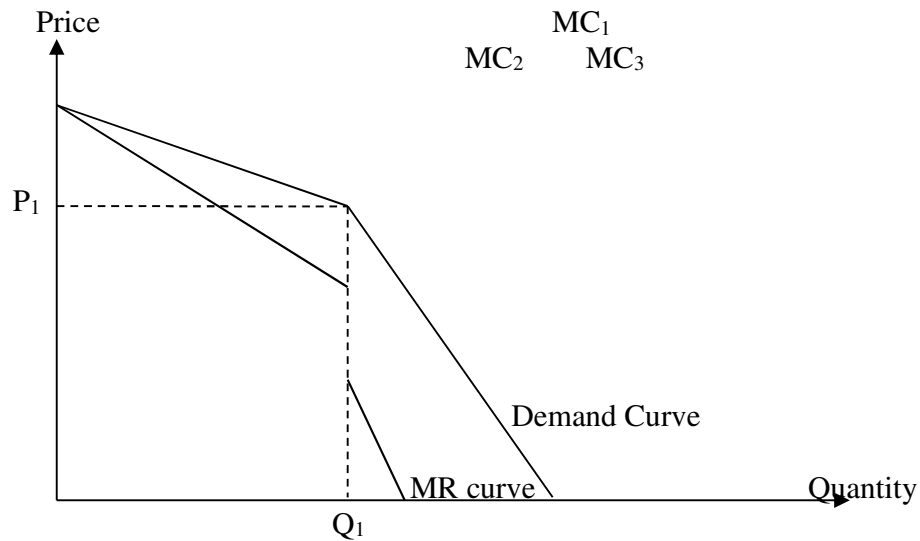
With the kinked demand curve ABC, the MR curve is ADEF, with a gap DE. The upper portion of MR curve follows the demand curve AB with twice the slope, while the lower portion of MR curve EF follows the demand curve BC, again with twice the slope. There will be a gap at the output level Q_1 .

3.4 Price stability in the Kinked Demand Curve Model

Due to the gap in the MR curve, even a change in MC of the firm will not affect the optimal output $MR = MC$, and hence the firm will have no incentive to change the price. This is shown in Figure 5.8

Assume that initially the marginal cost is MC_1 and the firm's optimal output is Q_1 where $MR = MC$. The firm will set the price at P_1 . If the MC were to increase to MC_2 or decrease to MC_3 , the optimal output is still Q_1 and hence there is no incentive to change the price P_1 . In fact, regardless of price increase or price decrease, the firms will earn a lower total revenue. The firm will have incentive to sell at the current price P_1 and produces at the current quantity Q_1 . There is price stability in the kinked demand curve model.

Figure 5.8: Price Stability in Kinked Demand Curve Model



4.3 Game Theory Model

In the game theory model, we assume that there are two players and each player has two strategies. When each player adopts a specific strategy, it will result in a joint outcome for both players. Thus one player's outcome is dependent on its own action and also the action of the other player. There will be in total 4 possible outcomes. The objective of the game theory model is to establish the solution of the game by considering the possible actions of the other player.

For example, consider two firms, Alpha and Beta, selling differentiated cars. Each firm is contemplating whether to increase their prices or reduce their prices. If both firms raise their prices, each can earn \$3 million of profit. If both lower their prices, each can earn \$5 million profit. If one firm raise its price while the other firm reduces its price, the firm that raise its price will suffer a loss of \$2 million, while the firm that reduces its price will earn \$10 million profit.

There are in total 4 outcomes in this game. They are (1) both Alpha and Beta increase prices, (2) both Alpha and Beta reduce prices, (3) Alpha increases price while Beta reduces price and (4) Alpha reduces price while Beta increases price. Each outcome will have a different payoffs for the two players.

These 4 outcomes and their respective payoffs for each player can be expressed in a payoff matrix as shown in Table 11.1. The objective of the game theory is to predict which outcome(s) will appear as the solution in this game. There are different methods to solve for the game and the method we used in this course is the Nash equilibrium method.

Table 11.1: Payoff Matrix of Alpha and Beta

		Beta	
		Raise Price	Reduce Price
Alpha	Raise Price	Alpha = \$3m Beta = \$3 m	Alpha = -\$2m Beta = \$10m
	Reduce Price	Alpha = \$10 m Beta = -\$2 m	Alpha = \$5 m Beta = \$5 m

5.4 Nash Equilibrium

The method to solve the game theory model is to establish the Nash equilibrium in the game. Nash equilibrium refers to the consistent strategies adopted by each player, given the decision of the other player.

Consider Alpha making decision giving Beta's action. Assuming that Beta raises price, Alpha can raise price to earn \$3 million or reduce price to earn \$10 million. Alpha will choose to reduce price. Now assume that Beta reduces price. Alpha can raise price to incur a loss of \$2 million or reduce price to earn \$5 million. Alpha will choose to reduce price in this situation.

Next we consider Beta making decision giving Alpha's action. Assuming that Alpha raises price, Beta can raise price to earn \$3 million or reduce price to earn \$10 million. Beta will prefer to reduce price. Now assume that Alpha reduces price. Beta can raise price to incur a loss of \$2 million or reduce price to earn \$5 million. Beta will again choose to reduce price in this situation.

Thus the Nash equilibrium in this game is that both players will reduce price, and both firms will earn a profit of \$5 million.

Note that in this game, Alpha and Beta discovered that regardless of the strategies adopted by the other player, it is always better off for the company to adopt the strategy of reducing price. Thus reducing price is a dominant strategy for both Alpha and Beta and raising price is a dominated strategy for both players.

A dominant strategy refers to one that gives the player a better outcome regardless of the strategies adopted by the other player. In contrast, a dominated strategy refers to one that gives the player an inferior outcome regardless of the strategies adopted by the other player. If there is a dominant strategy in a game, a player will always adopt the dominant strategy.

Note that if there are only two strategies for the players, if one strategy is the dominant strategy the other strategy will be the dominated strategy.

5 Prisoner's Dilemma Game

One type of the game theory model is known as prisoner's dilemma game. This type of game originates from two prisoners making decision whether to confess or not confess to a certain crime. The details are discussed below.

5.1 Prisoner's Dilemma: An Illustration

Consider two persons, Andrew and Bobby, who are arrested for simple theft. The punishment for simple theft is one year imprisonment. They are suspected to be involved in some robbery cases which carry punishment of 5 years imprisonment. However, there is no evidence to proceed with the robbery charges unless they confess in the court. If one party confess and the only deny, the party that confess is deemed to be remorseful and the court will release him after a stern warning. The party that deny will be punishment severely by 10 years imprisonment.

Both prisoners are aware of the various punishments but they are kept in separate cells with no communications among themselves. They will have to decide whether to confess or not confess when they appear in court. The 4 outcomes are both Andrew and Bob confess, both deny, Andrew confesses but Bob denies and Andrew denies but Bob confesses. These 4 outcomes are expressed in a payoff matrix as shown in Table 11.2

Table 11.2: Prisoner's Dilemma Game

		Bob	
		Confess	Deny
Andrew	Confess	Andrew = 5 years Bob = 5 years	Andrew = 0 year Bob = 10 years
	Deny	Andrew = 10 years Bob = 0 year	Andrew = 1 year Bob = 1 year

Using Nash equilibrium, consider Andrew making decision giving Bob's action. Assume that Bob confess, Andrew is better off confessing since 5 years is better than 10 years. But if Bob deny, Andrew is also better off confessing since 0 year is better than 1 year. Thus the dominant strategy of Andrew is to confess.

Now consider Bob making decision giving Andrew's action. Assume that Andrew confesses, Bob is better off confessing since 5 years is better than 10 years. But if Andrew denies, Bob is also better off confessing since 0 year is better than 1 year. Thus the dominant strategy of Bob is also to confess.

Thus the Nash equilibrium in this game is that both players will confess and both will get 5 years imprisonment. However, this is not the best outcome. In fact, if both were to deny, both will end up with only 1 year imprisonment which is better than 5 years. This is a game where the Nash equilibrium did not give rise to the optimal situation for both players. This type of game is known as the prisoner's dilemma game.

A prisoner's dilemma game occurs when the Nash equilibrium results in an inferior outcome. There exists another outcome which is better for both players compared to the Nash equilibrium outcome in a prisoner's dilemma game.

5.2 Overcome Prisoner's Dilemma

To overcome the prisoner's dilemma, there must be cooperation or collusion among the players to stick to a specific strategy. For this collusion to hold there must be reward for cooperation and punishment for non-cooperation. This will require the game to play more than once.

If the game is only played once, there will be no punishment for violating the agreement and both players will have incentive to cheat. Only if a game is played repeatedly that the player will know that non-cooperation will invite retaliation from the other player in the subsequent games which will result in long term loss and hence the players are willing to cooperate.

6 Illustration Questions

Question 6

The pay TV market in Country S is controlled mainly by two very large providers: Singsong and Starcup.

Each firm has to decide on a high or low price to charge for its sports package. If both firms set high prices, both will be able to earn an extra \$5 million profit per month. However, if both firms set low prices, each will be able to earn only an extra \$3 million profit per month. But if one firm sets a low price while the other sets a high price, the firm setting a low price will be able to gain more customers and market share at the expense of the firm that sets a high price, thus earning \$8 million per month. However, the firm setting the high price will make losses of \$2 million per month due to lost market share.

- (a) Construct the payoff matrix for the two players.
- (b) Solve for the Nash equilibrium. Explain if this is a prisoner's dilemma game.

Suggested answer:

(a) The payoff matrix is as follows. The payoffs are in millions and in the form of (Singsong, Starcup). This means the left value in the bracket is for Singsong while the right value is for Starcup.

		Starcup	
		High Price	Low Price
Singsong	High Price	(\$5, \$5)	(-\$2, \$8)
	Low Price	(\$8, -\$2)	(\$3, \$3)

(b) The process of solving for the Nash equilibrium are as follows:

Assume Singsong will offer High Price. In this case, Starcup will choose to offer a Low Price. Now assume Singsong will offer a Low Price. Starcup will now compare -\$2m versus \$3m and choose to offer a Low Price. Starcup has a dominant strategy for low price.

Assuming Starcup will offer a High Price. Singsong will choose to offer a Low Price to earn \$8m instead of just \$5m. Lastly, assume Starcup will offer a Low Price and Singsong will choose to offer a Low Price by comparing -\$2m versus \$3m. Singsong also has a dominant strategy for Low Price.

Thus the final Nash equilibrium is for both firms to set a Low Price.

This is a prisoners' dilemma game as the optimal situation for both of them is to both offer only a High Price and earn \$5m each but the Nash equilibrium derived shows them both ending up in a sub-optimal situation offering a Low Price each.

7 Discussion Questions

Question 1

A game in which each player adopts its dominant strategy _____.

- (A) will always result in prisoner's dilemma.
- (B) will not lead to an equilibrium.
- (C) could result in a Nash equilibrium.
- (D) can never result in a Nash equilibrium.

Question 2

When does a duopoly market encounter a Prisoner's Dilemma game?

- (A) When its Nash Equilibrium outcome is not equal to the best outcome for both firms combined.
- (B) When both firms break the law.
- (C) When neither firm has a dominant strategy.
- (D) When one of the firms has a side-contract with the Police Force.

Question 3

The kinked demand curve occurs because

- (A) firms match both price decreases and price increases
- (B) firms match price decreases but not price increases
- (C) firms match price increases but not price decreases
- (D) firms set price independently from each other

Question 4

A cartel is an arrangement

- (A) to flood the market and eliminate competition.
- (B) to steal industrial processes from rival firms.
- (C) by the government to restrict imports.
- (D) among firms to decrease output and raise price.

