NETAJI SUBHAS OPEN UNIVERSITY

STUDY MATERIAL

M. COM

PAPER - 2

Managerial Economics

POST GRADUATE
COMMERCE

PREFACE

In the curricular structure introduced by this University for students of Post-Graduate degree programme, the opportunity to pursue Post-Graduate course in Subjects introduced by this University is equally available to all learners. Instead of being guided by any presumption about ability level, it would perhaps stand to reason if receptivity of a learner is judged in the course of the learning process. That would be entirely in keeping with the objectives of open education which does not believe in artificial differentiation.

Keeping this in view, study materials of the Post-Graduate level in different subjects are being prepared on the basis of a well laid-out syllabus. The course structure combines the best elements in the approved syllabi of Central and State Universities in respective subjects. It has been so designed as to be upgradable with the addition of new information as well as results of fresh thinking and analysis.

The accepted methodology of distance education has been followed in the preparation of these study materials. Co-operation in every form of experienced scholars is indispensable for a work of this kind. We, therefore, owe an enormous debt of gratitude to everyone whose tireless efforts went into the writing, editing and devising of proper lay-out of the materials. Practically speaking, their role amounts to an involvement in 'invisible teaching'. For whoever makes use of these study materials would virtually derive the benefit of learning under their collective care without each being seen by the other.

The more a learner would seriously pursue these study materials, the easier it will be for him or her to reach out to larger horizons of a subject. Care has also been taken to make the language lucid and presentation attractive so that may be rated as quality self-learning materials. If anything remains still obscure or difficult to follow, arrangements are there to come to terms with them through the counselling sessions regularly available at the network of study centres set up by the University.

Needless to add, a great deal of these efforts are still experimental—in fact, pioneering in certain areas, Naturally, there is every possibility of some lapse or deficiency here and there. However, these do admit of rectification and further improvement in due course. On the whole, therefore, these study materials are expected to evoke wider appreciation the more they receive serious attention of all concerned.

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Vice-Chancellor

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Modules : 1 & 2
Managerial Economics

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Notification

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NETAJI SUBHAS OPEN UNIVERSITY

Post-Graduate : Commerce
M. Com-2

Module 1

Module 2

Unit-1 □ Introduction

Structure

1.0 Objective

This chapter defines the subject, matter, distinguishes between positive and normative economics, the nature and use of models and theories and lastly, the role of value judgement in economics.

1.1 The Family Tree of Economics

Economics is broadly divided into two sections : Macroeconomics and Microeconomics. **Macroeconomics** is the study of economics aggregates at the national, sometimes at international level, very often of relationships between unemployment, money supply inflation and Gross National Product and others. **Microeconomics** is concerned with the study of the operation of economic agents within these economies; it examines the structures of the markets within which they find themselves and the decision process by which they make their choices. This section of economics subdivides into a variety of sub-disciplines. Below, we are characterising four of them:

Managerial Economics is Economics of managerial decision and their applications though not necessarily non-over lapping.

Welfare Economics is concerned with analysing alternative definitions social welfare and of developing measures of such definition.

Industrial Economics (or Organisation) is concerned with the characteristics and structure of industries and the behaviour of firms within such industries.

Regulatory Economics is concerned with the reasons for state intervention in the market economy and in particular, the consequences for efficiency and social welfare arising from the state using different types of regulatory control to restrict the behaviour of private decision making agents.

Managerial economics is primarily concerned with firm, although any study of decisions at the firm level requires understanding of the structure of the industry within which the firm is located. While taking decisions, firms must also be aware of the institutional framework within which they operate. For these reason, we have to stray across the fuzzy boundaries of the sub-disciplines of managerial, welfare, industrial and regulatory economics, as well as related disciplines like management accounting and corporate finance.

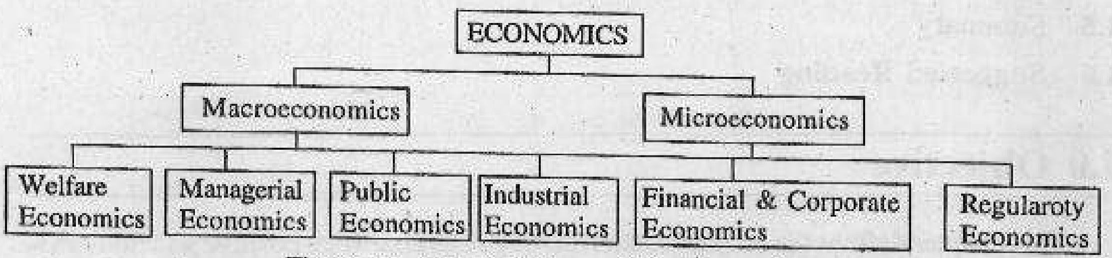


Figure 1.1 Sub-disciplines within Economics

The approach adopted in this study material is mostly neo-classical economics. Here the analysis begins at the level of the individual, having objectives in his/her analysis begins at the level of the individual, having objectives in his/her economic life, which can be identified to some degree of approximation such agents are assumed to make choices which, given the constraints they face, maximise the value of their objective function. This optimising view of individual and firm decision-making is generally very flexible. Uncertainty and risk, altruism and inter-temporal time horizons can all be introduced into the neo-classical approach. Neo-classical economics is like a chameleon, constantly extending in ways, which accommodate the views associated with other schools of thought.

1.2 Positive versus Normative Economics

Positive Economics is about 'what is' whilst Normative Economics is about 'what ought to be'. The first is concerned with explaining what happens in the real world without making any judgement as to whether what happens is desirable or not. Normative economics, on the other hand, is concerned with the analysis of what they need to do in order better to achieve their goals.

Economists commonly use a simple and operational measure (basically the sum and producer surplus) for judging whether policies or actions by agents in the economy are a good thing or not. Here, in view of the is/ought distinction, we are considering it in more detail. Let us consider the following statements.

(i) If I am a twin, I must have had, at some stage a brother or a sister.

(ii) That spinster has been recently widowed.

(iii) The planet Neptune is made of Stiltion cheese.

(iv) Nurses ought to be paid more than teachers.

(v) Increase the pay of all nurses!

These are clearly defferent types of Statement. The first is logically true, whilst the second is logically false. Thus, we can determine true or false by an analysis of the meaning of the term contained within them in addition with the application of the usual rules of logic. The third statement is an empirical statement, we cannot determine its validity by logic that can only be determined by empirical evidence. Statement (iv) is different from the others, it is termed as value judgement, and it implies a commendation or recommendation. One may agree or disagree with the statement, but it is not possible to determine its truth by any empirical evidence. On the contrary, statement (v) is an order of imperative. It is not either an empirical statement or value judgement. The individual who issues such an order may or may not hold value judgement such as (iv).

1.3 Value Judgement in Economics

The above discussion takes to the issue of value judgement in economics. In general we may say that any statement, which implies a recommendation is termed as a **value judgement.**

Considering the statements in 1.1 the fundamental distinction of interest is between empirical statements and value judgernents. They are basically different types of statement. This is sometimes referred to as 'Hume's Law' 'no value judgement can be deduced from wholly empirical premises' Most economists accept Hume's Law as a logical truth.

In commending of recommending, an individual will usually have reasons to do so. Economists usually like to argue that value judgements should be capable of being systematised. If an individual holds views that are selfcontradictory, then no rational debate is possible with that person. It can be argued that it is a fundamental tenet of individual nationality that the value judgements held by such a person should be mutually or internally inconsistent.

Consider the following value judgements :

(i) Killing people is always wrong/.

(ii) For individuals suffering from painful terminal illness, it is permissible to end their life painlessly.

These value judgements contradict each orther. So, it is possible to have rational debate about value judgements. In deciding on whether a statement is value judgement or not, a useful check is to ask whether its truth value (in principle) is testable by an examination of empirical evidence. If it is, then the statement is not a value judgement.

It is important to note here that much of this study material is concerned with positive economic analysis. However, often the consequences or particular policies or forms of behaviour need to be evaluated from a public interest of social welfare perspective. This is where normative economics visa-vis value judgement becomes relevant.

1.4 Characteristics of Economic Models

Most courses on managerial economics require critical assessment of theories and models. In this section, we will give some idea about the role of models and theories in economics.

1.4.1 Models and Theories

A model is a simplified representation of some part of reality; its function is to exhibit relationship and interdependencies. The model necessarily abstracts from what is assumed to be unimportant detail in order to clarify what are considered to be the key variables and relationships. A model in Economics can be verbal, geometric or algebraic. They are focussed, intended to deal with one particular aspect or reality, not to explain everything in the universe.

On the other hand, a **theory** can be regarded as a model along with a specification of the empirical variables and facts whose changes it is supposed to explain or predict. Thus, variables in the model need operatonal definition.

In practice, the terms model and theory are used interchangeably. But the distinction is important considering the various purposes of the models.

1.4.2 The uses of Models and Theories

Both models and theories are used for three basic purposes, teaching, prediction and explanation.

(a) Pedagogic (Teaching) Purposes

Models in basic textbooks in Economics are simple and straightforward. They are designed to communicate basic interrelationships between economic variables. Thus, the single-product, single period, profit-maximising monopolist with linear demand and constant marginal cost is a basic pedagogic device. It is a significant deviation from reality, but it facilitates the communication of basic and important ideas.

(b) Prediction

Economic theories often go for predictions, which are stochastic, rather than deterministic They typically offer only conditional and often probabilistic prediction. Repeatedly large divergences between the theory's predictions and actual outcomes would constitute poor predictive performance. It is normal to compare the relative performance of different theories to judge such predictive performance.

(c) Explanation

Here the main concern is causality. It is a quite complex issue specially when the possibility of statistical or non-deterministic causality is admitted. Many theories are adequate for prediction without having any real causal underpinnings. Observed realities are useful, but they are not explanations. A theory should make perdictions of a wide range of phenomena, all of which are validated. If it is successful in predicting events of a particular type, but fails in perdicting other types of phenomena, it is not an explanation. A good explanation should also lead us to look for new kinds of phenomena, which can also be correctly predictable. Thus, any failure in prediction suggests the inadequacy of the theory in explanation. This may lead to the examination of the assumpions and ultimately modification of the theory.

1.4.3 Evaluation of Models and Theories

Models, as long as they are internally consistent and able to capture at least some parts of the reality, even if they do not have very good predictive quality, can be termed useful. It is more difficult to evaluate theories, as here the models confront the empirical evidences.

It is always better to keep in mind that performance should be judged in a relative sense. Thus, there can be different types of performance criteria; the simplest can be as follows:

1. Predictive performance

If one theory always predicts future events more accurately than another, then obviously it is predictively better.

2. Explanation

If a theory seeks to establish causal links between more facts of the real world is *ceteris paribus*, a superior theory. A theory is more *elegant* if it achieves more from less (i.e. fewer assumptions). It is more *coherent*, If it draws on a common set of assumptions used in related models/theories.

Since economic models and theories necessarily omit elements of reality, they cannot provide perfect explanation. In a sense all models and theories can be viewed as stepping stones towards more complete systems.

1.5 Summary

In this introductory unit, we introduced the basics of economics as a discipline. We tried to describe the family tree of economics, i.e. how the basic discipline branched out to various sub-disciplines over the course of its development. Then, we concentrated on two basic approaches to economic analysis, the positive and the normative. The later approach took us to the issue of value judgement in economics. The last part of the section concentrated on the rolè of models and theories in economic analysis.

1.6 Suggested Reading

1. Dobbs, Ian M (2000), Managerial Economics firms, Markets and Business Decision, Oxford University Press, Oxford.

2. Salvatore, Dominick : Managerial Economics in a Global Economy, Thonson : South western.

Unit-2 □ Decision Analysis : Tools & Techniques

Structure

2.0 Objective

This section gathers together some of the tools and techniques, which are used in business decision-making and/or in models and theories developed throughout this study material. It starts with optimisation, a foundation stone for Neo-classical economic analysis. All economic agents are looked as optimisers, who maximise or minimise something subject to the constraints under which they find themselves. The next two sections deal with two other useful tools linear programming and tools from operations research. Section 2.4 deals with decision-making under risk and uncertainty and gives an account of the expected utility model.

2.1 Optimisation

In this section, an attempt has been made to provide a practical and non-rigorous approach to optimisation problems both unconstrained and constrained with either equality/ inequality constraints. It presumes familiarity with the concepts of mathematical function (linear/non-linear) derivatives (including successive and partial) and the ability to solve linear equations.

Economics is the study of the allocation of scarce resources. Scarcity implies constraints. As we have pointed out earlier most economic agents are assumed to operate as if they are maximising (minimising) some type of objective function (typically non-linear) subject to constraints (which may be linear/non-linear). Thus, the consumer maximises his utility subject to a linear budget constraint, firms may minimise their cost subject to a given level of output or maximise output subject to a given level of cost. In this discourse, we start with mathematical examples of generic rather than purely economic ones.

2.1.1 Unconstrained Optimisation

The general problem here is the following:

Maximise $f(x)$, (2.1)

where x is a vector of choice variables; $x = (x_1, x_2, \ldots x_n)$. A minimisation problem can be converted into a maximisation problem simply by attaching a minus sign to the objective; i.e. that problem of maximising $f(x)$ has the same solution as that of minimising $-f(x)$.

Here, we assume that functions are smooth and defined on a given domain. (The domain of a function is simply the set of the points for each of which the function is defined and takes a unique value). As for example the cost function C(q) is defined only for non-negative values of output q. A smooth function has no kinks, corners or discontinuities. This particular restriction simplifies the identification of optimal solutions. For such functions, if a maximum value exists, it will occur either at

(i) an interior point in the domain, when it must be the case that the gradient in all directions is zero, or

(ii) a point on the boundary of the domain (where gradients need not be zero).

These points are highly intuitive and can be understood by a geometric figure (Figure 2.1). It is a graph of a univariate function. It is sketched on the interval $0 \leq x \leq 4$. If this is the domain of the function, then clearly a global maximum occurs at the point x^d_r. However, if the domain was $0 \leq x \leq 3$, the maximum would have occurred earlier at $x = 3$, a point where the gradient is positive.

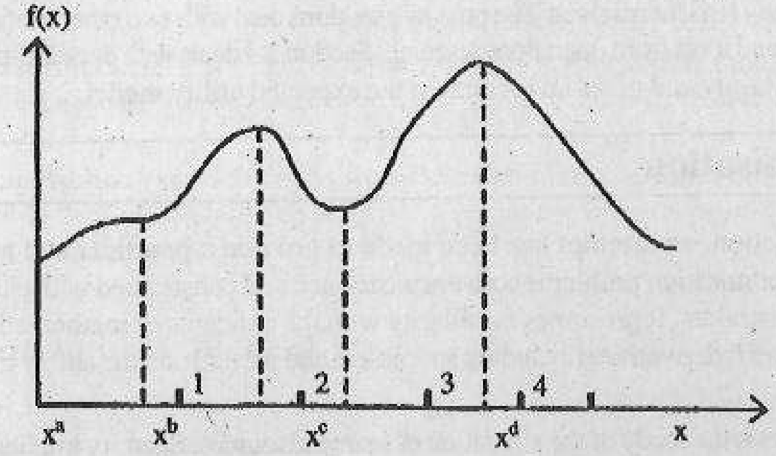


Figure 2.1 Univariate Function with turning points.

In this discourse, we will focus on solution occurring at interior points rather than at boundaries. It implies the only points of interest are those where the function has zero gradients. This indicates a way to locate the point (or points) at which the function attains a maximum value. The idea is simply to compute the partial derivatives associated with the function, and attempt to solve the set of equations generated by setting these derivatives equal to zero. The ith derivative of $f(x)$ is denoted as $\delta f(x)\delta x_i$, it is the measure of the rate of change of f corresponding to change of x when the change approaches to zero at a given value of x holding the other elements in x fixed). If the function involves n variables, then there will be n partial derivatives, and hence n equations to solve :

$\delta f(x)/\delta x_i = 0, i = 1,........n.$ (2.2)

Though this algorithm is pretty efficient at identifying a solution, the problem is that it does not always work. A univariate function as in Figure 2.1, having four points in the domain at which the derivatives are zero. Point x^a is a point of inflexion, at a point x^c, there is a local minimum, whilst at points x^b, x^d, there are local maximum occurs at a point where the value of the function at the point is at least as large as the value of the function at all surrounding points, for some neighbourhood for the point in question. The neighbourhood is arbitrarily small. A strict local maximum occurs if the value of the function is strictly greater at the point than at all surrounding point than at all surrounding points in the neighbourhood. A global maximum occurs at a point in the domain where the function attains its largest value. In the figure, x^b is a strict local maximum, but is clearly not a global maximum, whereas x^d is a strict local maximum and also a strict global maximum for the domain, $\{x : 0 \le x \le 4\}$.

So, identification of the points at which the gradient is zero, does not necessarily identify a global maximum, such points may also be minima of inflection points. Thus, identifying points having zero gradient is not a sufficient condition for identifying a global maximum, but it is a necessary condition; that is, any point in the interior of the domain at which a smooth function attains a global maximum must be a point at which the partial derivatives are equal to zero. So, we can state it more formally as.

For a smooth function $f(x)$ where $x = (x_1............x_n)$ a necessary condition for a local or global maximum to occur at a particular point, denoted by x^*, is that $\delta f(x^*)/\delta x_i = 0$, i, $= 1, 2,....n$.

This condition is often referred to as a **first-order necessary condition**. In practice, it is extremely helpful to know that a solution which satisfies the first-order necessary condition, it is one at which the function attains a global maximum and indeed whether this is unique. This is addressed in the next section.

2.1.2 Concave Functions and Their Role in Optimisation

If the objective function is concave or quasi-concave, then any point which satisfies the first-order necessary conditions in fact, identifies a global maximum for the function. Many of the functions in economic analysis are concave or quasi-concave, e.g. profit function, cost function, revenue function etc. Concavity is a special case of quasi-concavity. Concavity is more straight-forward to explain and so we are focussing on that.

A function $f(x)$ is said to be **concave** if, for any two distinct points **x, y** and at any point $z = ax + (1 - \alpha)y$, where a is a scalar such that $0 \le \alpha \le 1$, $f(z) \ge \alpha f(x) + (1 - \alpha) f(y)$, if the inequality is strict (*whenever z is not equal to x or y*), then the function is strictly concave.

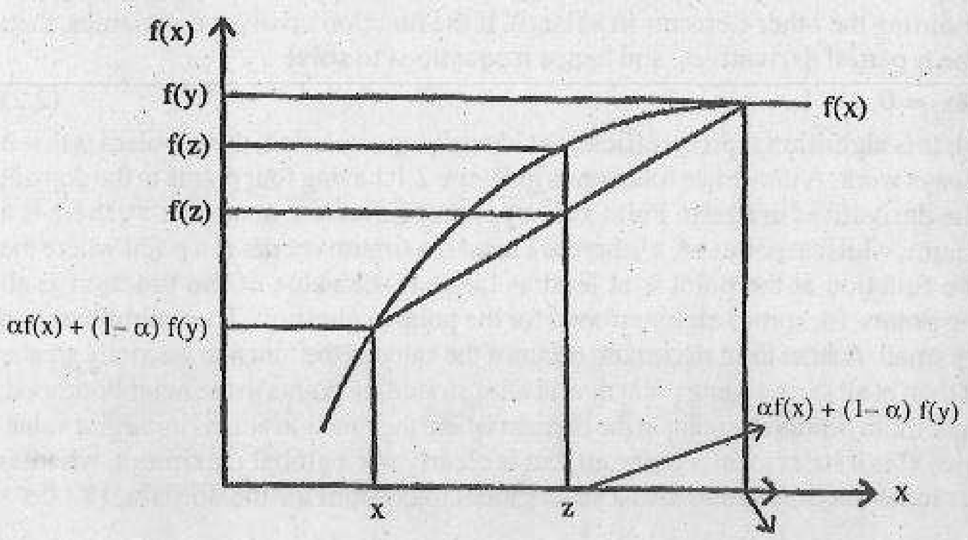


Figure 2.2 Concave Function

Figure 2.2 shows the definition of concavity for a univariate function.

The essential point to understand in the Figure is that z is a linear convex combination of x and y, and (iea $\le x \le 1$) and so lies on a straight line between them, while $\alpha f(x) + (1-\alpha)f(y)$ is the point on the line segment immediately above z. A function is concave if, for any x, y, the value of $\alpha f(x) + (1-\alpha)f(y)$ is less than or equal to the value of the function at that point.

A related concept is that of convexity :

A function f(x) is said to be ***convex*** *if—f(x) is concave, and strictly convex if f(x) is strictly concave.*

Any linear function of one or more variables is a concave, but not strictly concave function. Equally, linear functions are also convex but not strictly convex. They are simultaneously concave and convex. A univariate function, whose second order derivative is negative everywhere will be strictly concave (concomitantly, if the second order derivative is positive, the function is convex).

If a function f(x) is concave, where $x = (x_1\ x_2 \ldots\ldots\ldots x_n)$ *then there exists a point* x^* *such that* $\delta f(x^*)/\delta x_i = 0,\ i = 1, 2, \ldots n$ *then* x^* *yields a global maximum value for the function. If the function is strictly concave, then* x^* *is unique.*

The above theorem also holds if the word 'concave' is replaced by 'convex' and 'maximum' with the term 'minimum'. If a function is concave then a solution which satisfies the first-order necessary conditions yields a global maximum (and if it is convex, the solution yields a global minimum). If the function is strictly concave (or strictly convex), then there is a unique solution to the first-order conuitions. Similarly, if the objective function is neither concave nor convex, then it is possible for solutions to satisfy the first-order condition without being global maxima or minima. Often the objective function can be simply assumed to be strictly concave (or strictly convex); this is often reasonable for common economic functions like firm's profit, revenue or cost functions.

2.2 Optimisation with Equality Constraints

The general problem under consideration is now modified by introducing the quality constrainst as follows :

Maximise $f(x)$ (2.3)

subject to $g^i(x) = 0,\ i = 1, 2........m,\ m < n$ (2.4)

Where $f(x)$ denotes the objective function and $g^i(x) = 0$ denotes the ith constraint function. The number of constraints is assumed to be less than the number of choice variables.

The most natural way to save the above problem is to eliminate m variables, so reducing the problem or one of unconstrained optimisation, discussed in the previous section. However, it is not always convenient to approach the problem in this way. This is basically for two reasons :

i. the mathematical manipulations may become rather complex;

ii. in economic analysis, it is often the case that the functions are not analytic. In most of the cases, it is unnecessary to specify an explicit analytic form for the function.

An alternative approach, using an artificially constructed **Lagrangean** function is used to analyse these type of problem. This function is defined as follows :

$$L(x,\lambda) = f(x) - \sum_{i=1}^{m} \lambda_i g^i(x) \quad (2.5)$$

The first-order necessary condition associated with a maximum (or a minimum) can now be expressed in the form of the following theorem :

If (x) and the constraint $g^i(x)$ are smoath, and if the constraint functions are suitably well behaved, then if a particular point, denoted by x^* gives a local maximum (or minimum) for the function (subject to the constraints), them there exists a unique vector of ***Lagrange multipliers*** *λ^* such that the following first-order necessary conditions hold :*

$$L(x,\lambda) = f(x) - \sum_{i=1}^{m} \lambda_i g^i(x) \quad (2.6)$$

In all the problems in this discourse, the constraints are suitably well-behaved. Given that equation (2.6) provides n equations, and the m constraint equations must also hold, it follows that there are m + n equations and m + n unknown (namely x_is and λ_is), the procedure thus involves manipulating these equations to determine the solution values for these variables. Most of the problems encountered involve just one constraint, so this is not a major exercise.

2.3 Optimisation with Inequality Constraints

Most economic problems can be viewed as optimisation subject to inequality constraints. In many cases, the solution will obviously involve certain binding constraints, so usually problems are simplified by using the equality constraints. In the consumer's utility maximisation problem, conventionally it is assumed that the budget constraint will be binding. In reality, things may not be so obvious, and a less informal approach to the identification of the optimum solution is required.

The general problem under consideration can be modified by introducing inequality constraints as follows:

Maximise f (x) (2.6)

subject to $g^i(x) \leq 0$, i =1.2..........m (2.7)

where x is a vector of choice variables $x = (x_1, x_2 \text{ .... } x_n)$.

Here also, a minimisation problem can be converted to maximisation problem simply by attaching a minus to the objective function: i.e. the problem involving minimising $f(x)$has the same solution as that of maximising $-f(x)$. equally, a constraint $\alpha(x) \leq 0$ can be written as $-\alpha(x) \geq 0$. Equality constraint such as $\alpha(x) = 0$ can be accommodated by writing two constraints, namely $\alpha(x) \geq 0$ and $\alpha(x) \leq 0$

The above problem is much more complex than the equality-constrained problem, since we are not able to know whether each constraint will be active (i.e. $g^i(x) = 0$) or inactive (i.e. $g^i(x) \geq 0$) in the optimal solution. Accordingly, a 'step-by step' approach is adopted. This approach is not computationally very efficient, but for well-posed and well-behaved problems, there will be solution at the end. If the objective and the constraint functions are concave, a solution is guaranteed. The approach again involves the Lagrange function, which is defined as :

$$L(x, \lambda) = f(x) + \sum_{j=1}^{m} \lambda_j g^j(x) \qquad (2.8)$$

The equality-constrained optimisation problem reduced to finding particular values for the choice variables x_i and the Lagrange multipliers λ_i, which simultancounsly satisfied a set of equations (the first-order conditions).The particular vector of x-variables which did this was denoted by x* and the associated vector of multipliers was denoted by λ^*. The inequality-connstrained optimisation here involves particular values of x* and λ^* which satisfy a set of necessary conditions: They are referred to as Kuhn-Tucker conditions.

The Kuhn-Tucker conditions are as follows :

$\delta L/\delta x_i \leq 0, \quad i = 1,........n,$ (2.9)

$g^i(x^*) \geq 0 \quad i = 1,........n$ (2.10)

$\lambda_i^* \, g^i\,(x^*) = 0 \quad i = 1,.......n$ (2.11)

and $\lambda_i^* \geq 0, \quad i = 1,.......n$ (2.12)

The equation (2.11) are often termed as **complementary slackness** conditions. Thus is because they require either $\lambda_i = 0$ or $g^i\,(x) = 0$ (or both). Thus if a constraint is slack ($g^i\,(x) > 0$), then implics that $\lambda_i = 0$, or if $\lambda_i > 0$, then it must be that $g^i(x) = 0$.

The basic results are as follows.

If a constraint qualification holds and the objective and constraint functions are smooth functions, then if a particular point yields a local maximum (subject to satisfying the constraints), then the Kuhn-Tucker conditions are necessary conditions : they must hold at this point, (necessary condition).

If the objective and constraint functions are smooth concave functions, and a particular point satisfies the Kuhn-Tucker conditions, then at that point the objective function attains a global maximum (subject to satisfying the çonstraints). If the objective function is strictly concave, then the solution is unique (sufficient condition).

It can be simply assumed that the functions involved are in fact concave; then if a point can be found, which satisfies the Kuhn-Tucker conditions (KTC), this is the global optimum solution. Solutions satisfying the constraints are called feasible solutions and those over and above maximising or minimising the objective function is called optimal solution.

2.4 Linear Programming

Many business problems can be characterised as problems involving the maximisation of an objective function subject to constraints, where, all functions involved are linear or approximately linear. This type of problem is a special case of optimisation problem, is referred to as **linear programming.** Because of the special structure, this type of problem is rather more straightforward to solve, the solution methodology lends to itself to routine and computerised algorithm. Two-variable problems can be solved by graphical means in a straight forward way.

The general format of the linear programming problem is

Maximise $Z = c'x = c_1x_1 + c_2x_2 + ... + c_nz_n$ (2.13)

subject to $\mathbf{Ax} \leq \mathbf{b}$ ie (2.14)

where $c' = (c_1, c_2 ....c_n)$ $x = (x_1, x_2,.........x_n)$, $b' = (b_1, b_2.........b_m)$, and A is an mxn matrix.

The linear structure facilities alternative and computationally more efficient solution procedures; one reason for this is that in a linear problem, the solution will occur on the boundary of the feasible set, and at extreme or corner point and not inside it. The solution procedure essentially needs only to consider the value of the objective function at such corner points on this boundary. The linear program can also be written to include inequality constraints in equation form.

$$
\left.\begin{array}{l}
a_{n}x_1 + a_{12}x_2 + \ldots + a_{1n}x_n \leq b_1 \\
a_{21}x_1 + a_{20}x_2 + \ldots + a_{2n}x_n \leq b_2 \\
\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \\
\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \\
a_{m1}x_1 + a_{m2}x_2 + \ldots\ldots + a_{mn}x_n \leq b_m
\end{array}\right| \text{Indirect constraint.}
$$

$x_1, x_2 \ldots\ldots x_n \geq 0$ — Direct constraint.

Solutions satisfying the constraints are called feasible solution and those maximising or minimising the objective function is called optimal solution.

2.5 Decision making under Uncertainty Introduction

Most choices involve some situations when out come is not known with perfect certainty. This is obviously true for most games of decision. Risk of uncertainty is related in someway to the possibility that one of several outcomes could occur once the choice decision is made. The following scheme of classification is often used.

- A Choice under certainty leads to a unique outcome
- A Choice under risk is a choice which may lead to one of several, possibly infinitely many, outcomes, where the probability of each potential outcome is known.
- A Choice under uncertainty may lead to several outcomes, where the probability of any particular outcome is unknown.

In the light of the above classification, we can say that most business decisions are decisions made under uncertainty rather than risk. Probabilities associated with outcomes are generally unknown. Taking the normative prospective, it is possible to convert the decision problems under uncertainty into problems under risk, essentially through the use of the concept of subjective probability.

2.6 Other Tools of Decision Analysis

Managerial economics adopts the scientific approach of economic analysis, which involves :

- Reasoning for economic events and behaviour of business and economic entities.
- Tracing the cause-effect relationships among business economic variables and predicting economic behaviour.

- Building economic models and testing them empirically for making inferences towards decision making based on theoretical case studies from the real world. In this section, we will study the essentials of a case study.

To understand a problem fully, managerial economics undertakes case studies from the real world. In this section, we will study the essentials of a case study.

2.6.1 Case study

As managerial economics is an applied science, it is better understood in the light of relevant practical case studies. A case study is considered as a pedagogical technique in dealing with issues and problems of allied functional areas of business and management decision-making.

Cases are to be scientifically analysed using a sound conceptual framework. A case study should be undertaken with careful precepts and choice of tools and methods of the relevant disciplines. It should be further noted that the cases should be short and simple, devoid of rigorous analysis, indicative and based on simple and easily available data.

The steps of a Case Study

There is no precise technique of case study/analysis. It essentially involves logical reasoning and value judgement. A business firm is more concerned with recognising and acting on an opportunity rather than just solving a problem. For an effective case and analysis, a logical approach may involve the following steps : familiarisation, situation study, arriving at the core problem, analysis and inferences, list of recommendations and presentation of case report.

Familiarisation : One needs tobe thoroughly familiar with the concerned situation before analysing a case. This requires collecting information and details of the case problem. Date regarding the history, organisation, management and financial position of the concerned business firm as well as the industrial situation at large, have to be collected. The purpose, objective and the mission of the firm areto be taken into account. Again one needs to identify the strategic problems and opportunities encountered by the firm. The firm will always want to grab the opportunities even with apparent or emerging problems. this is the logical starting point in familiarising with a case.

Situation study : Once the manager becomes familiar with the firm's missions and goals, he should try to understand and study the situation-the business environment under which the firm is operating. Here one should look into the following dimensions of the situation like the size and growth trends in the industry, the market structure, the comparative position of the firm, prevailing economic situaton, the socio-economic and demographic scenario of the country, technological progress, policies of the domestic government, impact of global events (both political and economic) demand factors and consumers" attitudes, stages of porduct life cycle, market teritorisation and segmentation and its impact on marketing strategies, firm's resource base and availability of business finance and comparison of the firm's key financial ratios with that of other rival firms.

Situation study may be followed by the SWOT analysis, i.e. look for the relative strength (S),weakness (W), opportunities (O) and threats (T) of the firm.

Arriving at the core problem : Facts and observation made while doing the situation study represent the symptoms of the underlying fundamental problems. These are to be detected and defined in the case study. As for example, declining sales may be the result of the outdated product line rather the result of less expenditure made on advertising. In reality, a business problem is a complex phenomenon; most of the times it cannot be attributed to a single cause. So, the collected information has to be thoroughly and carefully analysed to identify the core problem. One should never be in hurry to accept the information on face value and make premature judgement. In a case study report, it is essential to provide sound reasons for the selection of the problems and issues. Problem statements should be result oriented with a focus on related key areas of operations and actions required.

Analysis and Inference : The identified problems need to be thoroughly analysed and interpreted on the basis of supportive data and investigation in the light of the existing theory. This is to be followed by generating alternative courses of actions and solutions on the basis of analytical results obtained, interpreted and inferences made. The alternatives should be practical and feasible. There should be specific and easy to follow course of action.

List of Recommendations : A case analysis must enlist the recommendations on a theoretically sound and justifiable manner to draw the attention of the decision-makers. The recommendations should be based on the firm's strength and not on weaknesses. The capacity and resources of the firm for implementation should also be evaluated.

Presentation of case Report : The report of the case study should highlight the major findings and course of decision making in dealing with the problems tackled in the study. The report should be brief, concise, and lucid in presentation of the ideas in a logical order of format. It should also contain an executive summary, i.e. an abstract of the main report, identifyling the major issues and problems with brief narration of the results and the main recommendations. Apart from abiding by standard format for the body of the report, the presentation should be made crisp by incorporating charts, tables etc.

2.7 Summary

In this unit we studied about some of the basic tools ofdecision-making in Managerial Economics. The technique of optimisation was studied in details, with all its variants. We also learnt about linear programming. We introduced the concepts of risk and uncertainty and touched the problem of decision-making under uncertainty. In the last part, we knew about the steps of preparing a case study, which is a most common method of managerial decision-making.

2.8 Questions

1. (a) Find the values for x_1, x_2, x_3 which maximise the functions $f(x)=1+x_1-2x_1^2-x_2^2-3x_2^2$

(b) If a monopolist has a lincar inverse demand function of the form p=100-q where p and q has their usual meanings, and the firm has a constant marginal cost of Rs. 10 per unit, what is the revenue-maximising output and price? What is the profit-maximising output and price?

2. Find the value of x_1, x_2 and x_3 which miximise the function $f(x)=1-x_1^2-x_2^2-x_3^2$ subject to the constraint that $g(x)=x_1-x_2-1=0$

3. Find the value of x_1, and x_2 which manimise the function $f(x)=x_1-x_2^2$ subject to the constraint that $g(x)$ $x_1 \geq 0$, $x_2 \geq 0$, $x_1+x_2 \geq 1$

4. What is a case study? What is the importance of case study for dealing with managerial problems?

2.9 Suggested Readings

1. Baumal, W. J. (1972), Economic Theory and operation analysis, Englewood Cliff, NL, Prentice Hall.

   Dobbs, Ian M (2000), Managerial Economics: Firms, Markets and Business decisions Oxford University Press Oxford.