Question 5

In the kinked demand curve, the MR curve

- (A) also has a kink
- (B) is upward sloping
- (C) has a gap at the point below the kink of the demand curve
- (D) is flatter than the demand curve

Question 6

There are three banks in a city state, DMB, OGB and UIB. They all offer loans to individuals and companies and charge the borrower interest rate. It is discovered that DMB reduces the loan interest rate, the other 2 banks will also cut their loan interest rate. But if DMB increases its loan interest rate, the other 2 banks will keep their existing loan interest rate unchanged.

- (a) Which market structure describes the banking industry in the city state and which model is consistent with the behaviour of DMB, OGB and UIB in the banking industry? Analyze this model and support your answers with a suitable diagram.
- (b) What is the reason that all three banks will charge about the same interest rate and the interest rate tends to remain unchanged in the banking industry?

Question 7

NOTLINE and NOTWHATSAPP are the only 2 messaging app companies in Singapore. Between them they service all the messaging customers, and have now decided to charge customers for sending text messages on their apps (a terrible news for consumers but they have no choice as they are addicted to sending text messages).

- (i) If both companies charge \$1 per message, each will earn \$15 billion in profit
- (ii) If both companies charge \$0.10 per message, each will earn \$1 billion in profit.
- (iii) If NOTLINE charges \$1 per message while NOTWHATSAPP charges \$0.10 per message, NOTLINE will suffer a \$2 billion loss while NOTWHATSAPP will earn \$25 billion.
- (iv) If NOTLINE charges \$0.10 per message while NOTWHATSAPP charges \$1 per message, NOTLINE will earn \$25 billion in profit while NOTWHATSAPP will lose \$2 billion.
- (a) Construct a pay-off matrix for the situation described above.
- (b) Solve for the Nash Equilibrium, stating each company's strategy and payoff.
- (c) Is this a Prisoner's Dilemma game? Why?

MICROECONOMICS

SESSION 12

EXTERNALITIES AND THE ENVIRONMENT

At the end of the session, students should be able to:

1. Explain how externalities arise
 2. Explain why negative externalities lead to inefficient output levels (overproduction) and how property rights, emission charges, marketable permits, and taxes can be used to achieve a more efficient outcome
 3. Explain why positive externalities lead to inefficient output levels (underproduction) and how public provision, subsidies, vouchers, and patents can improve economic efficiency
-

1. Introduction

In this session, we begin with the definition of externalities and introduce two types of externalities, the positive externality and the negative externality. Next we analyze the effects of negative externality, explain why the market is inefficient in the presence of negative externality, and discuss the methods to rectify negative externality in the market. Finally, we analyze the effects of positive externality, explain why the market is inefficient in the presence of positive externality, and discuss the methods to rectify positive externality in the market.

2. Market Efficiency and Market Failure

We have learnt that resources will be fully and efficiently allocated when market forces are allowed to operate freely. In the absence of government intervention, the demand and supply forces will ensure that all resources are allocated to their highest value of use, and hence the society will achieve the highest level of welfare. However, there are situations where market forces fail to allocate resources efficiently. This is known as the market failure. There are other ways to allocate resources that will lead to higher social welfare, instead of relying on the price mechanism to allocate resources in the market system.

2.1 Marginal Private Benefit and Cost Analysis

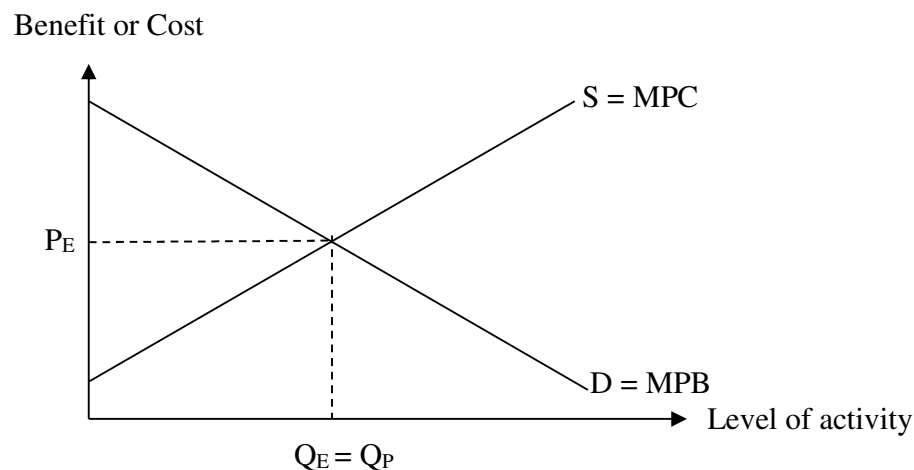
Market forces allocate resources based on the agent's perception of marginal benefit and marginal cost. Marginal benefit is the benefit received by the agent when one more unit of activity is operated. Marginal cost is the cost incurred by the agent to implement one more unit of the activity.

Consider a production or consumption activity. The first unit of the activity usually incurs a low cost but gives a lot of benefit to the agent. But when the scale of activity increases, each subsequent unit will provide less and less benefit but incur higher and higher cost. Thus the marginal benefit curve is downward sloping and the marginal cost curve is upward sloping.

In a market, the marginal benefit arises out of consuming a product available in the market. The benefits to the individual consumers are measured by their willingness to pay, reflected as prices in the market demand curve. Since the benefits are enjoyed solely by the consumers individually, the demand curve is also the marginal private benefit (MPB) curve in the society. In a similar context, the cost to the individual producers are measured by their willingness to sell, reflected as prices in the market supply curve. Since the costs are incurred solely by the individual producers, the supply curve is also the marginal private cost (MPC) curve in the society.

The market forces will allocate resources to the point at the market equilibrium where the demand curve intersects the supply curve. This is also the point where the marginal private benefit curve intersects the marginal private cost curve. At this point, the level of activity is the optimum and resources are allocated most efficiently. If the level of activity is lower, the agent did not maximize his welfare. But if the level of activity is higher, the agent can be better off by reducing the level of activity. The marginal private benefit and marginal private cost curve is shown in Figure 12.1

Figure 12.1 Marginal Private Benefit and Cost Curves



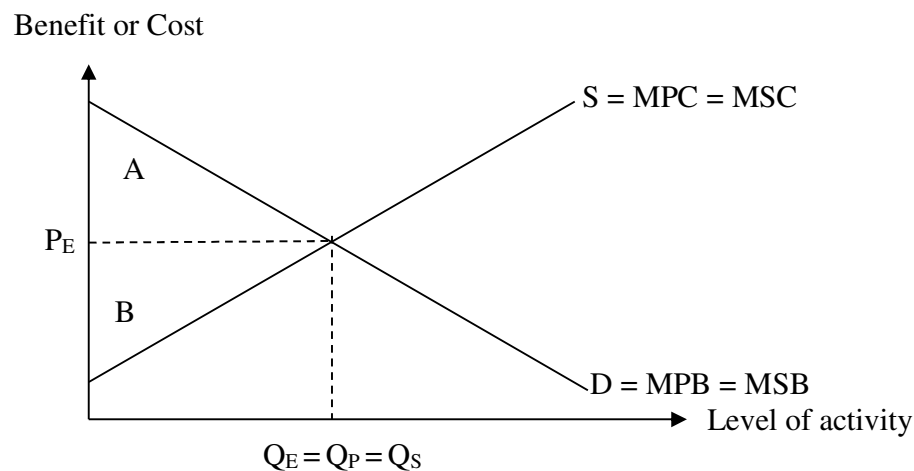
Under free market, the price will be at equilibrium at P_E . All agents will follow their private benefit and cost analysis to produce and consume up to the market equilibrium quantity Q_E .

This quantity also corresponds to the level where marginal private benefits equal marginal private cost, which is considered as the private optimal quantity Q_P . The individuals will maximize their own welfare under the market system.

2.2 Marginal Social Benefit and Cost Analysis

If in the entire society, only consumers receive benefits from consuming a product in the market, the marginal private benefit will be the same as the marginal social benefit (MSB). In the same context, if in the society, only the producers incur cost when producing the product in the market, the marginal private cost is the same as the marginal social cost (MSC). In this case the market equilibrium quantity which is the private optimal quantity will also be the social optimal quantity. This is shown in Figure 12.2.

Figure 12.2 Marginal Social Benefit and Cost Curves



In Figure 12.2, the social optimal quantity Q_S occurs when marginal social benefit equals marginal social cost. If there is no external parties outside the consumers or producers that enjoy benefits or incur costs from this product, the social optimal quantity will be the same as the private optimal quantity Q_P , which is the market equilibrium quantity Q_E .

In this situation, if resources and output are allocated using market system, the society will reach the highest level of welfare, measured by the sum of consumer surplus (Area A) and producer surplus (Area B) in the market. But if there are external parties besides consumers that enjoy benefits from the product, or external parties besides producers that incur cost from the product, then the marginal social cost will be different from the marginal private cost, and the marginal social benefit will be different from the marginal private benefit.

Consequently, using the price established under the market equilibrium to allocate resources and output will result in inefficiency. The market equilibrium level of activity will not be same as the social optimal level of activity. Specifically, the market equilibrium quantity may be higher or lower than the quantity that maximizes the welfare of the society. The market produces too much or too little and hence failure occurs. There will be inefficiency and deadweight loss under the market outcome.

2.3 Market Failure and Externality

There are several ways that market failure occurs. In this session, we focus on the presence of externality that causes market failure.

Externalities refers to external benefit or external cost accompanying an activity. External cost occurs when an activity creates pollution, noise, congestion or other harmful effects to other parties who are not participating in that activity. External benefits occurs when an activity provides pleasantness, satisfaction, happiness and safety to parties who are not participating in that activity. An externality arises whenever an individual's production or consumption decision directly affects an external party outside the market system.

An individual that participate in an activity in the market does not take into account his or her actions to the others. Hence if direct costs are imposed on the others, it is an external cost as it is external to the market system. Similarly, if direct benefits are provided to the others, it is an external benefit since it is external to the market system.

Direct costs imposed on others are negative externalities and direct benefits given to others are positive externalities. There are four types of externality:

- (1) Negative production externality where a production process imposes costs on the external party. An example will be the air, water and noise pollution from factories that affect the health and living quality of non producers.
- (2) Positive production externality where a production process provides benefits to the external party. One example is the situation of honey and fruit production next to each other. The honey farmer will get to collect more honey when the bees can collect more nectar from the flowers of the fruit trees in the vicinity. The fruit farmers will get to harvest more fruits when the bees like to pollinate the flowers in the fruit trees.
- (3) Negative consumption externality where a consumption process imposes costs on the external party. An example is a smoker smoking in the public. This will impose health hazard to the non-smokers through the second hand smoke.
- (4) Positive consumption externality where a consumption process provides benefits to the external party. One example is the vaccination taken by an individual to prevent a contagious disease. The vaccination not only protect the individual from the disease but also prevent the spread of the disease to the community, thus protecting the other people in the community.

In the presence of externality, the demand and supply curves which measure the private benefit and cost did not represent the society benefit and cost correctly. This is because external benefit and costs are not considered by the market system, hence the market fails. In this module, we will focus on negative production externality and positive consumption externality. We will discuss negative externality in Section 3 and Positive externality in Section 4.

3 Negative externality

Negative externality refers to production or consumption activities that impose cost on the external parties. In this section, we focus our discussion and analysis on the negative externality arises from production.