2. Mithani. D (2002), Managerial Economics, Himalaya publishing House, New Delhi
3. Henderson, J.M. and Quandt, RE : Microeconomic theoryMc Grow-Hill: (Appendix)

Unit-3 □ Demand Analysis

Structure

3.0 Objective

This chapter starts with a review of the neo-classical approach to consumer theory vis-a-vis theory of demand. Then it discusses the Lancaster's characteristics approaches to consumer theory. In the next three sections, it concentrates on relevant concepts like own and crossprice elasticities product life cycle. The chapter ends with direct and indirect methods of demand estimation.

3.1 Neo-Classical Consumer Theory-A Review

Neoclassical Consumer Theory : Here, we start with Marshall i.e. cardinal approach to utility analysis where utility is measured in terms of money and Marginal utility of money is constant. In this framework, price and demand are inversely related, assuming purchase of one only commodity.

Then comes the Hicks-Allen Indifference curve approach where consumer equilibrium is attained at the point of tangency between Indifference curve and Budget line price and income changes are incorporated leading ultimately to the decomposition of price effect between income effect and substitution effect.

Then finally comes the Revealed preference approach where conclusion are drawn by observing the actual behaviour of consumers in the market.

Demand Function—Identification and Estimation : Demand Function which we usually cover in Micro economic theory has some internet problems.

(a) Whether the statistical Regression of Q_t on P_t i.e. Quantity on price at time can be identified with demand curve of economic theory.

(b) The problem of aggregation is no less important.

 (i) From Individual demand function we can switch over to market demand function—Aggregation over individuals.

 (ii) From demand function for a particular item we can obtain demand function for food—Aggregation over Commodities.

 (iii) From daily demand function we can switch over to yearly demand function.

(c) When we regress demand on price and income there is a serious multi collinearity problem and for this pooling of cross section and time series data is necessary.

The basis of neo-classical consumer theory indicates some testable hypotheses (e.g. the existence of demand functions, presence of money, illusion, negative substitution effect etc.) It is the foundation for welfare analysis. It also gives an idea about the most important variables to consider in any empirical analysis of demand. But the model does not consider some important features like the following.

- *Search.* How do consumers come to find out about the product? How do they decide when to stop searching and start evaluating the available product? In the standard model, consumer is assumed to know everything about all existing and potential products. Hence the issue of advertisement expenditure by any firm does not arise.
- *Habit Formation* Individual consumption choices are much about habit formation, than anything else. Often, a search ceases after a satisfactory outcome is achieved. This is much more satisficing than optimising behaviour.
- *Preferences dependent on prices.* The model presumes that indifference curve of the individuals are derived from their preference pattern. Variation in prices is assumed not to affect the position of the indifference curve. But there are evidences which show that individuals not only judge quality by price but they may also prefer products more highly priced, because of status or snob effect. The standard theory will not be able to predict if all preference are allowed to shift with change in price.

- *New goods*. The model is not able to give any idea what the likely demand for a new good might be or why goods are substitutes or complements.

Though all these ideas can be incorporated within the optimising framework, the gains from such extended framework may be outweighed by the costs to undertaking it. In the next section, we will study another approach to consumer theory by Lancaster, where he attempted to rectify the deficiencies of the neo-classical model.

3.2 Lancaster's Characteristics Approach to Consumer Theory

Neo-Classical consumer theory assumes that individuals actually purchase goods and services. But Lancaster argued that consumers' preferences are defined over attributes and characteristics of such goods. As for example a car is not bought for its own sake but for its attributes like loadcarrying capacity, fuel economy, road-handling etc. Thus products package characteristics in different quantities and proportions, a choice of product is really a choice from one of the alternative bundles of attributes.

3.2.1 The Basic Model

The simplest version of the theory is based on some strong assumptions, which are listed below :

1. The characteristics contained in any good can be given a numerical measure.

2. All consumers agree on the above objective measures; they also agree on what they get in terms of characteristics from each unit of given product.

3. Linear additivity : two units of a given product give twice as much of each characteristic as one unit, and the units of a given characteristics provided by one commodity can be added to the characteristics provided by other goods.

Each of the assumptions can be questioned. Measurability may be more problemacte, for some characteristics than for others; individuals may not evaluate characteristics in the same way. The last assumption of linarity is definitely dubious. It is meaningless to say that there is twice as much tinginess in one unit of a particular toothpaste than another toothpaste. Anyway, measurability is not absolutely essential same result can be obtained by ordering, i.e. goods can be ranked on various characteristics. However, to develop the simplest model, it is convenient to stick to the assumptions of measurability and linear additivity.

We first set out the general characteristics and then constrict our discussion to the two characteristics case for a numerical example. Suppose any good has m characteristics, and there are n goods Let x_i be the quantity of the ith good purchased by the consumer at price p_i. If each unit of good i contains a quantity a_{ij} of attribute j, then one unit of good i give the consumer a budle of characteristics defined by the vector (a_{ij}, a_{i2},............a_m). If x = (x_1, x_2, ...x_n), denotes the consumption vector chosen by the individual consumer, then this choice gives the consumer a total quantity of a_i of characteristic J defined as :

$$\sum_{i=1}^{n} a_{ij} x_i$$

It is assumed that the six axioms of consumer theory (i.e. reflexivity, completeness, transitivity, non-satiation continuity and strict convexity), apply to the characteristics of goods. This implies the existence of utility function defined over characteristics rather than goods, thus, the consumer's choice problem can be written as

Maximise $U(a_1, a_2, \ldots\ldots\ldots a_m)$ 3.2

subject to $\sum p_i x_i \leq Y$, 3.3

$a_j = \sum_{i=1}^{n} a_{ij} x_i \qquad i = 1, 2, \ldots m$ 3.4

and $x_i \geq 0 \qquad j = 1, 2 \ldots\ldots n$ 3.5

Where Y is the budget of the consumer. Given the equality constriant (3.4) it is possible to analyse the problem in goods space by directly substituting (3.4) into the objective function, of reducing the problem to one involving solely the choice variables x_j. However, more clear insight can be obtained from diagrammatic exposition, which focuses on the characteristics space. The exposition parallels to the neo-classical consumer theory with two characteristics replacing two goods. Given prices and income, the budget constraint limits the amount of goods that can be purchased and so their is a limit to the attainable limit of characteristics. Thus, just as there is a feasible set in goods space, there is also a feasible set in characteristics space. The outer bound of this set is called the efficiency frontier.

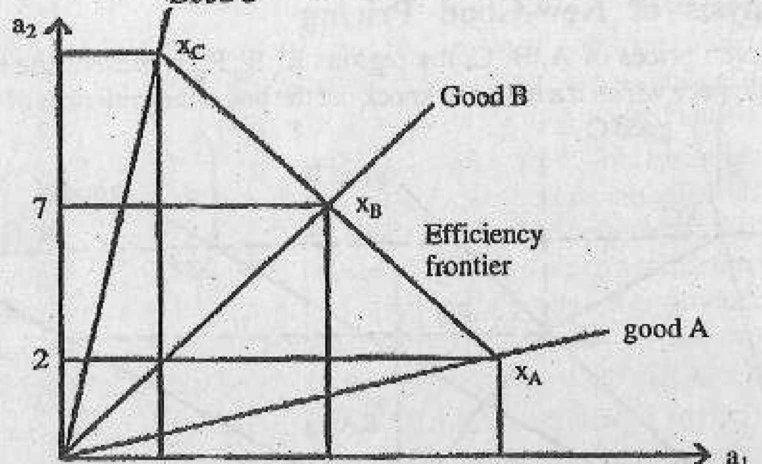


Figure 3.1 The Efficiency Frontier

To illustrate the determination of the efficiency frontier and its value in the pricing of two products, let us consider the following example involving two brands of cereal. We assume that all the cereals in the market have two characteristics, calories (per kilo) and vitamins (milligrams per kilo). There are three brands of cereals in the market, say A, B and C. Another firm is considering to introduce a new brand labelled N, but is not sure about what price to set for it.

Table 3.1 Lancaster's characteristics approach a numerical example

Brand	Price (Per Kilo)	a_1 (calories/kilo)	a_2 (Vitamin/kilo)
A	10	100	20
B	8	56	56
C	6	12	60
N	?	20	10

Given the linearity of the problem, we can set Y = Re. I. Ignoring new good and using the data in Table 3.1 we can write

$$10x_A + 8x_B + 6x_C = 1 \qquad (3.5)$$

$$a_1 = 100x_A + 56x_B + 12x_C \qquad (3.6)$$

$$a_2 = 20x_A + 56x_B + 60x_C \qquad (3.7)$$

Now, if the whole budget is spent on good A, then $x_A = x_C = 0$, and $x_A = 1/10$ kilo. This gives quantities $a_1 = 10$ and $a_2 = 2$. Similarly, if the total budget is spent on x_B then $x_B = 1/8$ kilo and $a_1 = 7$ and $a_2 = 7$. If the budget is spent on good C, then $x_C = 1/6$ kilo and a_1 and a_2 become 2 and 10 respectively. If we plot these combinations of a_1 and a_2 [i.e. (10, 2) (7, 7) and (2, 10)] and join them, we will get efficiency frontier points. Any point inside this frontier is inefficient.

3.2.2 Analysis of New-Good Pricing

At the given prices of A, B, C, the regions $R_A R_B R_C$ represent the regions of the characteristics apace which if a new, can knock out the brand the prefences of the consumers

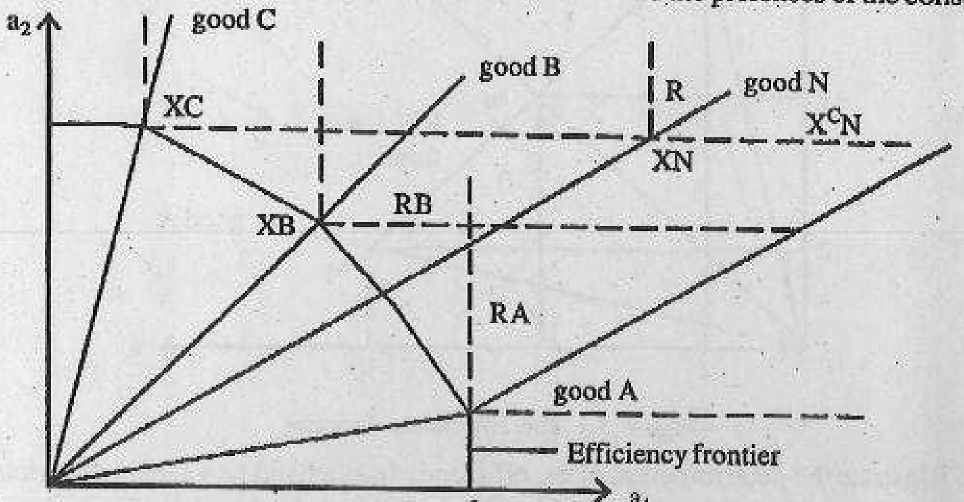


Figure 3.2.2 Lancaster's Characteristics Approach

provided the attributes are goods and not bad had the consumes are not satisfied with in attributes of characteristic.

The region $R = R_A R_B R_C$ represents the region of attributes space attain of which will knockout all the brands on the usual assumptions of (i) given prices (2) given budget (3) non satiability of the attributes (4) Even without knowledge of preference of relative attributes a indifference or prefence relation.

X^1n represent in appropriate and minimum level of a_1 and a_2 attributes that can knock out all the brands.

The issues involved are

(1) New product development i.e. combination of attribute per unit of out put of the brand. And (2) its unit prices.

Thus pricing policy and technology of combining levels of attributes in a unit are intricately involved in the new brand development and its launching in the market.

It in attributes are fixed in proportion. In the brand given by the ray good N, the new brand is to all ain X_n by appropriate pricing policy x_n^C x_n^B x_N^A are the knocking out point of C, B and A; given those points in the attributes space the corresponding knocking process of new good may be worked out.

Consumer Preference map for Hributs

If we introduce consumer preference map in the Attributes space, the situation may be complecated. It lughest attributes indifference (with usual shape) may be attained at a kink unpling lreand loyality to a single brand at the given price. It not, in two demenision attrebente space only two cheap brands will be combined the maxinise utility

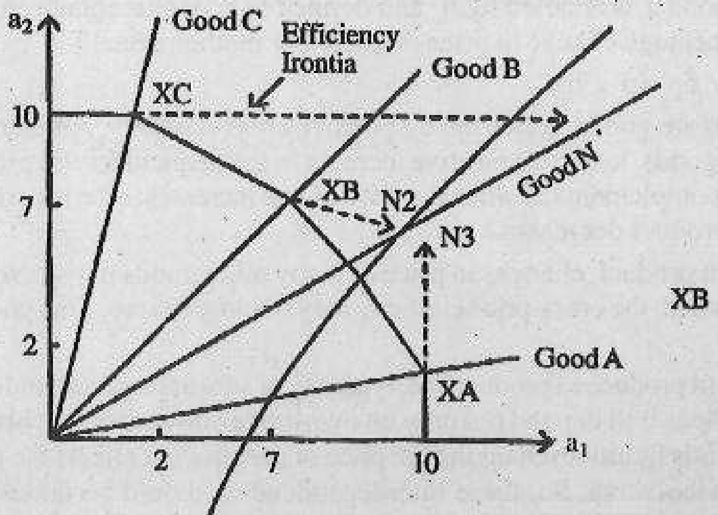


Figure 3.2. New good pricing

3.3 Elasticity and Its Application in demand analysis

Demand analysis is the study of how the quantity a firm is able to sell depends upon variable such as the product's own price, the price of related products and other market factors such as advertisement, income etc, An individual's demand function depends on available budget and the set of prices faced. Changes in price of each and every product can affect the individuals demand for a given product. Though in practice, only the prices of close substitutes and complements are likely to matter most. Aggregation over the individual demand functions yields the market demand function.

One of the major determinants of selling price is the price sensitivity of sales. So, one important component of demand analysis is that of measuring sensitivity. The concept of elasticity is used for this purpose.

Elasticity is a very general concept of how responsive a dependent variable is to variation in an independent variable. For a function like y=f(x), the elasticity of y with respect to x, denoted by

η_{yx} is defined simply as, $= \frac{dy/y}{dx/x} = \frac{dy}{dx} \cdot \frac{x}{y}$.

η_{yx} = percentage change in y/ percentage change in x (3.8)

holding all the other variables constant.

3.3.1 Cross-price Elasticities and Product-Line pricing

The price of close substitutes may affect demand for a given product significantly. The cross-price elasticity measures this measures this sensitivity. If the demand for a product j is denoted by q_j and its price as p_j, then the cross price elasticity for good i with respect to change in price p_j is denoted by η_{ij} and defined as η_{ij} = percentage change in demand for good i/percentage change in price of good j, or mathematically,

$$\eta_{ij} = \delta q_i \,/\, \delta p_j \, (p_i \,/\, q_j) \quad (3.9)$$

Substitutes are goods, which have a positive cross elasticity. An increase in the price of a substitute goods, leads to a positive increase in the demand for the product. Similarly, two goods are complements, if when the price of one increases, ceteris peribus, the demand for the other product decreases.

For a given product, changes in price of many other goods may have little impact on quantity demanded; the cross-price elasticity may be close to zero. This good is non-related to others.

When a firm produces a product line, typically of substitute goods, indicates that profit-maximising prices will depend not only on own-price elasticities, but also on cross price elasticities. This is intuitive; changing the price of one product affects the sales of the other products and vice-versa. So, these interdependencies should be taken into account in determining prices.

3.3.2 Short-run and Long-run Elasticity

For products like gas, electricity etc. the demand is less elastic in the short run than in the long run. This simple because, in the short run, individuals have specific fuel-using appliance. Thus, if the price of gas goes up, individuals will economise to an extent on their use of gas, but they cannot immediately do away with their gas burners, cookers etc. In the long-run, they may switch to appliances which run on other fuels or uses fuel. Hence the long-run adjustment is greater than that in the short run, and the elasticity is also more.

3.4 The Product Life-Cycle

Much of the above discussion is for the short-run. The elasticity estimates measure quantity responses to price changes over short and medium term. In the longer run, many products go through life cycle. At the launch of the product, few consumers know about the product; it is typically innovative and a head of his rivals. It is a matter of time, consumers know about the product and its qualities; the effect of new advertising also takes time to penetrate. Hence, for the product, at first there is a period of upswing, when individual consumers learn about the product and its qualities. It is likely to gain market share quickly at the expense of competitive products. The rival products will be squeezed by this added pressure in the market place (depending on the market structure, they may try resort to defensive strategies like price cuts). With the passage of time and with the entry of new competitive products in the market, technical advantages diminish and the product enters maturity phase. There is little impact of advertising. Lastly, there is decline as the product is no longer at the cutting edge of technology even with improved specification, it may not be able to compete. At this period, there is a need to decrease margins in order to compensate for the inferior performance.