3.1 Negative Externality: An Illustration

Consider a firm that produce useful chemicals to be used in the society. But the firm also discharges pollutant into a river during the production process. The quantity of pollutant discharged being in proportion to the level of chemical production. The pollutant has a negative effect on other people and firms that use the river.

The firm acts on its self interest. It will produce and pollute the river until the marginal private benefits of its production equals its own marginal private cost of production. It takes no account of the external marginal cost its pollution imposes on other users.

There is now a difference between the marginal private cost and the marginal social cost. The marginal private cost will consists of costs incurred by the firm to employ labour, to acquire land, machine and raw materials cost etc. But the marginal social cost will include those parties that are external to the firm but are affected by the river pollution. As such the marginal social cost is higher than the marginal private cost. Thus we have:

$$\text{Marginal Social Cost} = \text{Marginal Private Cost} + \text{External Cost.}$$

The benefit of producing chemicals is equal to the market price paid by the society to use the chemicals, which is the same as the revenue received by the firm. There is no different between marginal private benefit and marginal social benefit. Thus we have:

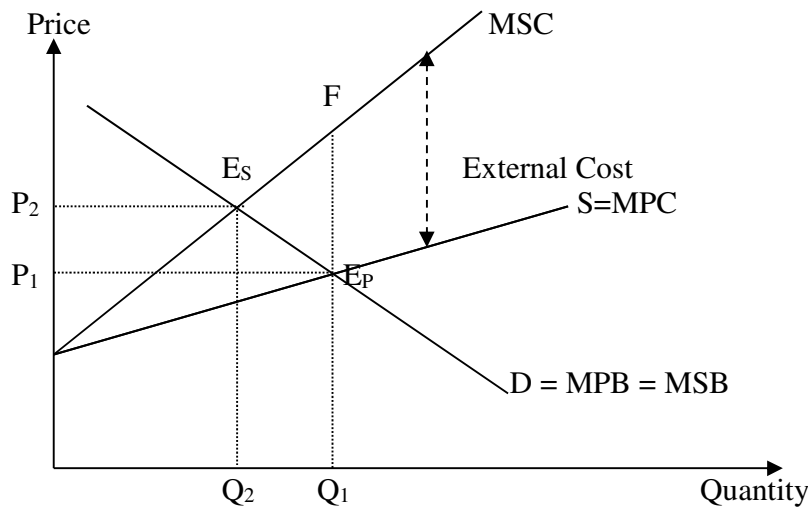
$$\text{Marginal Social Benefit} = \text{Marginal Private Benefit}$$

3.2 Implication of Negative Externality

The main implication of negative externality is that the market outcome is no longer efficient. There will be misallocation of resources using market price.

The diagram of a negative externality is shown in Figure 12.3. At small levels of chemical output, pollution is negligible and the cost imposed on the society is also negligible. But as the discharge of pollutant rises the costs of pollution rise sharply. Thus the marginal social cost (MSC) of chemical production is indicated by an upward sloping curve.

Figure 12.3: Pollution and Negative Externality



The gap between the marginal social cost and marginal private cost also increases as the quantity of chemical output increases. The divergence between marginal private cost and marginal social cost reflects the marginal cost imposed on other producers by an extra unit of the production externality of pollution that the chemical producer disregards.

The demand curve shows how much consumers are willing to pay for the output of the chemical producer. It is the marginal social benefit (MSB) of the chemical production. Since the firm receives its payment from the society, the MSB is also the marginal private benefit (MPB).

The firm's equilibrium occurs at point E_P where MPC equals MPB, its marginal private cost equals the price received by the firm for its output. The chemical producer's output is Q_1 . But at this output the marginal social cost exceeds the marginal social benefit.

The market for chemicals takes no account of the production externality inflicted on others. The output Q_1 is not socially efficient since MSB is less than MSC. By reducing the output of chemicals society would save more in social cost than it would lose in social benefit. The socially efficient output is Q_2 , where the MSB equals the MSC. The point E_S indicates the marginal social benefit of the last unit of chemical output equals its marginal social cost.

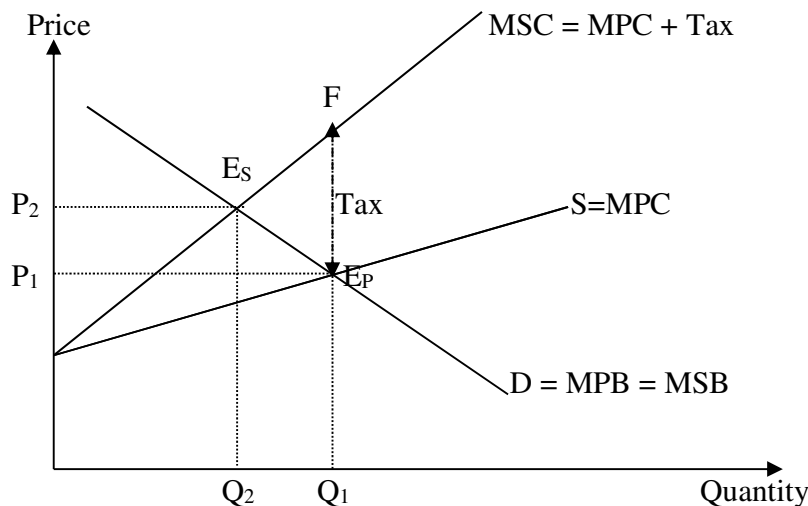
By expanding from Q_2 to Q_1 , society loses a total amount equal to the triangle $E_S E_P F$. This is the social cost of the market failure caused by the production externality of pollution and it is the deadweight loss due to the negative externality. Market forces fail to produce the social optimal output level (Q_1). In the presence of negative externality, market forces allocate too many resources to this production and produce too much of chemicals. Thus resources are not allocated efficiently.

3.3 Taxes to Rectify Negative Externality

One way to eliminate the problem of negative externality is for the government to use taxes. The government can impose a tax on the producers to increase its marginal private cost.

The tax could be designed in such a manner that the marginal private cost plus tax is exactly equals to the marginal social cost. In this case the firm will produces exactly at the point where marginal social cost intersects the marginal social benefit, and the social optimal output level is produced. This is shown in Figure 12.4.

Figure 12.4: Tax and Negative Externality



It is important to note that the tax amount must be the same as the external cost in order to make the marginal private cost plus tax equals to the marginal social cost. The market will be efficient and produce output Q_2 if this is fulfilled.

4 Positive externality

Positive externality refers to production or consumption activities that provide benefits to the external parties. In this section, we focus our discussion and analysis on the positive externality arises from consumption.

4.1 Positive Externality: An Illustration

Education is an activity that is often quoted with strong positive externality. The private benefit of education is obvious. Higher education allows an individual to perform higher value added job and earn higher income, among other prestige that comes with education. But education may also provide many benefits to others. An educated person tend to be more gracious and considerate, less likely to cut queue and damage public property, among other virtues. Hence there are benefits enjoyed by external parties besides the private benefits enjoyed by the individuals.

The suppliers need to incur cost to acquire resources, such as schools, equipment, books and hire teachers to provide education. Assume that there is no negative externality in the

production of education service. The marginal private cost incurred by the suppliers, which is the market supply curve, is the same as the marginal social cost. Thus we have:

$$\text{Marginal Private Cost} = \text{Marginal Social Cost}$$

The benefits obtained from the education consumption is reflected by the willingness to pay for the education. Thus marginal private benefit of the individual consumers consuming education can be represented by the market demand curve. However, the individual consumers do not take into account the consumption value of their education to the external parties in the society but external to the education market. The marginal social benefit MSB include those parties that did not consume education but are benefited from the educated consumers. As such the marginal social benefit is higher than the marginal private benefit. Thus we have:

$$\text{Marginal Social Benefit} = \text{Marginal Private Benefit} + \text{External Benefit}$$

The marginal social benefit will be larger than the marginal private benefit. This will result in the market equilibrium quantity is socially inefficient.

4.2 Implication of Positive Externality

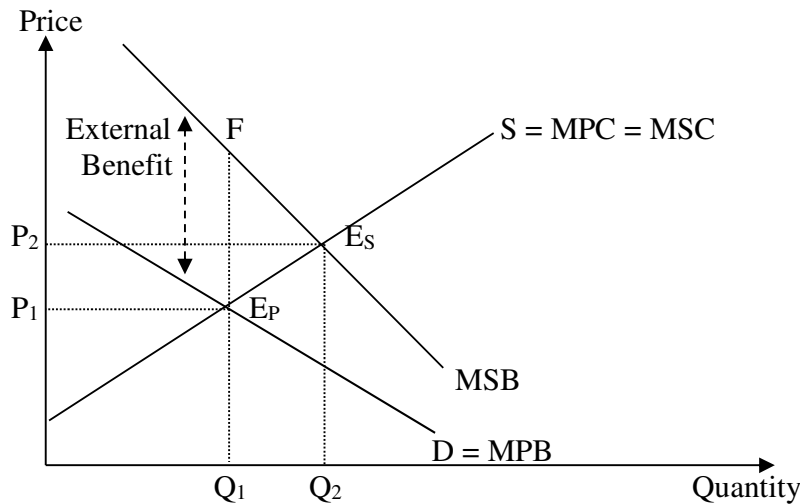
The main implication of positive externality is that the market outcome is no longer efficient. There will be misallocation of resources using market price. Consider the education market where individuals pursuing education based on their own private benefits and private costs but there is external benefit.

Just like any other products, a small quantity of education tends to generate large marginal benefits initially. But with increasing quantity of education, the marginal private benefit decreases. Thus the marginal private benefit, represented by the market demand curve, decreases as the quantity of education increases.

At a small quantity of education, the marginal private benefit as well as the external benefits generated is large. But as the quantity of education increases, both the marginal private benefit and the external benefit decreases. Thus the marginal social benefit (MSB) of education is indicated by a downward sloping curve and the gap between the MSB curve and the market demand curve decreases as the quantity of education increases.

Figure 12.5 shows the diagram of a positive externality associated with external benefits. The individual consumers compare their own marginal private benefits, represented by the market demand curve, with the marginal private costs incurred by the producers represented by the market supply curve S. The private optimal quantity is Q1 where the marginal private benefit equals the marginal private cost.

Figure 12.5: Education and Positive Externality



The gap between the marginal social benefit and the marginal private benefit is the external benefit. It decreases as the quantity of education increases because if there are already many educated consumers in the market, one more such consumer will not provide a large amount of additional benefits to the external parties.

The demand curve D shows how much consumers are willing to pay for the output of the education producer. It is the marginal private benefit (MPB) of the education consumption. Since the producers incur cost and there is no external cost, the MSC is also the marginal private cost (MPC).

The market equilibrium occurs at point E_P where MPC equals MPB, where the producer's marginal private cost equals the price paid by consumers for its output at P_1 . The equilibrium output is Q_1 . But at this output the marginal social benefit exceeds the marginal social cost.