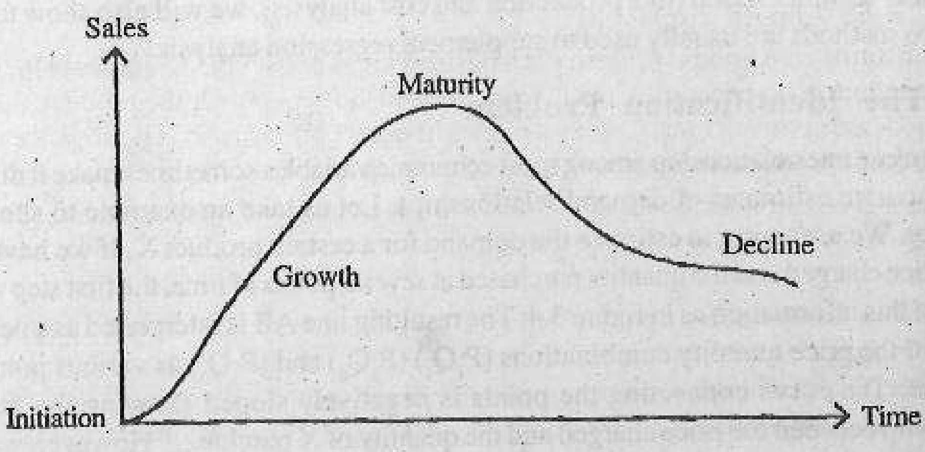


Figure 3.3 The Product Life Cycle

So, it may be said that for products with pronounced life cycle, it is expected that own-price, cross-price elasticities, income elasticities, advertising elasticities etc. tend to change over time and along with these, there should be change in advertising and pricing policy. The product life-cycle is pronounced for products with considerable technical change (e.g. personal computers). The recognition of the life-cycle is important for forecasting the demand for the product and consequently for capacity planning and for the decision on whether to keep the product in the market or withdraw it, not to speak of pricing and advertising policy. All these decision are inter-dependent, as the expected level of sales at each point of the product life-cycle is likely to be influenced by pricing and advertising policy. This theory has typical similarity with trade cycle theory where the basic macro economic variables like price output, income and employment rotate in a cyclical fashion with four phases—Boom, Recession, Depression and Recovery.

3.5 Elementary Ideas about Demand Estimation

The demand for a product and factors of production plays an important role in business decision. So it is essential to estimate the structural form and the parameters of the demand function. In this section, we would consider the common procedures of demand estimation.

Three common methods are used for demand estimation. Of these two are based on primary methods of data collection, i.e. consumer survey and market survey. The third method is to use a specific statistical technique, i.e. regression analysis for estimating the parameters of the mathematical demand function. Here we would deal with regression in details for two reasons. Firstly, sometimes this is the best even the only way to estimate the demand equation precisely. Secondly, apart from demand estimation, the regression analysis is used extensively for estimation purpose in managerial economics and other aspects of business administration (like production and cost analysis), we will also show that the other two methods are usually used to supplement regression analysis.

3.5.1 The Identification Problem

The close interrelationship among most economic variables sometimes make it difficult to get accurate estimates of demand relationships. Let us take an example to show the difficulty. We are trying to estimate the demand for a certain product X. If we have data on the price charged and the quantity purchased at several points of time, the first step would be to plot this information as in figure 3.4. The resulting line AB is interpreted as a demand curve and the price quantity combinations (P_1Q_1) (P_2Q_2) and (P_3Q_3) as various points on the curve. The curve connecting the points is negatively sloped showing the inverse relationship between the price charged and the quantity of X purchased. However, we will show that the available data is insufficient to conclude that AB is the demand curve for X.

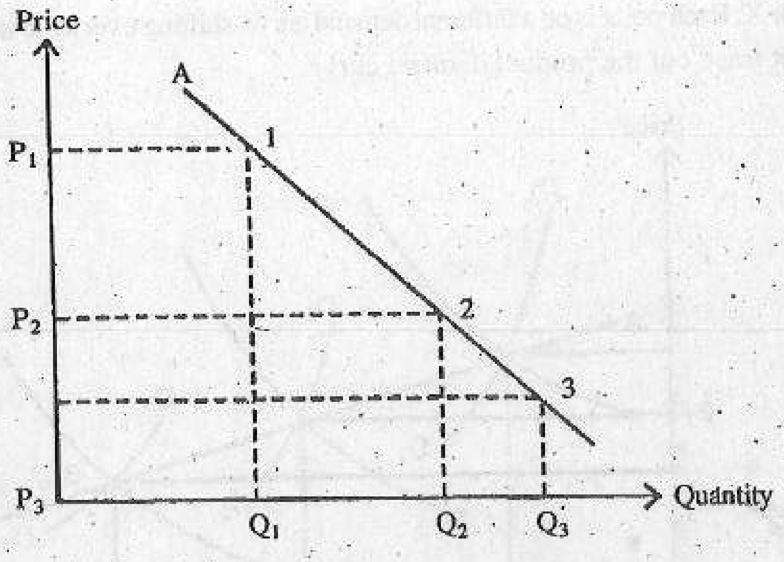


Figure 3.4 The Price Quantity Plot

For each of the points in time we have a price-quantity combination, which supports the theoretical relationship between them. But this will not yield the demand curve. We defined demand curve as the relationship between the price charged, and quantity demanded holding the effect of all the variables constant. Thus, to estimate the demand curve accurately, we must have been keeping constant the effects of all the variables in the demand function, other than price.

The price-quantity data used to construct AB in figure 3.4 are inadequate as all the effects of the variables may not have been eliminated. As a result, AB may be a demand curve, may not be. To see this, let us see the next figure (Figure 3.5). Here the price-quantity date is again plotted along with hypothesised true demand and supply curves for the product X. We See that the data points indicate the simultaneous solutions of supply-demand relationship at three points of time. The observed price-quantity data are the result of the interplay between the quantity of X supplied by the producers and the quantity demanded by the consumers. The intersection of the supply and demand curves result in the observed price-quantity points but AB is not a demand curve. The non-price variables in both supply and demand functions have changed during the data collectionperiods. New and more efficient production processes may have shifted the supply curve downwards. On the other hand, the price of a complementary good has fallen of income of the consumer has risen resulting in the shift of the demand curve. So the observed points do not lie on a single demand curve for X. Each point is on a different demand curve-shifting over time-so connecting them does not trace out the product demand curve.

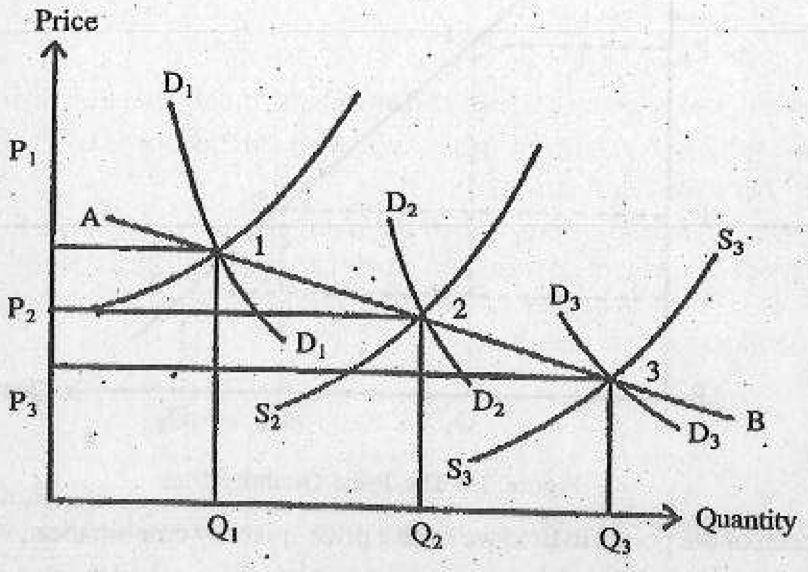


Figure 3.5 Supply and Demand curves and the Identification problem

If the firm makes the mistake of erroneously interpreting AB as the demand curve. It may reduce the price from P_1 to P_2 expecting a rise in demand from Q_1 to Q_2. In reality, this reduction will result in a much smaller increase-as the true demand curve is less elastic than the line AB. The producer will not be able to sell the increased output.

Given the possibility of such a situation, can data on price and quantity ever be used to estimate a demand curve? Of course, it can be done only when one is certain that only supply curves have shifted in the intervening time or there is enough information to determine the shifts of the curve.

It is clear from the above example that the problem of simultaneous relationship in supply demand analysis can be overcome if the researcher has enough information to identify the interrelated functions so that the shifts in one curve can be distinguished from shifts in the other. This particular problem is known as the **identification problem**, the problem of estimating one function when simultaneous relationship exits. This problem can be overcome if one we have sufficient in formation on the nature and extent of shifts of the supply and demand curves. When the identification problem cannot be solved, primary data collection techniques have to be used to obtain information about the functional relationships.

For identification problem, econometricians have suggested two restriction—

(1) Apriori Restriction :

$$D_t = \alpha + \beta p_t + u_t$$

$$S_t = r + \delta p_t + v_t$$

where u_t and v_t are error terms in demand and supply function respectively.

If we assume $v(v) \approx 0$ and $v(u) >> v(u)$ demand function is easily identified.

(2) Zero Restriction :

Suppose, demand function includes income apart from price. Then for different values of income, demand function shifts and supply curve is identified. Suppose, supply function includes weather apart from price. Then, for different values of weather supply function shifts and so demand curve is identified.

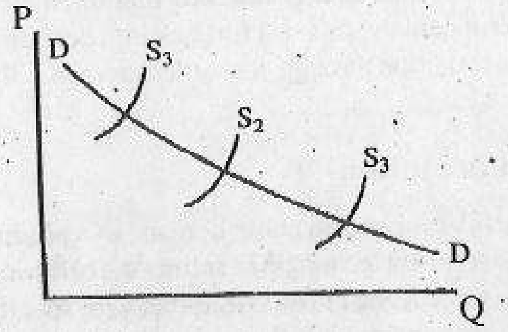


Figure 3.5A
Demand curve is identified

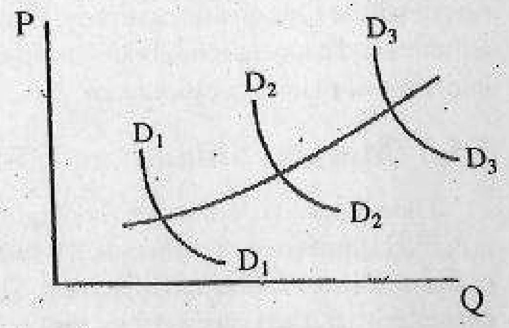


Figure 3.5B
Supply curve is identified

3.5.2 Consumer Survey

Consumer survey procedure requires the questioning of firms, customers or potential customers in an attempt to estimate the relationship between the demand for its products and a variety of variables received to be important for marketing and profit planning functions. The technique can be applied naively by simply stopping shoppers and asking questions about the quantity of the product they would purchase at different prices. At the other extreme, trained interviewers may percent sophisticated questions to carefully selected sample. Same type of result can be obtained by sending mailed questionnaires to a large number of customers.

Theoretically, consumer surveys can provide excellent information on a number of demand relationships. The firm may question a sample of its customers about projected purchases under a variety of different conditions relating to price, advertising expenditures, prices of substitutes and complements, income and any number of other variables in the demand function. Then, by aggregating data, the firm could forecast its total demand and estimate some of the parameters in the demand function for its product. Unfortunately, this procedure does not necessarily work so smoothly in actual practice. The quantity and quality of information obtainable by this technique is likely to be limited. Consumers are often unable, and in most cases unwilling, to provide accurate answers to hypothetical questions about how they would react to changes in the key demand variables. This does not imply that consumer survey techniques have no merit in demand analysis. Using subtle inquiries, a trained interviewer can extract a good deal of useful information from consumers. An interviewer might ask questions about relative prices of several competing goods and know that people are not aware of such price differentials. This is a good indication that demand is not highly responsive of price changes, so a producer would not attempt to increase demand by reducing price-consumers would not ever notice such reduction. Similar questions can be used to determine whether consumers are aware of advertisement programmes and to what extent. Again for certain kinds of demand information, there is no substitute for consumer survey. In short-term demand or sales forecasting, consumer attitudes and expectations about future business condition through consumer surveys, either interview of mailed questionnaire.

3.5.3 Market Studies and Experimentation

The alternative technique for obtaining useful information about demand of a product is market studies and experiments. The market experiment technique examines the behaviour of the consumer in the actual market. The firm selects one or more markets with specific characteristics, then varies prices, packaging advertisements and other controllable variables in the demand function. The variations may be over time or between markets. Then, it may be determined how these changes affect demand. With several segregated markets, the firm may also be able to use census or survey data to determine how such demographic characteristics as income, family size, educational level and ethnic background affect demand. Market experiments have several shortcomings. They are expensive and usually undertaken on a scale too small to allow high levels of confidence in the results. The short-run versus long-run effects are also related to this problem. These experiments are hardly run for sufficiently long periods to indicate the long-run effects of price, advertisement of packaging strategies. The firm is thus forced to extend the short-run results for longer periods.

Difficulties associated with the uncontrolled parts of the market experiment also reduce its value as an estimating tool. A change in economic conditions during the experiment would invalidata the results, especially if the experiment includes several separated markets: a local strike of layoff by a major employer in the locality or natural calamity may ruin the experiment. On the other hand, a change in a rival product's promotion, price of packaging can distort the result. Above all, there is the danger of losing customers during the experiment and never regaining them.

A second type of market experimentation utilises a controlled laboratory experiment wherein consumers are given funds with which they are instructed to shop in a simulated store. By varying prices, packaging, displays and other factors, the experimenter can learn a lot about consumer behaviour. This technique would provide similar information as the previous method, with lower cost and greater control over the exogenous factors.

This consumer clinic or laboratory experiment technique is not without short-comings. The main problem is that the subjects know that they are part of an experiment and this will distort their shopping pattern. High cost of such experiments restricts the size of the sample, which reduces the reliability of the inference. Even then, such experiments are used in those situations where the information needed for statistical demand estimation cannot be obtained from historical records.

3.5.4 Regression Analysis

The most frequently used statistical method for demand estimation is the regression analysis. In spite of the limitations of this technique, good estimations of demand functions can be obtained at relatively small cost.

For our convenience, we can study regression analysis in following five steps :

i. Specifying the variable: the first step is to specify the variables expected to influence the demand for the concerned product. The demand for the product is the dependent variable here. The list of independent variables is going to vary according to the nature of the product. As for example, demand functions for expensive durable goods would include interest rates and other credit terms, whereas the demand determinants for capital goods would include corporate profitability, wage rate trends and capacity-output ratio among other things.

ii. Obtaining data on the variables: The next step is to obtain accurate estimates of the specified variables. This is not an easy task, especially if the study involves a long period. Further some key variables like consumer's attitude towards quality and expectations about the future may have to be obtained by consumer or market surveys, which would introduce subjectivity and consequently bias in the data.

iii. Specifying the form of the equation: A number of mathematical forms can be used for demand equation depending on the situation. Here we will have a brief discussion on the two most common functional forms; namely, linear and power.

Linear functions. The most common specification is a linear relationships is the following; $Q = a + bP + cA + dY$ (3.10)

Here Q represents the quantity of a particular product demanded, P is the price charged, A is the advertisement expenditure and Y is the per capita disposable income. The demand curve for such a demand function is a straight line. This type of demand functions are often used in empirical works for two reasons. First, experience has shown that many demand relationships are approximately linear over the range of the data. Second, the method of least squares can be used to estimate the regression coefficients.

Power functions. The second most commonly specified demand relationship is the multiplicative form :

$$Q = aP^{b} A^{c} Y^{d} \quad (3.11)$$

This equation is popular for two reasons. First the multiplicative equation is logically the most appropriate demand function. It is the one with the most intuitive appeal, as the assumption of the marginal effects of each independent variable on demand are not constant; rather depend on the value of all other variables in the demand function. This can be easily seen be considering the partial derivative of the equation 3.11 with respect to income, $\delta Q/\delta Y = adP^{b}A^{c}Y^{d-1}$, which includes all the variables of the original demand function. This changing marginal relationship is more realistic than the implicit assumption of the linear model that the marginal relation is constant. For example, as income increases the demand for a luxury food item may increase continously. But it is unlikely that the increase will be linear. It will be more rapid at the lower income level, gradually tapering off at the higher income level.

The second reason for the popularity of the multiplicative demand function is that this algebraic form can be transformed into a linear relationship using logarithms. Then, it can be estimated by the least square technique.

An interesting and useful feature of this form is that they have constant elasticities over the whole range of the data. These elasticities are given by the coefficients estimated in the regression analysis. Constant elasticities are useful porperties in demand equations. The algebraic form of the demand function should always be chosen to reflect the true relationship between the variables in the system under study. The empirical demand function should be consistent with the suderlying theory. In fact, there in no a priori basis for specifying the form of the relationship. In such cases, several theoretically appropriate forms may be tested and the one that fits best should be selected as the most likely reflection of the true relationship.

iv. Estimating the regression parameter. Regression equations are typically fitted by the method of least square. At present, it is seldom necessary to perform the actual calculations, since in the age of computers, there are very good and easy-to-use statistical softwares to perform the job. All that a researcher has to do is to enter the relevant data.

v. Interpreting the regression equation. The most important step for a researcher is to interpret the value of the coefficients. This can be done it two steps for a multivariate regression. The first is the **measures of overall explanatory power :**

This can be done by using statistics like the coefficient of determination (R^2) (along with corrected coefficient of determination R^2) F-statistics and the standard error of the estimate. The second is **measures of the explanatory power of the individual variable.**

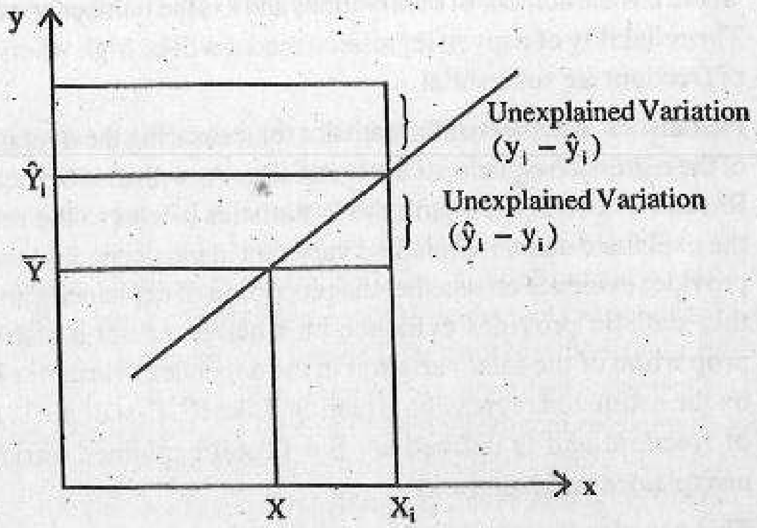


Figure 3.6 Explained and Unexplaine variation of the Dependent Variable in a Regression Model

R^2: The coefficient of determination R^2 is defined as explained variation as the proportion of the total variation, which is explained by the regression madel. An R^2 of 1 indicates that all the variation has been explained, i.e. each predicted value for the dependent variabel must exactly equal the corresponding observed value. As the size of the deviations about the regression curve increases, $R^2 = 0.8$ indicates a good estimate Generally speaking, R^2 would fall. At the extreme, it will be zero. In this case, the regression equation has been totally unable to explain variation in the dependent variable. In actual regression study, R^2 will seldom be equal to either 0 or 1. Usually in empirical works, R^2 is higher for time-series studies than cross-section studies, as exogenous factors are held constant in cross-section studies. A low R^2 indicates the inadequacy of the model, which generally arises for the omission or important variable of variables from the model.

The coefficient of determination is not highly reliable as it can be made artificially high if too small a sample is used to estimate the model's coefficient. So, a substantial number of data observations are needed to fit a regression model adequately, so that there is substantial number of degrees of freedom (*df*). Degree of freedom is defined as the numder of data observations beyond the minimum necessary to calculate a given regression coefficient or statistic. Since R^2 always approaches zero, statisticians have developed a method for correcting R^2 to account for the number of degrees of freedom. The corrected coefficient of determination R^2 is given by

$$R^2 = R^2 - (k - 1)/(n - k)(1 - R^2)$$

where n is the number of observations and k is the number of estimated coefficients. The reliability of a given regression model will be high when both R^2 and degrees of freedom are substantial.

F-Statistics. Another useful statistics for measuring the overall explanatory power of the regression equation is the F-statistics. As with the coefficient of determination R^2 (and its corrected from), the F-statistics relates to the relationship between the explained and un-explained variation in the dependent variables. whereas R^2 provides evidence on whether the proportion of explained variation is high of low, this statistic provides evidence on whether or not a statistically significant proportion of the total variation in the dependent variables has been explained by the estimeted regression equation. Like R^2, F-statistic is adjusted for degres of freedom and is defined as: F = [Total explained variation\(k-1)]/ [Total unexplained variation/(n-k)

This can also be calculated in terms of R^2 as:

$$F = [R^2 / (k - 1)]/[(1 - R^2) / (n - k)] \quad 3$$

The hypothesis actually tested is that the dependent variable is statistically unrelated to all of the independent variables included in the regression will be quite small. At the extreme, the F-statistic will take on a value of zero when the regression equation taken as a whole provides absolutely no explanation of the variation of the dependent variable. As the F-statistic increases from zero, the hypothesis that the dependent variable is not statistically related to one or more of the independent variables in the reression equation becomes easier to reject. At some point, F-statistic will be sufficiently large to assume that at least some of the variables in the regression model are significant factors in explaining the variation in the dependent variable. After constructing the F-statistic, the F-test is performed to test the hypothesis. This involves comparing the F-statistic for a regression equation with a critical value from the table of the F-distribution. If the F-statistic from regression exceeds the critical value in the F-distribution, one can reject the hypothesis of independence between the dependent variable and the set of independent variables in the regression. Then, it can be concluded that the regression equation, taken as a whole, does significantly explain the variation in the dependent variable.

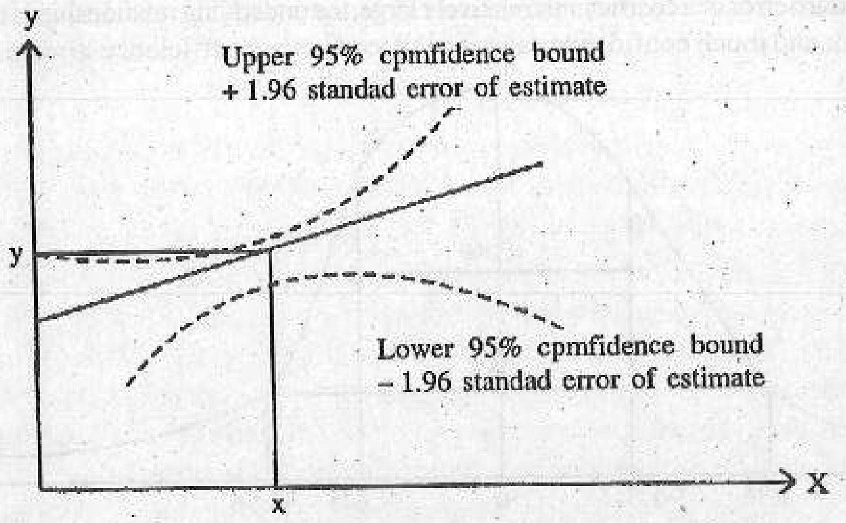


Figure 3.7 Illustration of the Use of the Standard Error of the Estimate of Define Confidence Intervals

Standard Error of the Estimate (SEE). Another measure for examining the accuracy of the regression model as a whole is the standard error of the estimate. This statistic provides a way of estimating confidence interval for predicting values of the dependent variable, give values for the independent variables. So, SEE is used to determine a range within which the value of the dependent variable can be predicted with varying degrees of statistical confidence. Although, the best estimate of the *i*th value for the dependent variable is, say $\hat{y}_i$ the value predicted by the regression equation, SEE can be used to determine just accurate the predition is. If it is assumed that the error terms are normally distributed about the regression equation, there is a 95% probability that future observarion of the dependent variable will lie within the range $\hat{y}_i$, ±1.96 (SEE), For 99%, it will lie within 2.576 (SEE). So greater predictive accuracy is associated with smaller standard error of estimate. Given the value of the independent variable, the interval between the upper and lower confidence bounds can be used of predict a value to the dependent variable with a certain percent of probability that the actual outcome will lie within that confidence interval.

Measures of Explanatory Powers of the Individual Variable

T-statistic. The standard error of the regression coeffcient provides a measure of the confidence that can be placed in the estimated regression parameter for each independent variable. When the standard error of a given estimated coefficient is relatively small, a strong relationship between the independent and dependent variable is suggested and it can be said with a high level of confidence, that the estimated coefficient accurately describes the relationship. On the other hand, if the standard error of a coefficientis relatively large, the underlying relationship is typically weak and much confidence cannot be placed in the coefficient estimate.

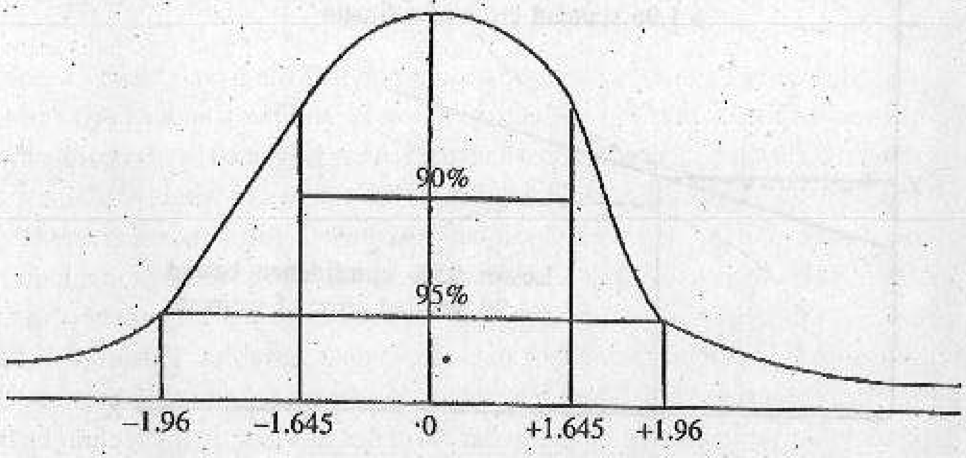


Figure 3.8 The t-distribution

A Variety of tests can be conducted based upon the size of a given estimated coefficient and its standard error. These tests are known as t-tests. This is performed to test whether the estimated coefficient $\hat{b}$ is significantly different from some hypothesised value b*. The t-statistics is given by

$$t = (\hat{b} - b^*)/\text{standard error of } (\hat{b} - b^*) \tag{3.12}$$

Thus, the t-statistics is a measure of the number of standard error between $\hat{b}$ and the hypothesised value b*. A t-test consists of comparing the calculated t-statistic with an apropriate critical t-value. If the sample is large, the t-statistic follows a normal distribution and the properties of normal distribution can be used to determine the critical t-values and construct confidence intervals. For small sample sizes (i.e. $df<30$), the t-distribution deviates from a normal distribution and a t-table should be used. There are two general types of hypothesis tests commonly undertaken using the t-statistics. Most common are simple tests to the size of the magnitude of a given coefficient if we want to know if a given independent variable has an effect on the dependent variable, it is appropriate to test the null hypothesis that the estimated regression coefficient is equal to zero. If this hypothesis can be rejected, then we can say that the independent variable is affected by the dependent variable. On the other hand, if the hypothesis is accepted, then we do not have any statistical evidence that this particular independent variable has any influence on the dependent variable, tests of the impact of effect of independent variable on the dependent variable are "two-tailed" tests. Sometimes managerial questions are not limited to the impact of the independent variable on the dependent variable.

It becomes necessary to determine whether the impact is positive or negative and in case of multivariate regression wherher the impact of one independent variable is greater of smaller than that of another. These tests of direction or comparative magnitude are " one-tail " t-tests.

Multicollinearity Problems in Regression Analysis. We have already seen the usefulness of the coefficient of determination R^2 and the standard error of the regression coefficients, but additional information can be gained by comparing these two statistics. If the R^2 is near 1, that indicates the model as a whole explains most of the variation in the dependent variable. However, if the standard errors of the coefficients for the various independent variables are also quite large in relation to the size of the coefficients, then little confidence can be placed in the estimated relationship between the dependent and independent variables. This implies that, while the regression model demonstrates a significant relationship between the dependent variable and the independent variables as a group, the technique has been unable to separate the specific relationship between each independent variable and the dependent variable. This is a problem of simultaneous relationships of multicollinearity, among the independent variables. The independent variables are not really independent of one another, but rather have values that are jointly or simultaneously determined. This problem can be troublesome resulting in assigning arbitrary values being assigned for the coefficients of the mutually correlated variables. When this problem occurs, it would be best to remove all but one of the correlated independent variables from the model before the parameters are estimated using a single equation regression model. Even then, the resulting regression coefficient assigned to the remaining variable can be used only for forecasting purposes rather than for explaining demand relationship. Actually, the coefficient of the remaining variable indicates joint effect on the dependent variable, both of it and of the removed correlated variables.

3.6 Summary

In this unit, we concentrated on a vary important aspect of managerial economics, i.e. demand analysis. We started with an overview of traditional demand analysis and identified it deficiencies. Then, we introduced Lancaster's approach to show that despite its limitations, it can cover some of these deficiencies. After that, we paid attention to the concept of elasticity and its application in some new area. The last section was devoted to elementary ideas of demand estimation, with a short review of both quantitative and qualitative methods.

3.7 Questions

1. What are the deficiencies of the new-classical consumer theory?
2. Do you think Lancaster's characteristics approach to consumer theory is an improvement over the traditional theory of consumer behaviour? Justify your answer.
3. Does the Lancaster approach give a better explanation for pricing of new goods?
4. How product-line pricing related to cross-price elasticities?
5. "The demand for a commodity is related to the phases of its life-cycle." comment of the statement with suitable examples.
6. Do you think elasticity (price or income) for the same product differs between the short-run and the long-run?
7. What, in your opinion, the gravest problem in quantitative demand estimation? How can you bypass the problem?
8. Describe in brief the methods of qualitative demand estimation.
9. How regression analysis be meaningfully used for demand estimation problems?

3.8 Suggested Readings

Dobbs, Ian M. (2000), *Managerial Economics : Firms, Markets andBusiness Decisions,* Oxford University Press, Oxford.

Hirschey, M and Pappas J.L. (1997), *Managerial Economics,* Drydenpress 7th Edition, New York. Salvatore, D Managerial Economics Part II, Ch 4.

Unit-4 □ Production and Cost Analysis

Structure

4.0 Objective

This unit gives an account of the traditional neo-classical theory of production and cost analysis. The theory of production is concerned with the relationship between inputs and outputs, whilet cost analysis concerns cost minimisation and variation of cost with output.

4.1 Production Functions

Production is a process of transforming inputs into outputs. Such inputs are also called factors of production. For a given set of input quantities, there is typically a limit to the amount of output that the firm can produce. The functional relationship between maximum output for given input is termed as the production function. More technically, the production function $q = f(x)$ (Figure 3.1) denotes the relationship between the maximum achievable output corresponding given input vector x. On the other hand, an isoquant is the locus of all the technically efficient combinations of K and L for producing a given level of output. The function f represents existing technology. There are four standard factors of production— Land, Labour; Capital & organisation since, land is god-gifted and capital is produced means of production we club them as k and since organisation is skilled labour we club them as

L. So, we write the production function as Q=f(K, L). However for Agricultural commodities we need some addition inputs like fertiliser, Irrigation etc.

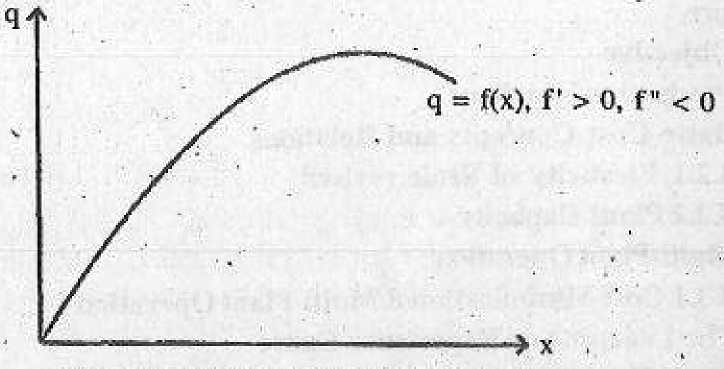


Figure 4.1 The Production Function

Two most common assumptions made about the production function are that

1. f(0) = 0; there is no output without some input

2. it is a smoth function; e.g at least, twice continuously differentiable.

But, there is a variety of commonly used production functions like Cobb-Douglas and Leontief, Which does not always abide by these assumptions.

A Leontief production function assumes strict complementarity (i.e. zero substitutability) of the factors of production. There is only one method of production for any one commodity. Here the isoquant takes the shape of a right angle. This type of isoquant is also called input-output isoquant, because Leontief originally used them for Input-output analysis.

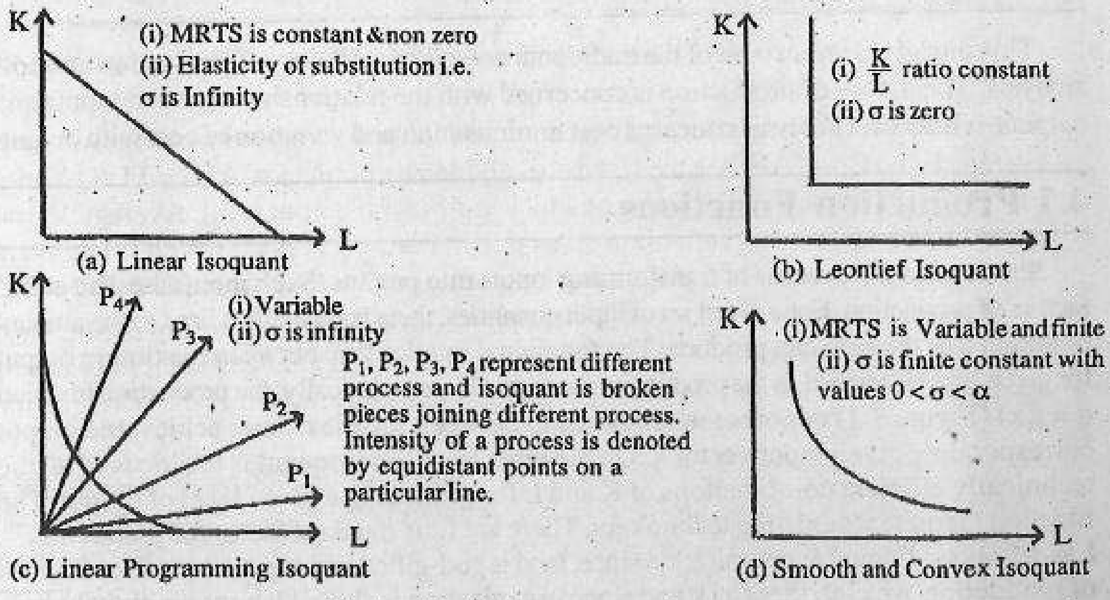


Figure 4.2 Different types of Isoquant

These different types of isoquants refer to different nature of substitubility between inputs captured by two conceps

(i) Marginal rate of technical substitution (MRTS)

(ii) Elasticity of substitution between input (σ)

$$MRTS = - dk/dL = MP_L/MP_K \quad \sigma = \frac{d(k/L)\Big/\frac{k}{L}}{d(MRTS)/MRTS}$$

On the other hand, there are also production functions which show constant elasticity of substitution. For two inputs capital (K) and labour (L), elasticity of substitution is defined as the percentage change in the capital-labour ratio divided by the percentage change in the rate of technical substitution i.e. = (percentage change in k/L)/percentage change in the marginal rate of substitution.