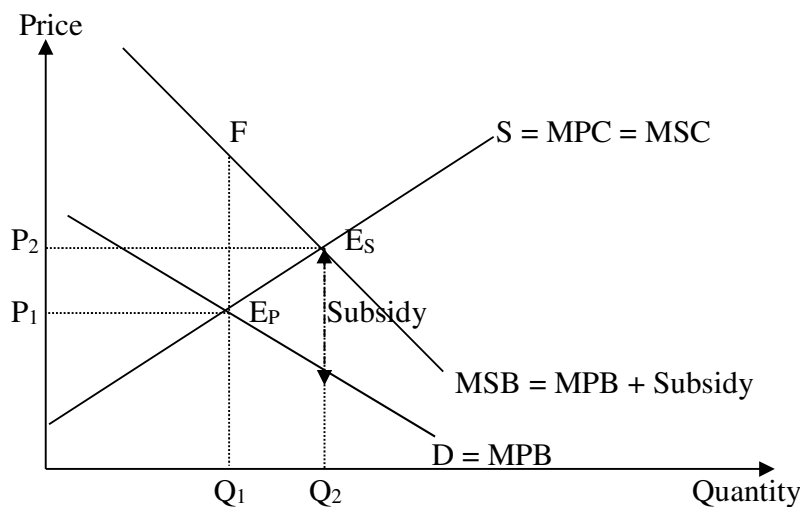
The market for education takes no account of the consumption externality enjoyed by others. The output Q_1 is not socially efficient since MSB is larger than MSC. By increasing the output of education the society would enjoy more welfare since the social benefit is larger than the social cost. The socially efficient output is Q_2 , where the MSB equals the MSC. The point E_S indicates the marginal social benefit of the last unit of education its marginal social cost.

By restricting output at Q_1 , the society loses a total amount of welfare equal to the triangle $E_S E_P F$. The loss occurs because the society would be able to enjoy the extra welfare if the quantity can increase to Q_2 . Thus the inefficiency of the market failure caused by the consumption externality of education is the deadweight loss represented by the triangle $E_S E_P F$ due to the positive externality. Market forces fail to produce the social optimal output level (Q_2). In the presence of positive externality, market forces allocate too few resources to this production and produce too little of education. Market forces will not result in this social optimal output level.

4.3 Rectifying Positive Externality

One way to eliminate the problem of positive externality is for the government to provide a subsidy. The government can provide a subsidy to the consumers, enhance their purchasing power to consume education. The subsidy could be designed in such a manner that the marginal private benefit plus subsidy is exactly equals to the marginal social benefit. In this case the market will produces exactly at the point where marginal social cost intersects the marginal social benefit, and the social optimal output level is produced. This is shown in Figure 12.6.

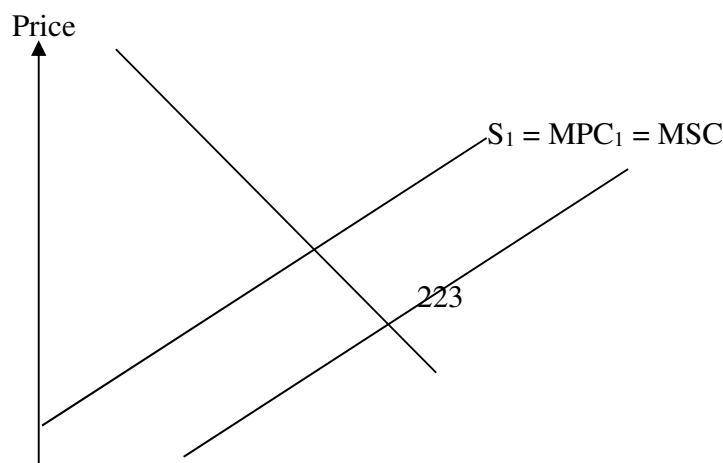
Figure 12.6: Subsidy to Consumers and Positive Externality

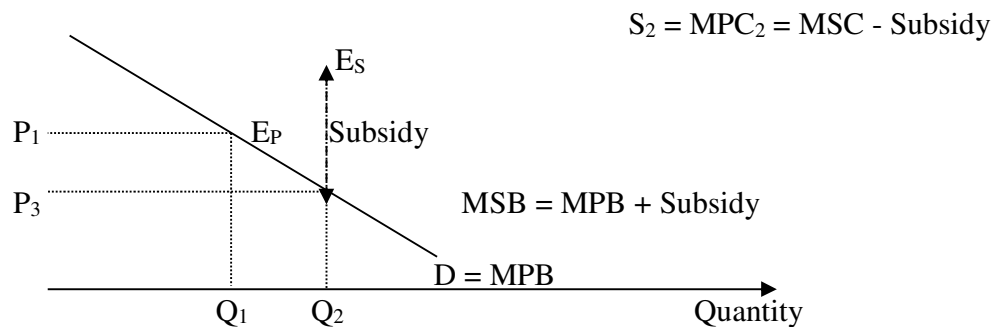


It is important to note that the subsidy amount must be the same as the external benefit in order to make the marginal private cost plus tax equals to the marginal social cost. With the subsidy, the consumers' ability to consume education has increased. They will be able to afford a higher price P_2 to induce the producers to produce the quantity up to Q_2 . The market will then be efficient to produce the social optimal quantity.

The subsidy need not be given to the consumers to increase their ability to consume more education. It can also be given to the producers to reduce the private cost of production so that the producers can produce a larger quantity of education, charge a lower price and induce consumers to consume a higher quantity of education. This is shown in Figure 12.7.

Figure 12.7: Subsidy to Producers and Positive Externality





With the subsidy given to the producers, the marginal private cost reduces from MPC_1 to MPC_2 and the supply curve shifts right from S_1 to S_2 . If the subsidy is the same as the external benefit at Q_2 , the new supply curve will be $MSC - \text{subsidy}$. The producers will produce up to quantity Q_2 and charge a lower price P_3 to entice consumers to consume a larger quantity of education up to Q_2 where social efficiency occurs.

5 Alternative Methods to Eliminate Externality

We have shown that negative externality result in too much output while positive externality results in too little output being produced. As such the society did not maximize its welfare. Besides using taxes to rectifying negative externality and subsidy to rectify positive externality, there are other methods to eliminate the problem of externality. We discuss two methods, one method involves the private party applying Coase Theorem and the other involves the government.

5.1 Coase Theorem and Property Rights

Coase theorem states that as long as bargaining costs are small, an efficient solution to the problem of externalities will be achieved by assigning property rights. Thus one method to ensure that the social optimal amount of product is produced is to assign property rights to individuals. Property rights refer to the legal right for an individual to be compensated for infringement of his right to perform certain activities.

If the chemical firm has the right to pollute the river, then the other users will have to compensate the chemical firm to reduce its output. If other users have the right to use clean river, then the chemical firm will have to compensate the other users for polluting the river. Who has the property rights determines who must compensate whom, but it does not affect the quantity that the bargain will determine. It must pay to reach the point at which the marginal benefit of one equals the marginal cost to the other.

Thus property rights have a distributional effect of who compensate whom and it also results in socially efficient allocation. They set up implicitly the missing market for the externality. The market ensures that the price equals the marginal benefit and the marginal cost.

According to Coase theorem, the government may just need to define and assign property right to individuals and provide an environment where private negotiation is easy to occur. In this case the parties involved in activities that generate externality will negotiate with each other such that the social optimal output always occur.

But establishing an externality market is not easy due to two reasons:

(1) The cost of organizing the market may be excessively high. The negative externality may affect many individuals, each having a small cost. Regardless of who has the property right, it is difficult for the firm to work out how much to compensate each individual. It is also difficult to collect a small sum from each individual to compensate the firm.

(2) There is the free rider problem. If other people pay to compensate the firm to reduce its output, an individual who did not contribute cannot be prevented from getting the benefits. Thus he becomes a free rider as there is no incentive for him to contribute. Everyone else will reason similarly and hence no one will pay.

Hence for the Coase theorem to be applicable to solve the externality problem, the following conditions must be fulfilled:

(i) Well-defined property rights - There must be a well-defined property right such that the parties involved know which party to compensate and seek compensation. It does not matter which party has the property right but it is possible that in the event that the property right belongs to the polluters, the victim may have to compensate the polluters and this is countering social justice.

(ii) Small number of parties - A small number of parties will make it manageable for the parties involve to negotiate for the social optimal outcome. It is not possible to negotiate and seek consensus if a large number of parties are involved.

(iii) Low or no transaction costs - Transaction cost refers to the time and money needed to effect a transaction. For example, when buying a house the transaction cost involves the time spent to view the house and negotiate with the sellers, the money spent to engage a property agent, the money spent to draft the legal contract and the time spent to seek a housing loan. If transaction cost is high, it may not be worth the effort of negotiation among the parties involved in an externality.

5.2 Command and Control System

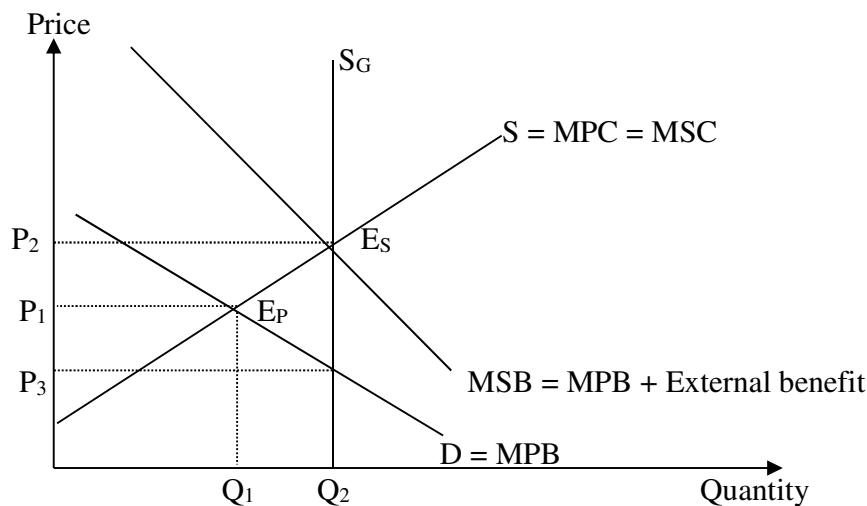
In the presence of negative externality such as pollution, one alternative method is to impose environmental charges on consumers or firms. For example, emission charges levied on firms discharging wastes and use charges to households for sewage disposal or rubbish collection.

This method is to simply enforce the social optimal output level by using rules and regulations. The government simply requires the firm to produce at the social optimal output. The requires the government to set the maximum permitted levels of emission or resource use, or minimum acceptable levels of environmental quality. The government may issue marketable permits or imposing charges for households or firms who are involved in activities that generate negative externality. Firms or households contravening these limits may be penalized with a fine.

However, the government usually has to incur the extra cost of monitoring the output of the firm or the level of pollution generated by the firm. There must be inspectors to monitor the amount of pollution, and the fines have to be large enough to deter firms from exceeding the limit.

As for positive externality, the government may simply take over the production and produce the social optimal quantity of output, financed by tax revenue. Refer to Figure 12.8 which shows the education market.

Figure 12.8: Government Supply and Positive Externality



To obtain the social optimal quantity of Q_2 , the government may appoint a public authority, such as the Ministry of Education, to supply the required quantity Q_2 via supply curve S_G using government funding. If the consumers pay the price P_3 , the government will top up the difference $P_2 - P_3$ using tax revenue.

6 Illustration Questions

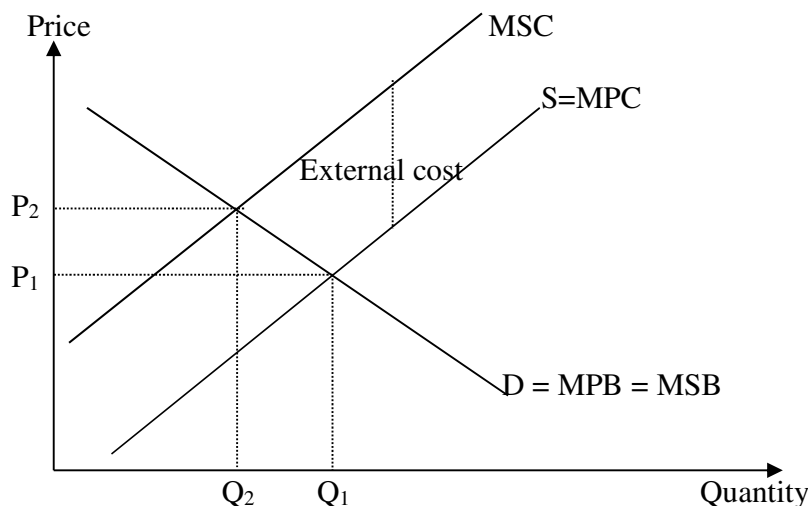
A developer is building an integrated resort with a casino at the coastal area of an island economy. However, there are concerns that the construction will damage the coral reefs at the coastal area and reducing the catch of the fishermen in the area.

(a) What type of externality occurs? Explain with a suitable diagram while the market outcome is inefficient in the presence of this externality.

(b) What can the government do to rectify this externality?

(a) This is a negative externality or external cost. Refer to the market diagram below. There is a downward sloping demand curve measuring the marginal private benefit (MPB) and an upward sloping supply curve measuring the marginal private cost (MPC). The equilibrium price and quantity is established at P_1 and Q_1 respectively.

With negative externality, there is external cost. The marginal social cost is the sum of marginal private cost and the external cost and it is higher than the marginal private cost measured by the market supply curve. The marginal private benefit is the same as marginal social benefit. Hence the social optimal quantity occurs where the $MSB = MSC$ which is Q_2 at the price P_2 . The social optimal quantity is lesser than the private optimal quantity and the market over produce.



(b) The government can impose a tax on the developer. If the tax is of the same magnitude as the external cost, then the market supply curve will raise to the same level as the marginal social cost curve. The market will produce the optimal output with the government tax imposed.

7 Discussion Questions

Question 1

According to the Coase Theorem, a condition that is needed for private transactions to be efficient is that property rights _____.

- (A) Need not be defined as long as there are no transactions costs present.
- (b) Must be defined, and it is crucial as to who owns the property.
- (C) Need to be defined by the government to avoid producers from exploiting high transactions costs.
- (D) Must be defined, but it does not matter who owns the property.

Question 2

A market generates a negative externality. In such a situation, a free market equilibrium (without government intervention) _____.

- (A) maximises producer surplus
- (B) is inefficient
- (C) is not fair to the government
- (D) is efficient

Question 3

If the market equilibrium quantity is greater than the socially optimal quantity, one can infer that

- (A) the demand curve measures the marginal social benefit.
- (B) the production of this good has a positive externality.
- (C) the production of this good has a negative externality.
- (D) the production of this good has no externality.

Question 4

Marginal social cost is equal to the

- (A) sum of marginal private cost and the external cost.
- (B) sum of marginal private cost and marginal private benefit.
- (C) marginal cost incurred by the producer of the good.
- (D) marginal cost imposed on others.

Question 5

Marginal private cost is equal to the

- (A) sum of marginal social cost and marginal external cost.
- (B) sum of marginal social cost and marginal private benefit.

- (C) marginal external cost imposed on others.
- (D) marginal cost incurred by the producer of the good.

Question 6

News Flash: “NEA is extending the smoking ban to more places with effect from 15 January 2013. The new list of smoke free areas included in the Smoking (Prohibition in Certain Places) Act extends to cover common areas of residential buildings such as common corridors, staircases, stairwells and void decks as well as multi-purpose halls, covered walkways and linkways, all pedestrian overhead bridges, within 5 metres of bus shelters and hospital outdoor compounds. Smokers who wish to smoke may do so at other areas.”

Extracted from: <http://app2.nea.gov.sg/public-health/smoking/faq-on-smoking-ban-in-public-places>

The detrimental effects of second- and third-hand smoke on non-smokers have been well documented and this was one of the reasons why the government has amended the Smoking Act to cover more areas to protect the general public.

- (a) Analyse the effects of the externality caused by smoking in public places, with the help of a suitable diagram. Explain why the market is inefficient when this externality is present.
- (b) Using Coase Theorem as a model for discussion, will the amended Smoking Act help to solve this externality problem?

Question 7

The market for BCG vaccinations is viewed as having a positive consumption externality. Children who are vaccinated also benefit their neighbours, as they have little risk of getting and spreading disease.

- (a) Assume that the government does not interfere in the BCG vaccination market. Show, on a chart, the market equilibrium in the BCG vaccination market. There is no need to show numbers on the price or quantity axes.
- (b) Given the market equilibrium in 5(b)(i), the Government has now decided to intervene by tackling market demand. What can the Government do to ensure that the new market equilibrium is now at a socially-optimal quantity? Illustrate our answer with a diagram.

Answers to End of Session Questions

Session 1

Question	1	2	3	4	5
Answers	D	D	A	C	C

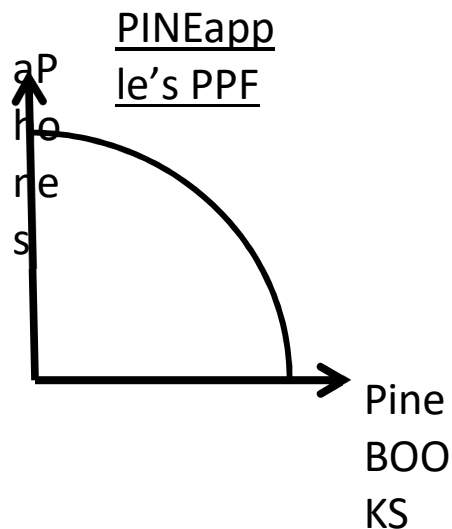
Question 6

The statement is false. A production point must first be productively efficient before it can be considered allocatively efficient (and not the other way around) as the definition of productively efficiency is contained within the definition of allocatively efficiency with an added condition of being a point where society values most highly.

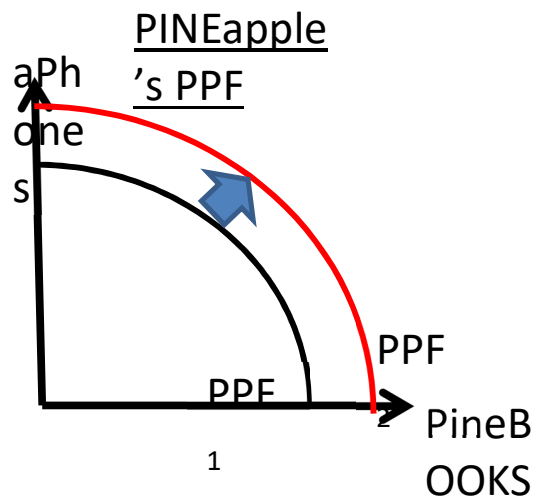
Question 7

(a) This is a normative statement as it is a statement of opinion - the analyst's view.

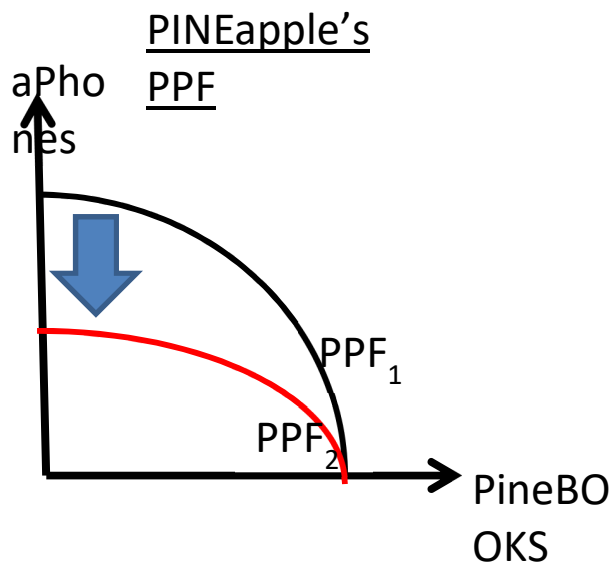
(b)



(c) The addition of new workers allows PINEapple to produce more aPhones and produce more PineBOOKS. PPF shifts outwards.



- (d) The fire at PINEapple's aPhone part supplier reduces PINEapple's ability to produce aPhones by half. Its ability to produce PINEbooks are not affected. PPF pivots inwards.



Session 2

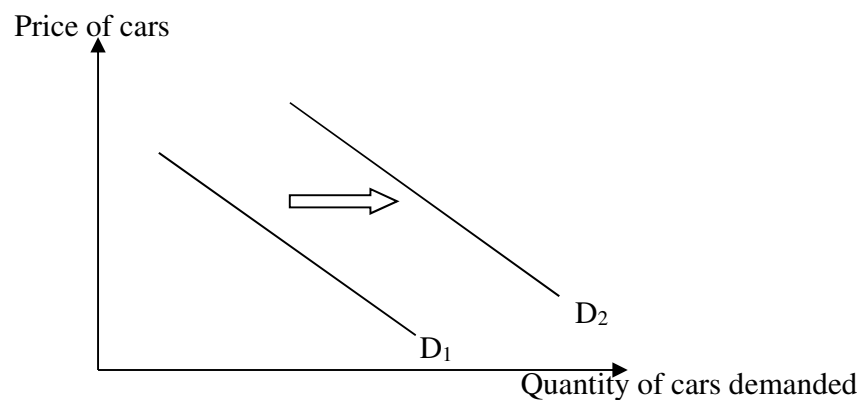
Question	1	2	3	4	5
Answers	C	B	B	B	B

Question 6

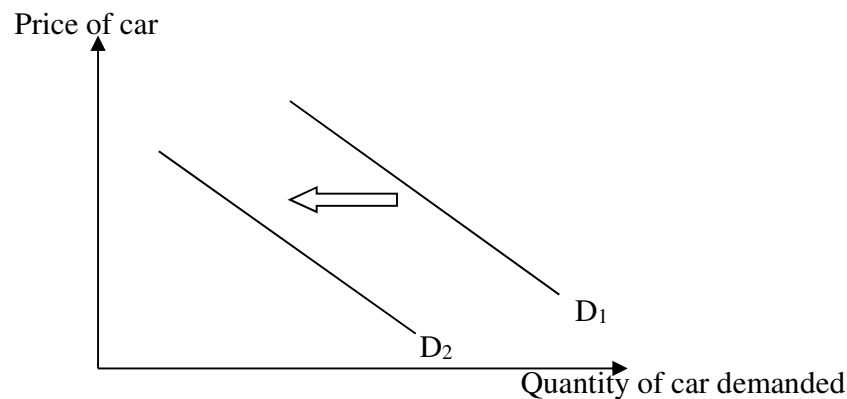
- (a) True. This is the definition of the Law of Demand where a price increase results in a negative change in quantity demanded. All other factors are considered demand factors.
- (b) True. When the price of an input falls, the cost of production also falls. This should result in an increase in supply, *ceteris paribus*.
- (c) False. An increase in income does not necessarily result in an increase in demand as the good in question could be an inferior good. If this is the case, the increase in income actually decreases demand.