The Cob-Douglas production function is a specific mathematical form of production function, i.e. $Q = A \cdot k^{\alpha} \cdot L^{\beta}$ α and β denote elasticity of output wrt Capital and Labour when this production function obeys CRS, $\alpha + \beta = 1$. It is most popular in applied research, because it can be Landled vary easily mathematically. It is also a special form of CES (Constant Elasticity of Substitution). Production function as here the elasticity of substitution is equal to one. The form of CES looks like $Q = [\delta k^{-\rho} + (1-\delta)L^{-\rho}]^{-1/\rho}$ and $e_s = \frac{1}{1+\rho}$.

δ = Distribution Parameter ; ρ = Substitution Parameter, $\rho \to 0$, $e_s \to 1$.

4.2 Basic Cost Concepts and Relation

In this section, we start with a set of definitions of the basic concepts and their relationships with each other.

Fixed cost, (FC hereafter), are the costs which do not vary with changes in output. Average Fxed Cost (AFC) is the fixed cost divided by output i.e. AFC = FC/Q Variable Cost (VC) is that part of the total cost which varies with output level. Average Variable Cost (AVC) is defined as variable cost per unit of output. i.e. AVC = Vc/Q. The average total cost (AC) is total cost per unit of output i.e. AC = C/Q where C = FC + VC.

Marginal Cost (MC) at a given level of output is the additional cost of producing one more unit of output (for discrete units) or the rate at which total cost increases as output is increased (for continuous production), i.e. it is thus the gradient of the cost function at the input level, MC = dC/dQ.

We have not specified the time horizon deliberately; distinction between fixed cost and variable cost will depend on the decision context involved. When the concern is primarily with short-run variations in the level of output, the rental costs of plant machinery, land and building are all regarded as fixed costs, while labour and material are regarded as variable, However, we have to remember that in the long run, all costs are variable.

$C = FC + VC$ (4.1)

So it follows that, dividing through by output, average total cost equals average fixed plus average variable costs :

$AC = (FC/Q) + (VC/Q) = AFC + AVC$ (4.2)

Since fixed costs are invariant with output $dFC/dq = 0$. Hence is follows that

$MC = dC/dQ = d(FC + VC)/dQ = dVC/dQ$ (4.3)

Thus, marginal cost, MC is equal to the gradient of the total cost function, which, at the same output level, equals the gradient of the variable cost function. The relationship is illustrated in Fig. 4.3.

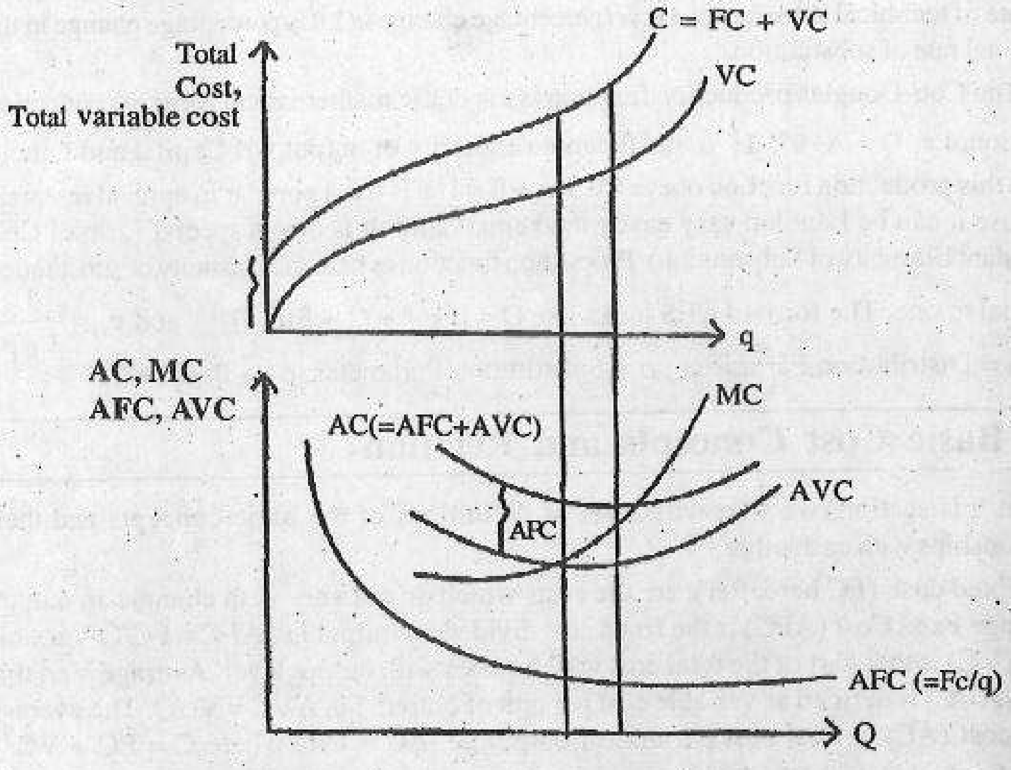


Figure 4.3 Cost and Average cost curves

With every unit increase in output, if marginal cost is greater than average cost, it is adding more than the average cost, and so it leads to the average cost increasing; equally it marginal cost is below average cost, this means marginal cost pulls down as output increases. The same argument applies to the relationship between marginal cost and average variable cost. Thus the gradient of the average variables cost functions is given as :

$$d(AVC)/dq = d(VC/Q)/dQ = [q(dVC/dQ) - VC]/Q^2 = \frac{1}{Q}(MC - AVC) \quad (4.4)$$

Since q > 0, the gradient of the AVC curve is positive if MC > AVC and negative if MC < AVC. So AVC has positive/negative gradient, depending on whether MC is about or below it. Similarly,

$$d(AC)/dQ = 1/Q(MC - AC) \qquad (4.5)$$

So that AC has positive/negative gradient depending on whether MC is above or below it.

As with demand elasticities, it is possible to speak of cost elasticity η_c. This is defined as for a discrete change in output caused by percentage change in cost caused by the percentage change in the level of output : AFC curve is a rectangular hyperbola as because it takes the form (xy = C). AVC curve is u-shaped $AVC = \frac{VC}{Q} = \frac{wL}{Q} = \frac{w}{Q/L} = \frac{w}{AP_L}$ o

Following laws of returns AP_L increases first and then decreases. So, AVC decreases first and then increases.

$MC = \frac{dC}{dQ} = w \cdot \frac{dL}{dQ} = \frac{w}{MP_L}$. Applying previous logic, MC Curve is also u-shaped and it passes through the minimum point of AC Curve.

$$\eta_c = \text{percentage change in cost/percentage change in output} = \frac{dC/C}{dQ/Q} = \frac{dC}{dQ} \cdot \frac{Q}{C} = \frac{MC}{AC}. \qquad (4.6)$$

4.2.1 Elasticity of Scale Revied

Though the elasticity of scale measures how output increases when inputs are increased prorata, but the cost-minimising behaviour would often require that starting from an input configuration which is cost minimising, any move to another input configuration which was also cost-minimising would be unlikely to feature a pro.rata expansion in the level of all inputs. At points in input space which are cost-minimising ways of producing output, the following relation between cost elasticity, scale elasticity, marginal cost and average cost holds :

$$\eta_s = 1/\eta_c = AC\backslash MC \qquad (4.7)$$

Thus, at any given level of output, local economy of scale greater than unity ($\eta_s > 1$) inplies a cost elasticity of less than unity and MC < AC, equally, if there are diseconomics of scale, the inequalities reverse. The argument applies in reverse too; falling average cost at a given output level implies local economies of scale associated with the (cost minimising) input vector used to produce that level of output.

4.2.2 Plant Capacity

'The point at which marginal cost and average variable cost start increasing is conventionally termed as the point of full capacity. The difference between the actual output level at any point in time and full capacity is referred to as excess capacity. Firms often install plant with full capacity in excess of current production needs, to allow for expansion for demand in future, or to cope with demand fluctuations and uncertainty. Installing excess capacity can also help when there are problems in production (machine failures, labour disputes etc), since it implies that inventory can be rebuilt more quickly when production does eventually get back on stream.

4.3 Multi-plant Operation

In reality, many firm operate multiple plants. These may be located on the same site or on different sites. Out preceding discussion on cost curves implicitly assumed that the firm would select a single plant size, and the plant would have a particular optimal scale depending on the output the firm wished to produce.

The merits of having multi-plant system are :—

1. Reliability : if there is a positive probability of a plant not being able to run, because of technical failure, disputes etc, then having several plants, possibly in different countries, can at least maintain some level of output. The plants in operation can often, in the short run, cover the shortfall in production.
2. Multi-plant operation facilitates routine maintenance; maintenance of a single production unit would typically lead to shut down. With several plants, the loss of output by one unit being out for maintenance can be compensated by higher output from the remaining units.
3. It may allow plants to be located closer to local demand, and this may reduce transportation or transmission costs.
4. If there is fluctuation in demand, plants can be put into or taken out of production. Those remaining in operation can be maintained at close to minimum average variable cost. With just a single plant, unless inventory can take the strain, the plant may have to be operated at significantly above minimum average variable cost.

The disadvantages of multi-plant operation lie in :

1. Increased complexity in co-ordinating production (rise in operational and administrative costs).
2. Possible loss of economies of scale; larger plants may be able to operate at lower average cost.

4.3.1 Cost Minimisation & Multi-plant Operation

If a certain total output is required, then assumption that it is rational to run all the plants, cost minimisation involves operating each plant at a level such that all plant marginal costs are equalised. Suppose there are two plants, labelled 1 and 2, and their costs of production are $C_1(q_1)$ and $C_2(q_2)$ where q_1 and q_2 are the output levels of the two plants. Thus the total output q is the sum of q_1 and q_2.

The problem is to minimise total costs $C_1(q_1) + C_2(q_2)$, Subject to producing output q. Thus; the choice variables are q_1 and q_2 where q is a fixed constant as far as the optimisation is concerned. Given the Lagrangean equation :

$L = c_1(q_1) + C_2(q_2) + \lambda[q - q_1 - q_2]$, λ being the undetermined Lagrange Multiplier. (4.8)

the first-order condition yields that $MC_1 = MC_2 = (\lambda)$ (4.9)

i.e. marginal cost should be equalised.

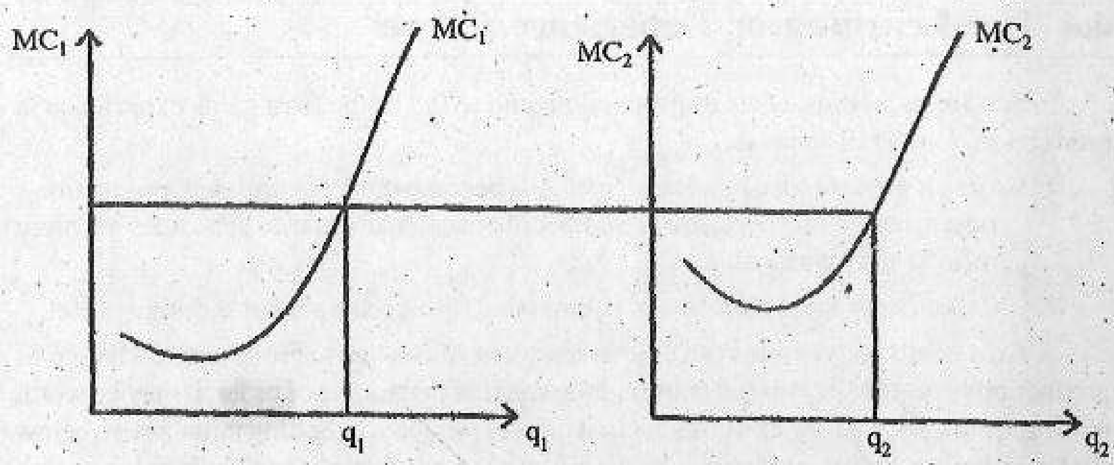


Figure 4.4 Multi plant Operation

The intuitive explanation for this result is straightforward and it is illustrated in Figure 4.4. Suppose the marginal costs are different, i.e. $MC_1(q_1) > MC_2(q_2)$. Then, the total output can be maintained if output in plant 1 is decreased by one unit whilst output in plant 2 is increased by one unit. The overall saving in cost is $MC_1 - MC_2$. If marginal costs are still different, the process should be repeated and so on. Eventually, a point is reached where the marginal costs are equal. This analysis assumes that all plants are always used. In practice, this may not be the case. Depending on the level of demand, it may be perferable to operate only a subset of all the plants. If the plants have the usual U-shaped marginal cost curves, then the analysis is quite complex. Firstly, it implies computation of the optimal solution for operating n plants and then finding out how many plants should be operated at once tominimise the total cost. As q increases, it becomes optimal to operate more and more plants, and each plant gets to be operated nearer its minimum average cost. For the subset of plants that are used, their marginal costs should be equalised. As output increases from zero, the optimal solution is satisfied by one plant only. This continues till the marginal cost becomes greater than the minimum of the average cost curve; suddenly, it becomes optimal to introduce a new plant. At this point, the output of the first plant drops by a half and both plants produce this new output level. As the new output increases, production at both plants expands equally; eventually it becomes optimal to switch to three-plant operation, outputs of the original two plants drop and so on.

An important feature of the multi-plant production is that the average cost tends to flatten out, as does the marginal cost to a constant level. This reason is often shown for the flatness of the longrun average cost. But one should remember that with increasing output and increasing number of plants, the problems of coordinating and managing production may start to increase. Thus, the long-run average costs for the firm as a whole may start to rise.

4.4 The Learning or Experience Curve

In certain industries, costs of production tend to fall as the firm gains experience in production. Costs fall because.

1. labour productivity improves : methods become more streamlined, production organisation improves, lesser number of errors, maintenance schedules get more refined and manageable;
2. defective process elements get eliminated, sub-processes get redesigned etc.

A firm needs to try to make some assessment of how costsare likely to change as production proceeds. If costs fall substantially with the magnitude of order, it may be worth while setting a price below unit costs for first units of production. Setting initial prices below cost may help to secure orders; the increased level of production then leads to lower unit costs for future production such that initial losses can be made up from later sales. This is like moving in a circle, failure to recognise the learning curve may lead to initial production being too costly, with tender prices set at uncompetitive rates; the worst result would be low or zere orders for the product with disastrous consequences.

If the rate of learning can be estimated from an analysis of the past, this can be used as a predictor for changes in costs for new or similar products. The learning curve model does not examine the reasons of fall in costs for certain type of manufacturing process as cumulative output increases. If costs have to be reduced, the learning process has to be active and cost reduction has to be sought activety. The pursuit for increased efficiency can continue for new products in the same way as old products. But the past may not always be a good guide in case of learning curve. This is because the time spans involved are longer and there is a great potential for the environment to have changed in between.

A simple model of learning by doing assumes that average costs per period falls at a constant per cent rate. Let q_t denote output at period t, and Q_t the cumulative amount produced up to and including period t (since the launch of the product); C_t is the cost (more likely variable cost) incurred in period t. The constant-percentage learning curve postulates that average variable cost (or average cost) C_t/q_t falls at a constant rate i.e. exponentially. So we, may write :

$$C_t / q_t = AQ_{t-1}^{-b} \qquad (4.10)$$

Multiplying throughout by q_t, this implies

$$C_t = Aq_t Q_{t-1}^{-b} \qquad (4.11)$$

The common 80% learning curve suggest that if total cumulative production doubles average cost, for any given output level will fall by 20%. More generally, an L% learning curve corresponds to the value b = In (L\100)/In (2). The typical structure of the curve is depicted in Figure 4.5.

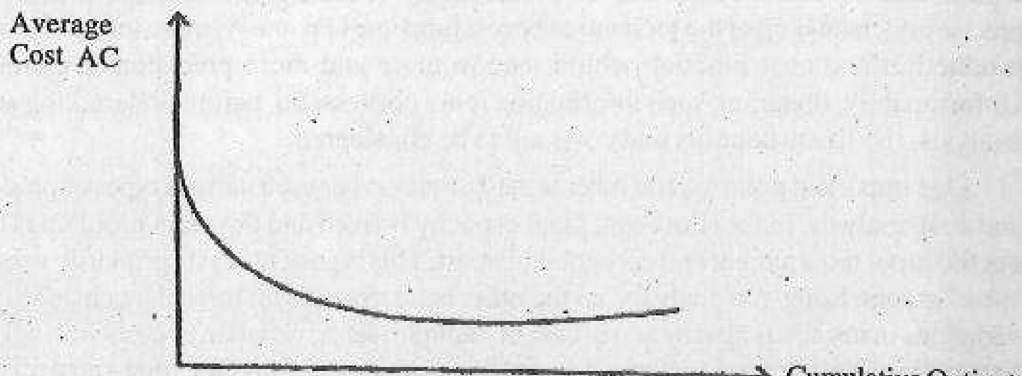


Figure 4.5 The Experience curve

4.5 Multi-product Cost Function

Most firms actually produce more than one product. This has many implications on market structure and also leads to complexities in the formal analysis of product costing and determination of optimum selling price. Without entering into such details, in this section, we will explain the idea that the multi-product cost function is established as a cost-minimising solution to the problem of organising production in order to produce a given vector.