Question 7

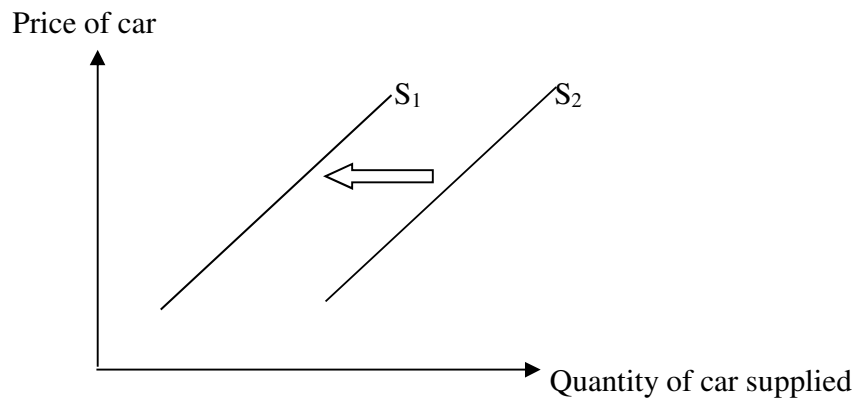
- (a) Public transport is a substitute to cars. A more expensive public transport will induce consumers to buy more cars at the current price. Thus demand for cars increases.



- (b) Petrol and cars are complements in consumption. An increase in the price of petrol will reduce consumers' desire to own a car. Thus demand for car decreases.



- (c) An improvement in the technology of producing cars will make it easier for producers to produce cars at all prices. Thus the supply of cars increases.

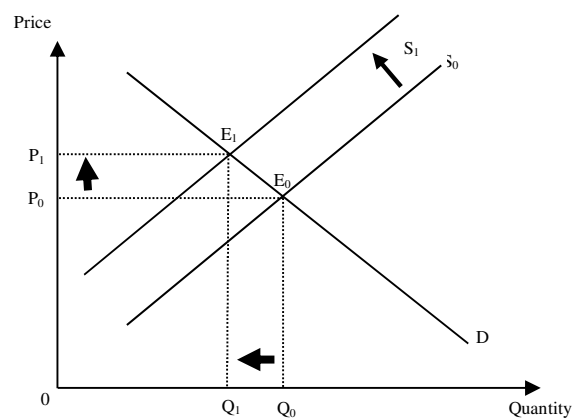


Session 3

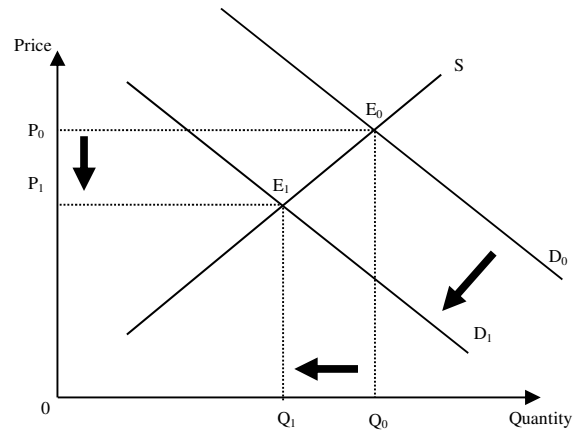
Question	1	2	3	4	5
Answers	B	B	D	A	C

Question 6

- (a) Phablets and mobile phones are substitutes in production. When the price of phablets increase, the quantity supplied for phablets will also increase. The resulting channelling of resources toward production of phablets will decrease the supply of mobile phones.

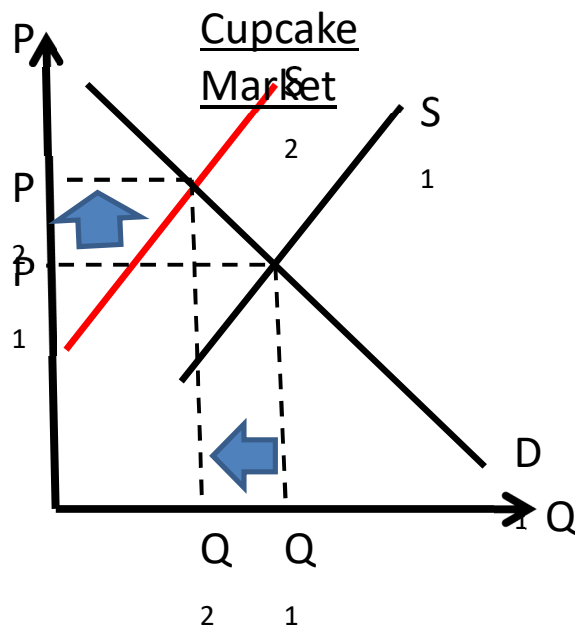


- (b) The concern about radiation and brain tumours should reduce the preference of consumers for mobile phones and cause its demand to decrease.

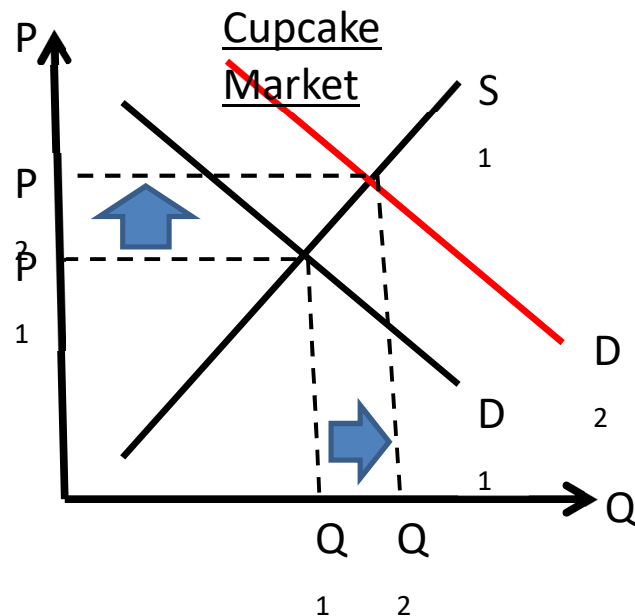


Question 7

- (a) The rise in cost of sugar will increase the cost of production of cupcakes. This results in a leftward shift in the Supply of Cupcakes (S_1 to S_2 in diagram beneath). The equilibrium price of cupcakes rises, and the equilibrium quantity of cupcakes falls.



- (b) Consumers have greater income, which allows them to buy more cupcakes at any given price. This shifts the Demand for cupcakes to the right (D_1 to D_2 in diagram beneath). The equilibrium price of cupcakes rises, and the equilibrium quantity of cupcakes rises.



Session 4

Question	1	2	3	4	5
Answers	C	C	A	D	B

Question 6

- (a) Let Q be the unknown new quantity demanded figure.

Price Elasticity of Demand = $\% \Delta$ in Quantity Demanded / $\% \Delta$ in Price

$$-3.2 = \{(Q_1 - 140) / [(Q_1 + 140) / 2]\} \div \{(450 - 510) / [(450 + 510) / 2]\}$$

$$-3.2 = \{(Q_1 - 140) / [(Q_1 + 140) / 2]\} / [-60/480]$$

$$-3.2 = \{(Q_1 - 140) / [(Q_1 + 140) / 2]\} / [-0.125]$$

Solving for $Q_1 = 210$

Absolute price elasticity is greater than 1, thus the demand is elastic. The seller should have decreased the price in order to earn more revenue. Students can also arrive at this conclusion by multiplying the price and quantity to arrive to this conclusion.

$$\text{Original Total Revenue} = P \times Q = 510 \times 140 = \$71,400$$

$$\text{New Total Revenue} = P \times Q = 450 \times 210 = \$94,500$$

(b) Cross Elasticity of Demand

= %Δ in Quantity Demanded of Good X / %Δ in Price of Good Y

= $\{(10,000-12,000) / [(10,000+12,000)] / 2\} \div \{(60-50) / [(60+50)] / 2\}$

= $[-2,000/11,000] / [10/55]$

= $-0.1818 / 0.1818 = -1$

Cross elasticity is calculated to be negative, thus the two goods X and Y are complements in consumption. When price of Good Y decreases, its quantity demanded increases and consumers will increase demand for X. An increase in demand will result in an increase in both equilibrium price and quantity. Total revenue must increase since the former is nothing more than the multiple of two variables (price and quantity) that are both increasing.

Question 7

(a) P.E.D. = %Change in Quantity / %Change in Price

= $1.03 / (-0.5)$

= -2.06 or 2.06 in absolute value

(b) The Cross Price Elasticity of Demand between SDF donuts and coffee has a negative coefficient. This means that an increase in the price of coffee (which causes a fall in the quantity demanded for coffee) results in a fall in the demand for donuts. This suggests that coffee and SDF donuts are consumed together, i.e. they are complements.

(c) The Income Elasticity of Demand of SDF has a negative coefficient. This means that an increase in consumers' income will cause a fall in the demand for SDF donuts.

Session 5

Question	1	2	3	4	5
Answers	C	D	C	D	D

Question 6

Answer

Quantity of Chocolate	MU of Chocolate	MU/P of Chocolate	Quantity of Candy	MU of Candy	MU/P of Candy
1	48	16	1	44	22
2	33	11	2	29	14.5
3	25	8.33	3	16	8
4	12	4	4	8	4
5	6	2	5	4	2
6	3	1	6	2	1

Since the condition to maximise satisfaction is to equate MU/P for each product, there are three combinations which fit this condition.

The possible optimal consumption bundles are 4 chocolate and 4 candy, 5 chocolate and 5 candy, and also 6 chocolate and 6 candy.

With Harry's income of \$20, he can buy only the bundle of 4 chocolate and 4 candy, which costs $(4 \times \$3) + (4 \times \$2) = \$20$. All other combinations are beyond Harry's budget.

Question 7

(a) Buy 2 units of X and 5 units of Y. Marginal utility of last dollar spent will be equal at 4 ($= 8/\$2$ for X and $4/\$1$ for Y) and the \$9 income will be spent.

Total utility = 48 ($= 10 + 8$ for X plus $8 + 7 + 6 + 5 + 4$ for Y).

(b) When the price of X falls to \$1, the quantity of X demanded increases from 2 to 4 (income effect). The consumer will buy 4 units of X and 5 units of Y which exhaust his income of \$9.

Total utility is now 58 ($= 10 + 8 + 6 + 4$ for X plus $8 + 7 + 6 + 5 + 4$ for Y).

Session 6

Question	1	2	3	4	5
Answers	D	A	C	D	B

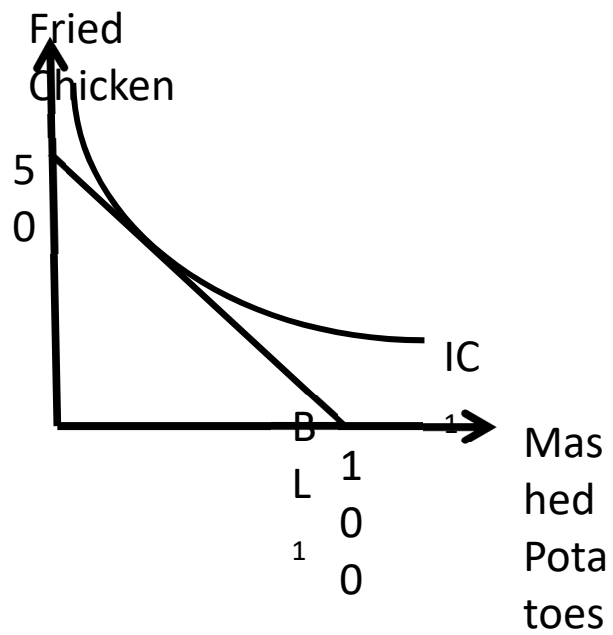
Question 6

(a) The statement is False. A fall in price of lobster or steak will cause the budget line to pivot outwards, changing the slope of the line.

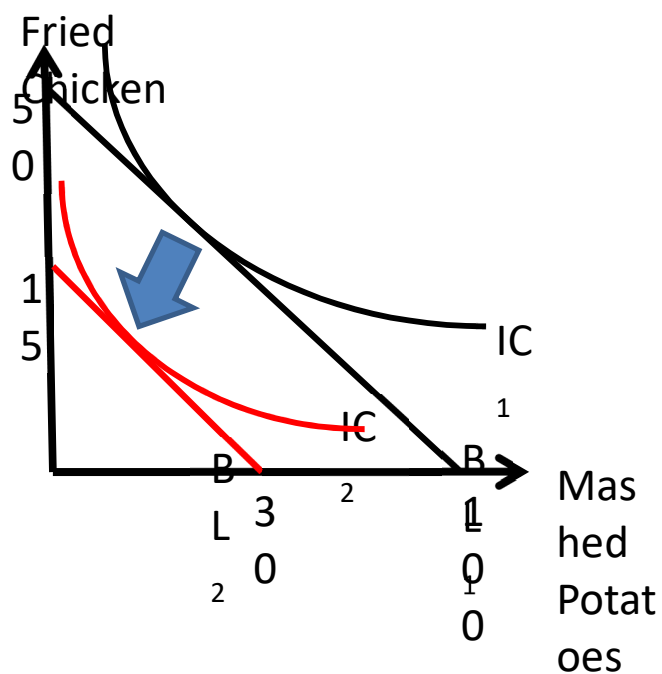
(b) The statement is true. At the tangency point of an indifference curve with the budget line, the consumer gets the highest total utility given his budget constraint, and hence the point is the optimal consumption point.

Question 7

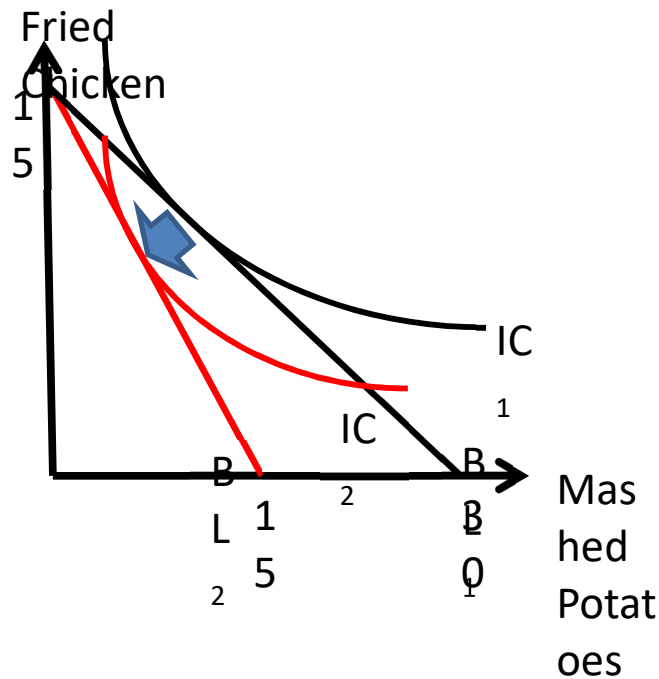
(a) The required diagram is as follows:



(b) LIC's fall in incomes results in his budget line shifting from BL_1 inwards to BL_2 . His new optimal consumption point will result in him consuming less Fried Chicken and Mash Potatoes.



- (c) The rise in price of Mashed Potatoes pivots LIC's budget line inwards from BL_1 to BL_2 and a new optimal consumption bundle on IC_2 .



Session 7

Question	1	2	3	4	5
Answers	B	A	B	C	B

Question 6

The Law of Diminishing Marginal Returns is the main economic theory being discussed here. Diminishing returns occur in the short run when more and more variable inputs (workers) are continuously added to an unchanging amount of fixed inputs (machines) resulting in a loss of efficiency.

To increase productivity of the workers in the short run, the plant manager can add in a third shift (assuming production is not already at full capacity) to make full use of the fixed machine resources.

To increase productivity of the workers in the long run, bear in mind that all factors are now variable, the plant manager can increase the number of machines to match the

increased number of workers or increase their productivity by upgrading the skills of the workers.

Question 7

(a) The total fixed cost is \$1,200 because at zero units of production, total variable cost is zero. Thus all total cost is attributed to fixed costs.

(b) The table below shows the marginal cost of the various output.

Quantity of X480M	Total Cost (TC)	Marginal Cost (MC)
0	\$1,200	-
1	1,600	400
2	1,800	200
3	2,400	600
4	3,600	1,200
5	6,000	2,400

Session 8

Question	1	2	3	4	5
Answers	C	C	D	B	C

Question 6

To maximise profits, $MC = MR$. However, students will not be able to find a point where $MR = P = MC = \$1,000$. Instead, students should find the maximum of TR minus TC. Profit is greatest at 3 units and the corresponding profit is \$600.

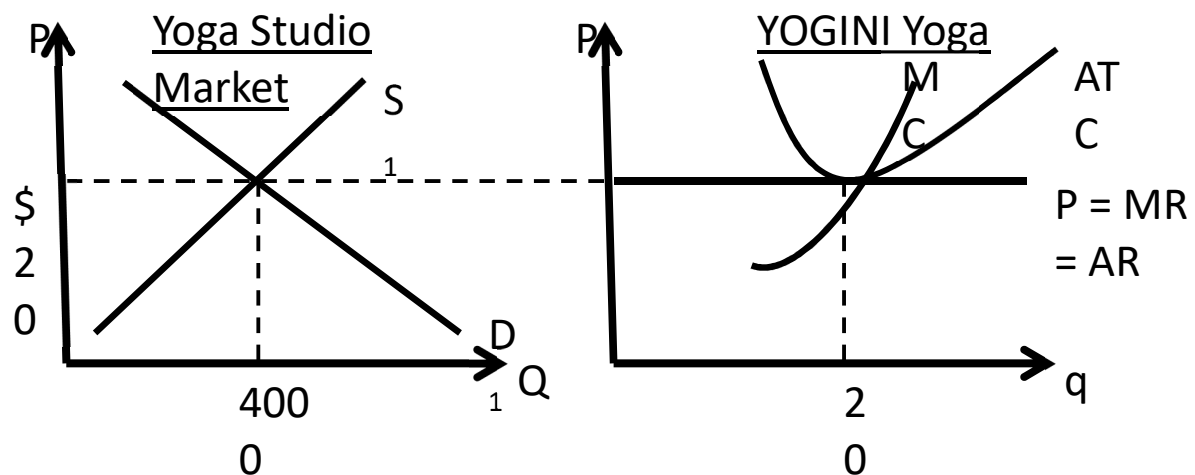
Quantity of X480M	Total Cost (TC)	Marginal Cost (MC)	Total Revenue (TR)	Profit
0	\$1,200	-	0	-1,200
1	1,600	400	1,000	-600
2	1,800	200	2,000	-200
3	2,400	600	3,000	+600
4	3,600	1,200	4,000	+400
5	6,000	2,400	5,000	-1,000

Question 7

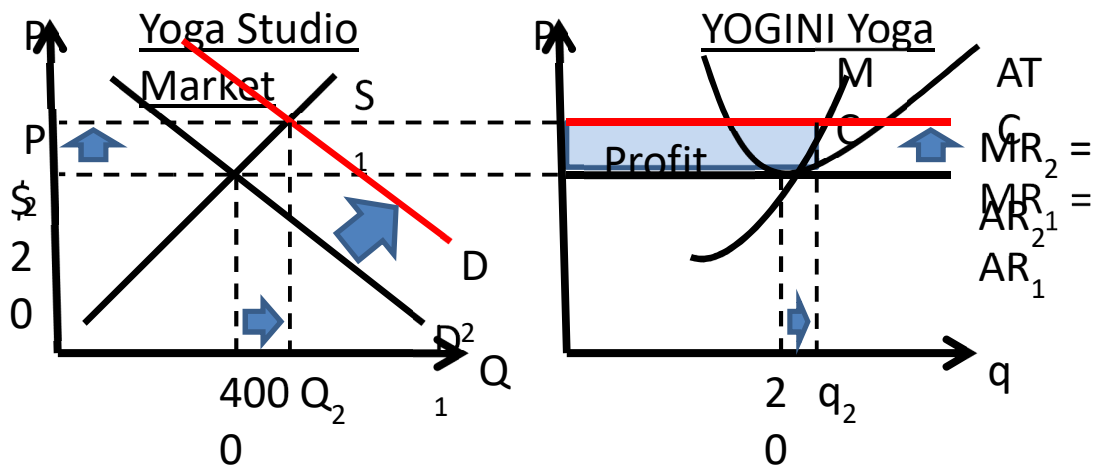
(a) YOGINI Yoga is part of a perfect competition market structure. This is because the following characteristics:

- (i) There are many sellers
- (ii) The product is identical
- (iii) There are no barriers to entry

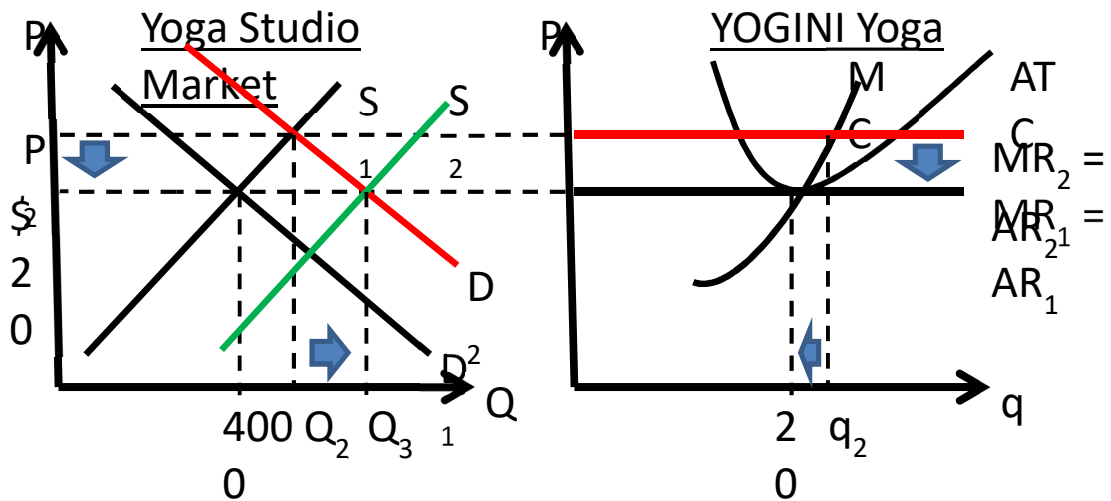
(b) Being at Long-run Equilibrium, YOGINI Yoga earns zero profit supplying 20 Yoga lessons at \$20. It is a price-taker, hence the Market Demand and Supply curves must have intersected at \$20, and the total market equilibrium quantity is $20 \times 200 = 4000$ Yoga lessons.



(c) Two Directions' take-up of Yoga increases the demand for Yoga and shifts the market Demand Curve rightwards to D_2 . The short-run impact is that Market Price and Quantity increases to P_2 and Q_2 . YOGINI Yoga ends up earning positive profit (blue shaded area) and supplying a larger equilibrium quantity (q_2), where the new MR curve intersects its MC.



(d) The short-run profit earned by YOGINI Yoga and other Yoga firms will attract more entrants into the Yoga Studio market, increasing the number of firms. This will cause the market supply curve to shift rightwards to S_2 . The new Market Equilibrium Price will then fall back to \$20, with the Market Equilibrium Price increasing further to Q_3 . At the firm level, YOGINI Yoga will now earn zero profit (with price back at \$20), and its quantity supplied will fall back to 20.