Let the output vector for a firm producing m products, as $q = (q_1, q_2, \ldots\ldots\ldots q_m)$ and the vector of inputs as $x = (x_1, x_2, \ldots\ldots\ldots x_m)$ The multi-product production function can be written in the implicit form f (q, x) = 0 (4.12)

Here, we may also mention the concept of a joint product firm which produces two outputs Q_1 and Q_2 from a given input level x. Product transformation curve is also defined as locus of different combination of two outputs which can be produced from a given level of input. Correspondingly cost function can be defined as—$c = c(x) = [h(Q_1, Q_2)] = c(Q_1, Q_2)$.

The problem of producing q at minimum cost involves choosing input vector x so as to minimise $C = \Sigma w_i x_i$ subject to the production function. For a given vector of outputs q, the optimisation leads to optimal levels for each of the inputs, such that these are functions of the output vector. Hence the minimised cost is $C = \Sigma w_i x_i^* (q, w)$. Thus the minimised cost depends solely on input prices and the output vector.

4.6 Alternative Methods of Cost Estimation

The cost function, once estimated can be used as the basis for cost forecasting and for analysis of price, output and advertising decisions. The neo-classical theory of production and cost presumed that the production function was known and hence cost minimisation would lead to a cost function known with certainty. In reality, however, firms do not have precise understanding of the production or cost function. Obviously, more information about production and cost function would lead to more and more precision in estimation. Unfortunately, obtaining such information is not costless. So, before undertaking such an analysis, the likely benefits and costs are to be considered.

One important point to remember is the distinction between various types of production and cost analysis. In the short-run, plant capacity is fixed and the main problem is to find out the input requirement and consequently cost. This type of analysis primarily uses firm-specific data. Long-run analysis, on the other hand, focuses on how plant costs vary with variations in installed capacity and in case of multiple plants, variation of costs with aggregate firm output. This type of analysis is useful for capacity planning, the long-run decision on size and timing of plant installation. Estimation is usually on the basis of cross-section data, looking at costs and outputs of different firm-plant sizes across an industry. This type of analysis is quite complex and there is a variety of statistical problems that may arise. In this study, we are not considering long-run analysis.

4.6.1 Engineering Analysis

The engineering analysis is conceptually straightforward it consists of two or three stages (depending on whether there is a choice of process in the short run), namely:

1. establishing the input-output relationship for each process
2. pricing the inputs, and
3. optimising production to derive the cost function.

In the short-run, the production process will often fix how the input requirements vary with increase in output. The input requirement will depend to some extent on the physical or chemical laws and to some extent on spoilage and wastage rates associated with the production process. Sometimes, the relationship will be linear (raw meterialswill increase pro-rate with output), sometimes theywill be non-linear (i.e. fuel efficiency and spoilage rate).

The second stage is quite simpler, involving the determination of input prices. Depending on the objective, the current or future prices are to be used. This is quite straightforward, though for some specific inputs, there may be complications. As for example, often the aggregate labour cost is used. But labour is heterogeneous with respect to quality and price. There is not only occupational wage variation but also complications may arise due to overtimes and higher rates for shift work etc.

Finally, it is possible to vary the input mix and/use alternative processes to generate output, the production process needs to be optimised. It is often possible to set up the problem of minimising cost subject to certain restrictions on input mix.

The main drawbacks of the engineering approach are as follows :

1. Often, there is no explicit consideration of input optimisation. In such a case the calculated engineering cost-output relationship may be based on inefficient process and input use.

2. In case of complex, highly interdependent production process, there may be many inputs used in common to produce many outputs. In Such a case, it may become difficult to construct the mathematical relationship between inputs and outputs and the statistical approach becomes absolutely necessary.

3. In is purest form, the engineering approach does not include the relationship between the distribution, selling and administrative costs and variation in output these relationships are to be estimated beforehand by using the statistical approach.

4.6.2 Statistical Cost Estimation

Statistical cost estimation involves the following steps:

1. Identification of variables likely to affect cost (usually, and primarily, the level of output)

2. Collection of date on such variables, and

3. Analysis of the relationship between these variables.

Date for Statistical Cost estimation

Essentially data can be generated either through direct experimentation or through an examination of the firm's past experience of production.

Experimental Data

In some circumstances, the firm may be able to set up a controlled experiment to explore how inputs and outputs are related. In farming, there may be studies exploring how changes in fertliser input affect the outputs of particular crops. In pharmaceutical industry, controlled experimentation may be used to study the close-response relationship. Such experiments are not costless, but produce data of much higher quality.

Historic (Accounts-based) Data

Usually the accounting approach typically classifies inputs as fixed, variable and semi-veriable. We are not going into accounting details here but focus on general considerations, pitfalls and problems with historical data.

Some of the important considerations in selecting historical data are as follows :

1. *Stable production processes*. There should be no major changes in the production process within the estimation period chosen. This consideration can severely limit the availability of date but ignoring such changes would imply misspecifications of the model.
2. *Period Choice and Problem of Spillovers.* A reasonable longer period for date is required, as the data must feature significant variation in the output levels across periods. A longer period is statistically desirable, but longer the period, there is lesser chance of ceteris paribus; input prices change, processes gets changed. On the other hands shortening of the measurement period may increase the data set, but the problems of spillovers and measurement errors tend to increase.
3. *Overhead Cost Allocations.* Overhead costs often vary to some extent with output. It the firm produces a single product, it may be possible to study how overheads very with output, one may find out the fixed component of overhead. But usually firms often produce several products. In such a case, the overheads appear to be variable.
4. *Adjustment for Inflation and Relative Price Changes.* So long as there is no significant flexibility in the use of inputs and no change in input prices, then cost can simply be taken as a function of out put. In input prices change because of general inflation, if the inputs remain fixed, the also cost is a function of output, only all the elements of costs are to be expressed in terms of constant prices. But if there is notable flexibility in the choice of inputs, then modelling cost as a function of output would become misspecification.

- The Regression Exercise

The procedure of regression is almost the same as in case of demand estimation. The specification is an important issue here. This is more because the economic theory does not suggest any particular function form for the cast function. The simplest forms of cost function usually estimated are the log-linear (Cobb-Douglas) form

$$\log C_t = \alpha_0 + \alpha_1 \ \ln q_1 + \varepsilon_t \text{——Double log Form.} \qquad (4.12)$$

Where q_t is the level of output in periods t and C_t, the magnitude of cost under investigation.

4.7 Estimating Learning Curves

As production for new products get started and initial problems are eliminated unit costs of production may fall, such an effect is referred to as the learning curve or the experience curve. If there are significant learning effects, cost functions are misspecified, the estimated function obtained form regression exercise can be seriously misleading for prediction purposes.

In section 4.4, the simple model for learning by doing was outlined, where the average cost fell at a constant percentage rate as cumulative production increased. The constant percentage learning curve postulates that average variable cost C_t/q_t falls at a constant rate (exponentially). Thus, we can write,

$$C_t / q_t = AQ_{t-1}^{-b} \tag{4.13}$$

Multiplying throughout be q_t, implies that

$$C_t = Aq_t Q_{t-1}^{-b} \tag{4.14}$$

This is a pure learning curve model, as it presumes that variations in output within the period do not affect the average variable cost. In absence of learning curve effect also, the average (vaiable) costs could be influenced by the output per period. With constant elasticity formulation, without learning effect, the standard form of cost function would be $C_t = Aq_t^{\alpha}$. To accommodate this, we may write $C_t = Aq_t^{\alpha}Q_{t-1}^{\alpha}$. This model allows that average variable costs may vary within the period (as a function of output) and from period to period (as cumulative output increases). Thus we can examine whether there is a decreasing, constant or increasing variable cost and whether there is any significant learning effect. Taking log of both the side and adding an additive error term, the ordinary least square methods may be applied to estimate and test the significance of α_1 and α_2.

4.8 Summary

This unit started with a recapitulation of production function and isoquants. Then if reviewed the basic costs concepts and related ideas like elasticities of scale and plant capacity. After that, more recent problems like multi-plant operation and learning curve were discussed, lastly, it concentrated on alternative methods of cost estimation.

4.9 Questions

1. Define production function and isoquant and describe their importance in traditional analysis of production.

2. Bring out the relationship between total cost, average cost and marginal cost in both short and long run.

3. What is the importance of differentiation between fixed and variable cost in the traditional cost analysis?

4. For a single product firm, what is the relationship between scale elasticity, cost elasticity and economies/diseconomies of scale?

5. Is it necessary for the multi-plant firm to choose outputs such that all marginal costs are the same? Discuss.

6. What are the difficulties in statistical estimation of cost function?

7. To what extent, engineering analysis is an improvement over the standard statistical analysis as a basis for cost estimation?

4.10 Suggested Readings

Dobbs, Ian M (2000), Managerial Economics : Firms, Markets and Business Decisions, Oxford University press, Oxford.

Koutsoyiannis A (1979), **Modern Microeconomics**, 2nd, Edition, Macmillan.

Unit-5 □ Market Structure

Structure

5.0 Objective

This unit will give a brief review of the essential characteristics of the four primary forms of market structure. Here, apart from the traditional views, we will also learn about some new approaches towards market structure like Lancaster's characteristic approach towards monopolistic competition and application of game theory to cooperative oligopoly.

5.1 Introduction

	No of sellers	No of buyers	Product	Price	Entry	Knowledge
Perfect Competition	Many	Many	Homogenious	Same	Free in the longrun	Perfect
Pure Competition	"	"	"	Same	"	Imperfect
Monopoly	One	"	"	1. Discrimination 2. Non- Discrimination	No	Perfect
Monopolistic	Many	One	"	"	No	"
Bilateral Monopoly	One	One	"		"	"
Monopolistic Competition	Many	Many	Differentiated	different	Free entry in the longrun	"
Oligopoly	Few	"	differentiated undifferentiated	deffernt	in the longrun	"
Oligopoly	Many	Few	"	"		"

Market forms may be analysed according to the characteristics they possess. A schematic out line is given in the table.

5.2 Competition Perfect/Pure

Here we will confine out attention to the broad characteristics of an approximately competitive market. The adjective 'approximate' is used because 'perfect competition' is not found in the real world.

1. *Buyers and sellers should be small in size and numerous.* The term 'small' is relative here. Both the sellers (or producers) and buyers are small in size compared to the overall market size. So that their product and purchase decisions do not influence the market price. Their number also ensures that each of them has a negligible influence on the functioning of the market.
2. *The product must be homogeneous.* This is in fact the most difficult condition to be fulfilled. A good in a perfectly competitive market must be homogeneous in every respect.
3. Here, we assume that every buyer or seller is a price taker. Price is determined by the interaction of market demand and supply. Buyer can only decide how much to buy and seller how much to sell.

If it is sold in a different place, or at a different time, or differentiated in terms of any details (however small it is, then it is not truly homogeneous. There could be a single price in the market for a commodity, only if it is homogeneous.

4. *There should be free entry and exit into the buyers market by the producters in the long run.* By free entry and exit, we mean that there should be no sunk cost. It implies that, if a producer wants to close down, he will be able to recover the full value of the productive assest. If this is not so, the producer may not want to enter the market at all.

5. *There should be perfect knowledge on the part of both buyers and sellers.* All the buyers and sellers operating in the market should know everything about the prevailing technology, quality of the product and the market price.

In the real situation not many markets match up to these specifications. Financial, agricultural and small goods market sometimes approximate to these specifications. But bulk of industrial and retail products do not fall into this catagory, because firstly they are differentiated and secondly, they are produced by a relatively small number of producers. Who have considerable influence over the market.

5.2.1 Monopoly

Monopoly is a typical market characterised by the following characteristics:

1. *Single supplier but many buyers.* The buyers are numerous, scattered and small relative to the market. So the single supplier has and can yield considerable influence over the price and output decision of the market.
2. *Homogeneous product.* As the monopolist is the only seller in the market, the product is usually homogeneous and has no close substitute. But the monopolist, if necessary may differentiate in terms of price and also produce different varieties of the same product.
3. *Barriers to entry and/or exit.* These usually arise dueto some peculiar reasons like legal restrictions, ownership of natural resource or patent over the production technology.
4. The firm is a price-maker. He can sell more at lower price and sell less at higher price.

5.2.2 Monopolistic Competition

Monopolistic Competition is typified by the following characteristics :

1. *Buyers and sellers are numerous relative to the market size.*

2. *Products are differentiated.* The producers produce a large number of products, which are distinct but close substitutes of one another. The basic utility of the commodity is same to the user. Individually, every firm is a monopolist and there is strong competition among them.
3. *There is free entry and exit by the porducers.* The conditions are almost same to those in perfect competition.
4. There is huge role of selling cost which may be either informative or competitive.

5.2.3 Oligopoly

Oligopolies have the following characteristics:

1. *There are many buyers but few sellers.* There are more than one seller but they are quite few in number. The price and output decision of a single producer have considerable impact on the same of the other producers. The firms also monitor the other firms operations quite closely. Any change in the policy of any one of them would result in competitive reactions.
2. *The Product may be homogeneous or differentiated.* Diferentiated oligopoly (as in case of automobile) is most common form of market. But homogeneous oligipolies (e.g. automobile fuels) show more clearly the interdependent nature of the market.
3. *Nothing can be said with certainty about the cost of entry and exit from the market.* The producers may or may not have any cost; it depends on the interdependence of the firms in the market.
4. There is strong interdependence among sellers in connection with price and output decision. Hence profit maximisation is not possible and sales/security maximisation is the only alternative.

5.3 Dominant Firms and Monopoly Market

The key feature to the monopoly market is that there is only one seller of a product, which has no close substitute. Apparently, this is a simpler form of market structure where firms compete with each other for survival and domination. So here the firm has the liberty to take its own decisions about price and output. However, if the product of the firm is not protected by law (e.g. Patents), there is always the chance for other firms to enter the market. This will lead to competition and decrease in profitability. Actually, pure monopoly is not found in the real world. The most common form in practice is that where a dominant firm faces competition from a number of small firms. Examples can be given of the international giants like Microsoft and Intel, which face competition in every country from the small local firms. More closely, a super market faces competition from numerous small corner shops and roadside stalls.

The dominant firm, while setting its price has to take into account the behaviour of the fringe. An increase in the price will lead to the shift of the customers to the smaller shops. Another consequence would be the entry of new smaller firms in the market. Thus, the existence and the vigour of the fringe will limit the monopoly power of the dominant firm.

The most common models of the dominant firm is the firm which shares the market with the small price-taking firms. The fringe firms accept the price set by the dominant firm, but they will produce more if the set price is quite high. The dominant firm takes into account the total supply of the smaller firms, and supplies the residual to the market.

In the Figure 5.1, at the prices below P_2 there is no fringe supply, and the dominant firm faces the Market demand curve. However, at the price P_1, the whole market is served by the fringe. Thus the dominant firm faces the residual demand curve DD_1D, which is the horizontal difference between the market demand curve and the supply curve of the fringe. For price above P_2 this demand curve is more elastic than the original market demand curve. So the dominant firm sets the standard monopoly price, treating the residual demand curve as its relevant demand curve. It will equate marginal revenue with marginal cost and determine its own output and price. This will, in turn, determine the total quantity produced by the smaller firms.

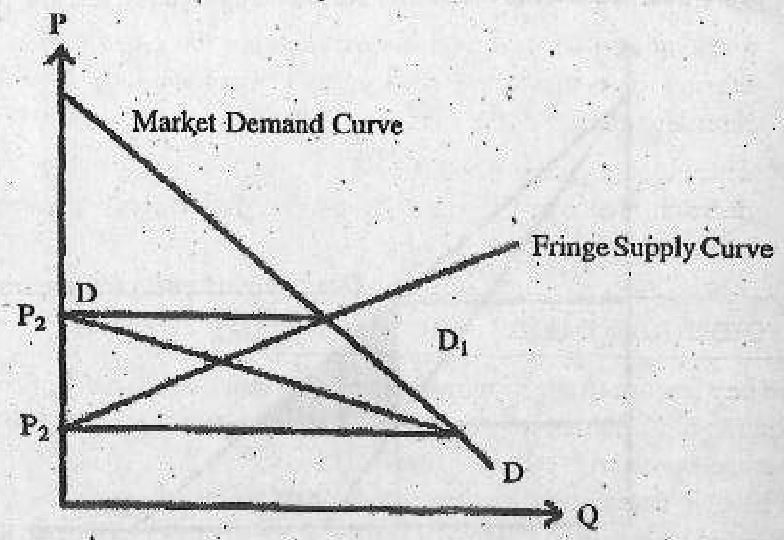


Figure 5.1 The Dominant Firm Model

Thus the dominant firms will exert monopoly power and charge prices above the marginal cost. The actual degree of dominance would have to be analysed to find out the appropriate from of regulation to control such a firm, if necessary.