In summary, the number of firms increase, price falls back to \$20, Market Quantity increases, YOGINI Yoga's quantity of lessons falls back to 20, and its profit falls back to zero.

Session 9

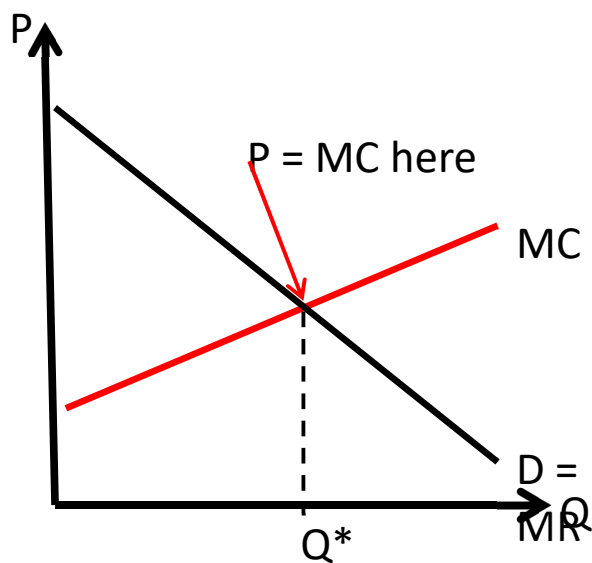
Question	1	2	3	4	5
Answers	B	A	B	D	B

Question 6

- (a) The optimal output occurs at $MR = MC$, which is 30 units.
- (b) The price is given by the demand curve, which is \$20.
- (c) The firm is earning a profit of $(20 - 18) \times 30 = \$60$.

Question 7

- (a) TICKfit is able to Perfectly Price-Discriminate, which means it does not need to lower the price for existing customers. This makes TICKfit's MR equal to its demand curve. TICKfit produces to where $MC = MR$, and its Market equilibrium is Q^* .



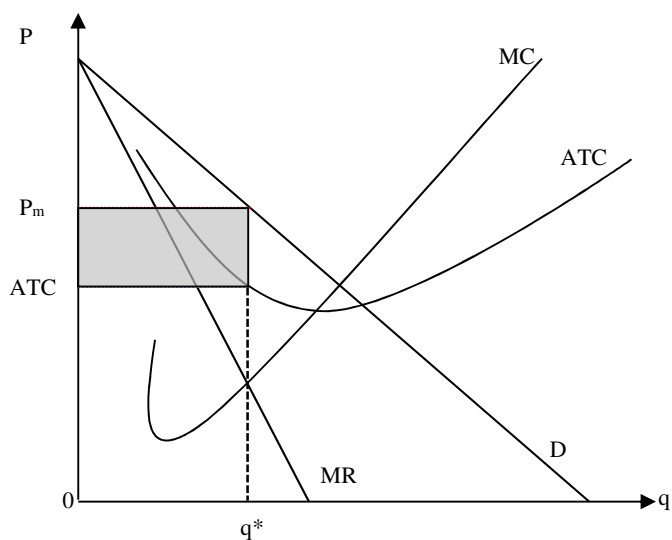
(b) TICKfit is allocatively efficient because at the market equilibrium point, the price charged at that quantity, $P = MC$.

Session 10

Question	1	2	3	4	5
Answers	D	A	B	C	A

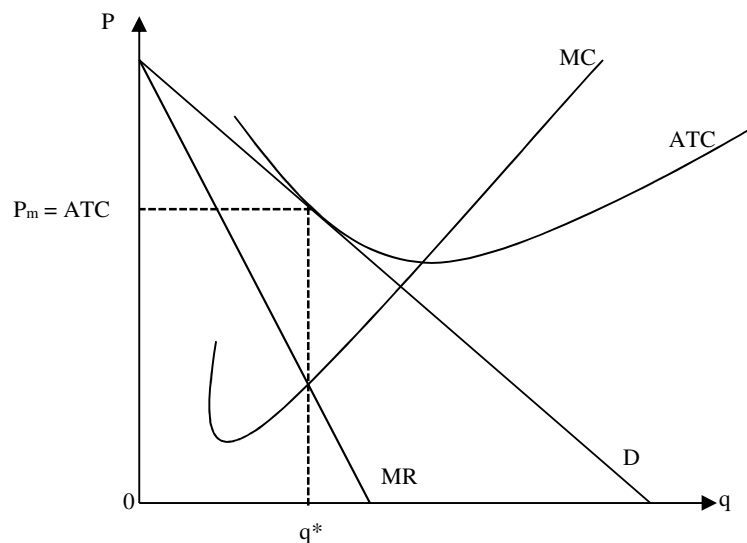
Question 6

(a) Refer to the diagram



In the short run, this particular seller will be able to capture a larger share of the market and the demand curve of this seller will shift to the right and possibly become steeper. Thus, this will result in economic profits being earned.

(b) In the long run, other monopolistic firms will be able to copy the idea/technology of the collapsible laptop and the particular trendsetter will lose the advantage it once had. As more firms enter the market freely, the demand curve of the trendsetter will shift to the left as market share is now lost to the new entrants and to reflect the larger number of substitutes; its demand curve becomes more gentle. At the end, only normal profits remain for all monopolistic competitive firms in the long run.



Question 7

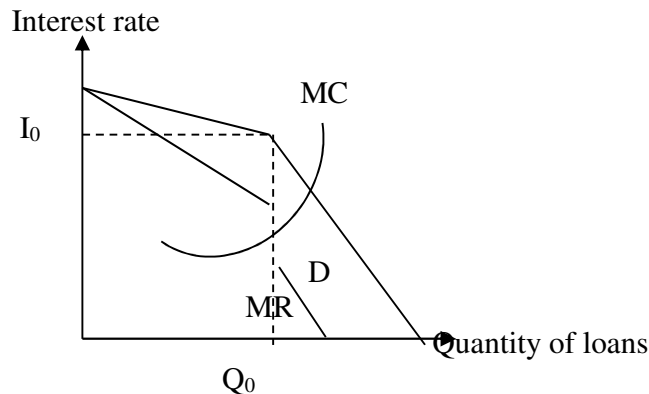
Advertising is a fixed cost and hence with advertising the average total cost of the firm will increase. Advertising generate awareness of the firm's product and makes consumers attracted to the firm's product relative to its competitors. Thus the demand for the firm's output will increase and become more inelastic. The larger output will also allows the firms to achieve economies of scale and produces the output at a lower average total cost. There is also the signaling effect of advertising which creates an impression of better quality for the firm's output. If the revenue effect arises from higher price and larger output exceeds the cost of advertising, the profit of the firm will increase. It will not be attractive to advertise if the cost effect exceeds the revenue effect to the firm.

Session 11

Question	1	2	3	4	5
Answers	C	A	B	D	C

Question 6

(a) The banking industry in an oligopoly, The behaviour of DMB and the other banks are relevant to the kinked demand curve model and The kinked demand curve model is shown in the diagram below:



Assume that initially DMB is charging an interest rate I_0 and provides a loan amount of Q_0 .

When DMB increases its interest rate, the others banks will not follow and hence DMB will lose a large quantity of customers seeking loans, resulting in a elastic demand curve in the upper portion.

When DMB decreases its interest rate, the others will follow in cutting theirs and hence DMB will only gain a small quantity of customers, resulting in an inelastic demand curve in the lower portion.

Thus the demand curve for DMB has a kink in the middle, with upper portion elastic and lower portion inelastic. Corresponding, there will a gap in the downward sloping MR curve.

(b) Since the services provided by the three banks are identical, there is not much scope for product differentiation consumers are only concern about the price, which is the interest rate. The interest rate offered by the three banks will be similar.

The two portion of different curve creates a gap in the MR curve. This gap can accommodate a small adjustment in the marginal cost but still retain the same price and quantity. Hence this give rise to interest rate stability among the three banks in the banking industry.

Question 7

(a) The payoff matrix is shown below:

		NOTLINE ("NL")	
		Charges \$1 per user	Charges \$0.10 per user
NOTWHATSAPP ("NW")	Charges \$1 per user	NW: \$15 billion NL: \$15 billion	NW: -\$2 billion NL: \$25 billion
	Charges \$0.10 per user	NW: \$25 billion NL: -\$2 billion	NW: \$1 billion NL: \$1 billion

(b) The Nash Equilibrium is for NOTLINE to charge \$0.10, earning \$1 billion, and for NOTWHATSAPP to charge \$0.10, earning \$1 billion.

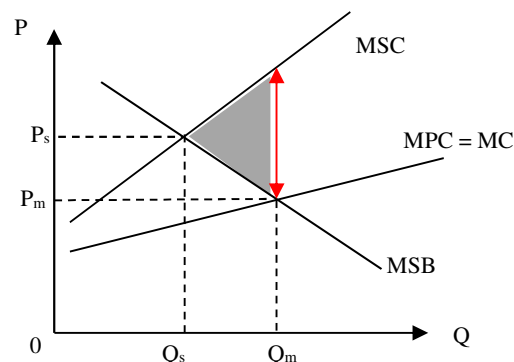
(c) Yes this is a Prisoner's Dilemma game, because the socially optimal outcome is for both firms to charge \$1 per user, which will maximise their total profits, but this is not the Nash Equilibrium that is attained by NOTLINE and NOTWHATSAPP.

Session 12

Question	1	2	3	4	5
Answers	B	B	C	A	D

Question 6

(a) This is a negative consumption externality problem. Production and consumption are at Q_E and do not take into account the true cost to society. Red arrow shows the marginal external cost exacted upon bystanders and passer-bys. Market is inefficient due to allocation of resources to the overproduction of an undesirable good and deadweight loss is shown on the diagram being the grey triangle.



(b) For Coase Theorem to work properly, the following conditions must exist:

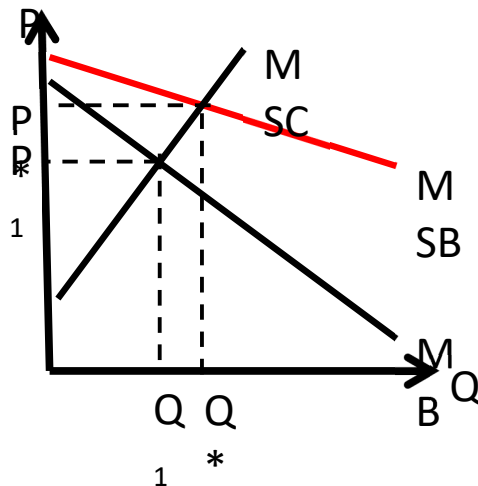
- Well-defined property rights;
- Small number of parties; and
- Low or no transaction costs

A no-smoking zone establishes property rights and assigns the rights to the non-smokers. Non-smokers will now be able to enjoy clean air and if smokers violate the rule, they will be penalised by a fine.

Now if smokers want to smoke within the no-smoking zone, the former may actually pay the non-smokers to be allowed to smoke. This will internalise the externality and the non-smokers will bear with a certain amount of second-hand smoke in exchange for payment from the smokers. However, this will only work if there are only a few parties present with low transaction costs.

Question 7

(a) Each consumer considers only its private marginal benefit (black line MB) rather than the social marginal benefit (red line MSB). This results in under-consumption at Q_1 , a lower quantity than the optimal quantity of Q^* , where Marginal Social Benefit = Marginal Social Cost (black line MSC).



(b) If the Government could give a voucher to each family (amount equal to the difference between MB and MSB), such that the demand curve for vaccinations shifts to the MSB curve. This will result in increased consumption of vaccinations, and the socially-optimal quantity Q^* can be achieved.