Degree of monopoly power (Lemer)

The divergence between price and marginal cost is the main source of monopolistic exploitation. Prof. Abba. P. Lemer has expressed this gap per unit price

$$DMP = \frac{P-MC}{P} = \frac{P-MR}{P} = \frac{P-P\left(1-\frac{1}{e}\right)}{P} = \frac{1}{e}.$$ Thus, lower the elasticity higher will be the chance of exploitation.

5.3.1 Monopoly welfare loss

The profit maximising monolopolist usually sets the price above the marginal cost and this leads to loss in welfare. In this section, first we will discuss the specific case of linear demand curve and linear marginal cost curve and then a more general case.

- **The Welfare Loss Triangle**

The existence of welfare loss under profit-maximising monopoly price, provides insight that monopoly can be against public interest.

- The Linear Marginal Cost/Linear Demand Function:

Let us consider the Figure 5.2. The area under the demand curve and above the price line represents consumer surplus are (area A), and the profit is given as the

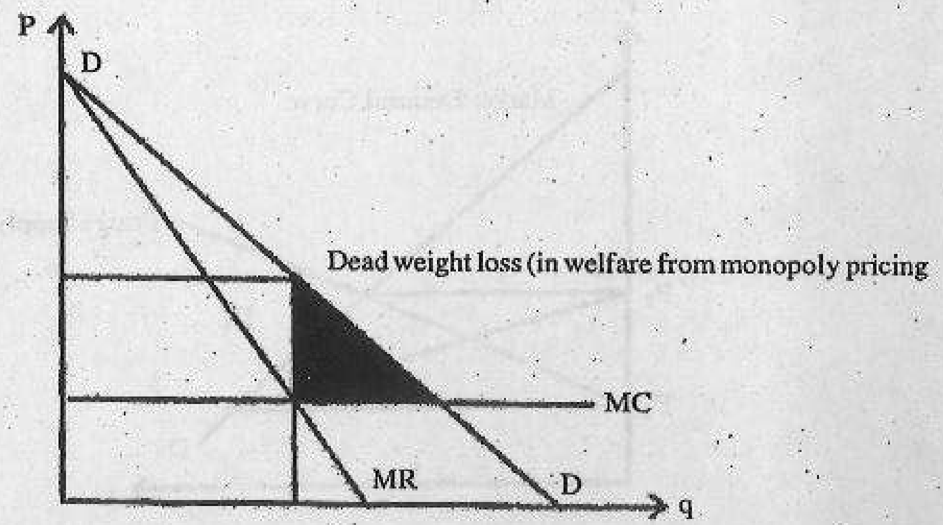


Figure 5.2 The Linean Marginal cost Linear Demand Function case

area B. So, the monopoly pricing yields total economic welfare to W=CS+π=A +B. By contrast, marginal cost pricing would lead to the firm just breaking even (i.e. π=0), with output q_c and consumer getting total surplus equal to area A+B+C. Therefore the total welfare in this case is also the area equalling to A+B+C. For this reason, the area C has been indentified as the dead-weight welfare loss associated with profit maximising monopoly pricing. In the geometrical representation, the area of A is equal to that of C and equal to one-half of area B. Since $\pi = B$, we have in this special case, $\Delta W = {}^1/_{2\pi}$ (5.1)

This is of interest, since welfare is less readily observable than firm profit levels. From this naive model, one can infer that the firm profitability gives an indication of the welfare loss persent in the economy.

- **The General Case**

In reality, the demand curves are not always linear and marginal costs are also not always constant. If the function involved are non-linear, then the welfare loss could be more. We can derive the simple measure of welfare loss, by assuming that between the monopoly output and competitive output, the economies of scale are largely exhausted, so that the marginal cost curve is almost flat and demand curve is approximately linear. The behaviour of both the curves to the left of monopoly output is of no inportance here. In the Figure 5.3, the demand, marginal revenue and marginal cost curve are non-linear to the right of q_m but linear to the right. On the interval $[q_m, q_c]$, the total cost function can be modelled as (5.2)

where c denotes the (constant) marginal cost on this interval. The first-order condition

for profit maximisation requires that $\frac{p - MC}{p} = \frac{1}{\eta}$ (5.3)

Where η is the elasticity of demand. Finally, the dead-wight loss is measured as triangle DWL:

$$DWL = {}^1/_2 \, (p_m - c)(q_c - q_m) \quad (5.4)$$

The elasticity of demand at the monopoly Price/output level is given as $\eta = (dq/dp)(p_m / q_m)$. In Figure 5.3, for the linear demand curve on this interval, the gradient (dp/dq) of the inverse demand curve at the point α is also by assumption equal to the gradient of the line $\alpha\beta$. Thus,

$$\frac{dp}{dq} = \frac{1}{\eta}\frac{Pm}{qm} = -\frac{(Pm - C)}{(q_c - q_m)} \quad (5.5)$$

Hence,

$$DWL = {}^1/_2 \, (p_m - c)(q_c - q_m).$$

$$= 1/2 \, \frac{(P_m - C)2}{P_m} \eta q_m \quad (5.6)$$

So, using the first order condition, (5.3)

$$DWL = 1/2\ \frac{Rm}{\eta}, \tag{5.7}$$

$$\text{or } DWL = = 1/2\ R_m \left(\frac{Pm - MC}{Pm}\right) \tag{5.8}$$

Thus, the welfare loss is also measured as minus one-half sales revenue divided by the elasticity of demand, or as one-half sales revenue times the price-cost mark-up. The sales revenue can be measured vary simply and if an estimate of the elasticity of demand, or price cost mark-up can be made, the welfare loss can be calculated.

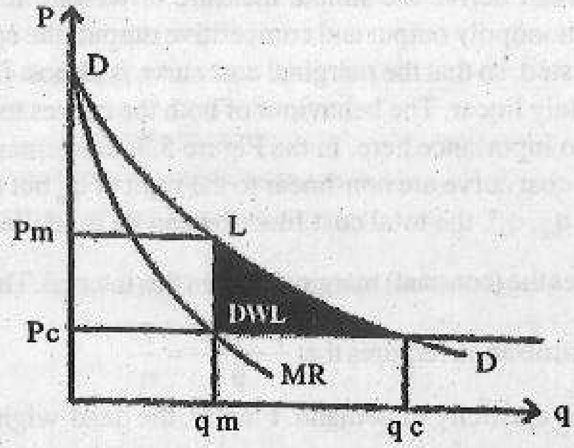


Figure 5.3 Dead Weight Loss in the General Case

5.4 Monopolistic Competition-Lancaster's Characteristics Approach

5.4.1 Monopolistic Competition—The Traditional View

Monopolistic Competition is characterised by markets having a large number of small firms, but each firm produces differentiated product. There is free entry in the market. The most well-known model of monopolistic competition is the large-number model by Chamberlain (1933). The model is constructed using the following assumptions:

i. There are large number of buyers and sellers, each small relative to the market size.

ii. There is free entry and exit for firms (positive profit inducing entry and negative profit inducing exit)

iii. Each firm produces a single product or brand.

iv. All firms face identical cost and demand function.

v. Firms, while setting price, ignore the behaviour of other firms.

The first two assumption are descriptive, but the other three assumptions can be disputed. The third assumption is quesionable, both in theory and practice. Most of the firms would like to develop new products or products closer to the existing ones. The fourth assumption does not acknowledge the fact that if product differentiation is unlimited, the cost and demand curves of all the firms in the market, may not be identical (Chamberlain later relaxed these assumptions and discussed the consequences). The last assumption is also problematic. In practice, firms are likely to face competition from the firms producing the nearest substitutes. This type of induced competition encourages this type of free entry oligopoly.

5.4.2 Lancaster's Characteristics Approach—The Modern View

Lancaster's 'characteristics approach' (discussed in detail in unit 2) is a modern way to think about the products in monopolistic competition. He emphasised the point that goods are only similar if they have similar characteristics and cluster in the characteristics space. It implies that each product will always have a set of nearest neighbours in the characteristics space. Figure 5.4 illustrates the case for products, which have only two characteristics. In this case, each product has at most two neighbours (they may of may not be near neighbours). Clearly, with the increase in the number of characteristics, the number of neighbours will increase substantially. However, it is only the nearest neighbour that matters, a significant reduction in price will steal the market share of the neighbours. So it is irrational to assume that firms will ignore this interdependence and the nearest neighbours will behave as oligopolists. Thus monopolistic competition will be more like a web of intersecting.

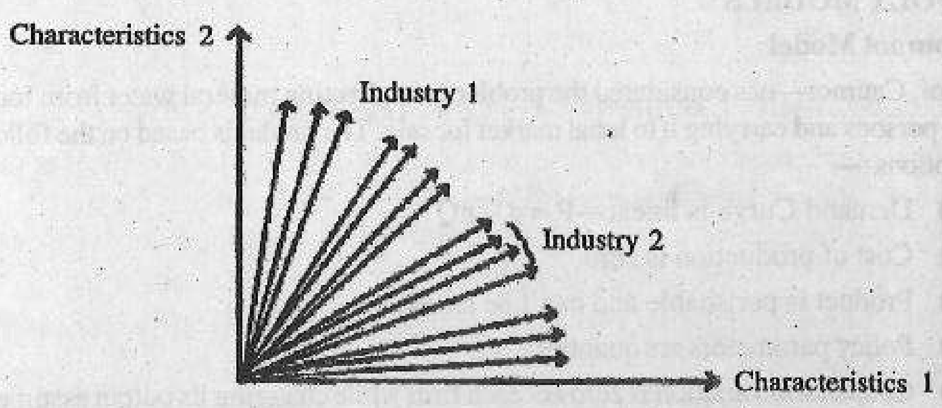


Figure 5.4 Good in Characteristics space

In reality, the complexities will be more with free entry and free choice of product positioning in the characteristics space. If the choice of product characteristics does not affect the cost of production and if the consumer demand is reasonably uniform over the characteristics space, more or less uniform coverage by the firms over the characteristics space can be predicted. The density in demand and extent of economics of scale in production will definite the number of products and the differences between them. If there are constant economies of scale one would expect a condinuum of products, while discrete number of products might be expected in case of fixed costs of other sources of economies of scale. Descreteness will also arise in case legal protections like brand name, trade name and patents, which prevents close copies of existing products.

If there are significant difference in the cost of production for certain combinations of characteristics, then we may expect gaps in the provision in characteristics space. Consequently, Some degree of bunching in the characteristics space may be expected. This can be conceptualised as an industry. An industry may be very tightly defined with large gaps around the bunch (industry 1 in Figure 5.4) or may be fuzzy around the edges if product density falls away more gradually (industry II in Figure 5.4)

These criticisms against Chamberlain's original ideas are quite powerful to take the view that there is no distinct market form as monopolistic competition. The modern argument is that monopolistic competition is a particular type of oligopolistic spatial competition. The term 'spatial' can be interpreted as geographical space or more generally as characteristics space. There are a number of models developed with free entry into product characteristics space and oligopolistic competition among the firms. But they are technically quite complex and beyond the scope of this course.

5.5 Cooperative Oligopoly—Application of Game Theory

DUOPOLY MODELS

1. Coumot Model

Prof. Caumot—has considered the problem of collecting mineral water from fountain by two persons and carrying it to local market for sale. The model is based on the following assumptions :—

(1) Demand Curve is linear—$P = a - nQ$

(2) Cost of production is zero.

(3) Product is perishable and can't be stored.

(4) Policy parameters are quantity

(5) Conjectural variation is zero i.e. each firm while changing its output assumes that his rival will maintain output at the same level.

$TR_I = PQ_1 = (a - nQ)Q_1 = a - nQ_1^2 - nQ_1Q_2$

$MR_I = a - 2nQ_1 - nQ_2 = MC_1 = 0$

$$\text{Therefore, } Q_1 = \frac{a - nQ_2}{2n} \qquad \text{....... (i)}$$

$TR_{II} = PQ_2 = (a - nQ) \,.\, Q_2 = a - nQ_1Q_2 - nQ_2^2$

$MR_{II} = a - nQ_1 - 2nQ_2 = MC_2 = 0$

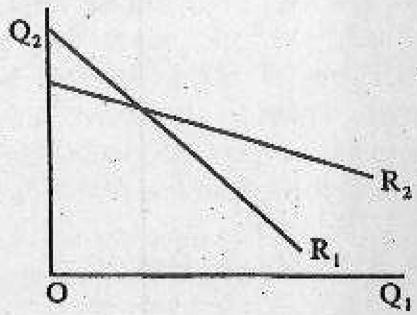
$$\text{or } Q_2 = \frac{a - nQ_1}{2n} \qquad \text{....... (ii)}$$

(i) and (ii) are called reaction functions In Equilibrium, output sold by two producers are equal i.e. $Q_1 = Q_2$.

Again, Reaction functions are linear and negatively sloped.

$$\text{Duopoly output (Q)} = Q_1 + Q_2 = \frac{a - nQ_2}{2n} + \frac{a - nQ_1}{2n}$$

$$= \frac{a - nQ}{2n} \qquad \text{or, } 3nQ = 2a \qquad \text{or, } Q^* = \frac{2a}{3n}$$



Competitive output is produced under Competitive conditions i.e. $P = MC = 0$ or $Q = \frac{a}{n}$. Thus, duopoly output is 2/3rd of Competitive output. Geometrically it can be shown that Cournot Equilibrium is the point of intersection of two reaction functions.

KINK DEMAND CURVE MODEL

Unlike Cournot, Prof. M. Sweezy had paid more attention on price behaviour of two sellers. The model is based on the following assumptions :—

(1) There are a few sellers.

(2) Products produced by them are close substitutes.

(3) Advertising expenditure is zero.

(4) Each oliogopolist believes that if he raises the price of his product, his rivals will maintain it at the same level and so his sale will drastically decline. Again if he lowers the price of his product, his rivals will also lower it and there is no appreciable improvement in his sales. Hence, this model is a justification for price stability or price rigidity.

Thus, the upper portion of demand curve is elastic and lower portion is in elastic. Thus, there will be a discontinuity in MR Curve and the length of this discontinuity is determined by the difference between elasticities of two parts. We know the relation between MR, price and elasticity of demand.

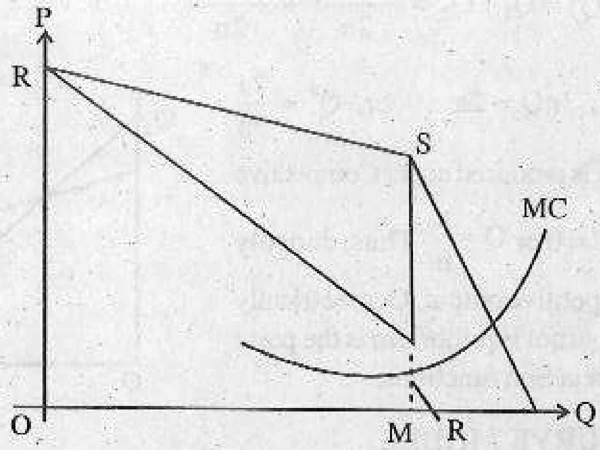
Hence, $MR_I = P(1 - {}^1/e_1)$

$MR_{II} = P(1 - {}^1/e_2)$

Thus, $MR_I - MR_{II} = P\left(\frac{1}{e_2} - \frac{1}{e_1}\right)$

Now, $e_1 > e_2 \Rightarrow {}^1\!/_{e_1} < \frac{1}{e_2}$ and thus the gap.

Sweezy makes one comfortable assumption that MC Curve passes through the discontinued portion of MR Curve, so that rigid price is consistent with profit maximising price.



Application of Game theory in Oligopoly

Optimising is a Catch-all term for maximising, minimising or finding the laddle point of a function. Game theory deals with finding that saddle point and it has originated from the game off chess.

There are two players and there is strong rivalry among them. Each player has a finite set of strategies. The outcome of the game can be represented by mxn pay off matrix $[a_{ij}, b_{ij}]$ where

a_{ij} = A's Pay off when A employs ith strategy and B employes ith strategy.

b_{ij} = B's pay off when A employs ith strategy and

B employs jth strategy.

When, $a_{ij} + b_{ij} \equiv 0$, it is called a two person zero sum game. When $a_{ij} + b_{ij} \neq 0$ but any other constant number it is called a constant sum game. The pay-off matrix can be represented in a matrix form as follows.

A \ B	B_1	B_2	B_3	......	B_n
A_1	a_{11}	a_{12}	a_{13}	......	a_{1n}
A_2	a_{21}	a_{22}	a_{23}	......	a_{2n}
A_3	a_{31}	a_{32}	a_{33}	......	a_{3n}
|					
A_m	a_{m1}	a_{m2}	a_{m3}	......	a_{mn}

In the Context of Oligopolistic market structure players are sellers and strategies adopted may be price reduction, quality improvement, introduction of selling cost etc. Pay off are obviously profit, market share etc.

Oligopoly is concerned with markets involving relatively small number of firms. Here the levels chosen by one firm for strategic variables such as price, output advertisement and investment decisions can have significant inpact on the sales, profits and long-term viability of other firms in the industry. So, the firms will carefully watch the behaviour of its competitors and also take into account the potential reactions in case of any change of policy. The earlier models focussed on competitive (or non-collusive oligopoly). The behaviour of the firms usually modelled on either quantity setting or price setting. A study of these models show that the firms are able to maximise their individual profits in the short run but the total industry profit is never maximised. So, the firm collude giving rise to cooperative oligopoly.

5.1.1 Co-operative Oligopoly

The firms in an oligopolistic market collude because :

1. They find out that if they behave competitively, they earn less profit than when they collude.
2. So, they will do either one of the following.
   a) integrate (vertically or horizontally). However, in most of the devéloped countries, the government attempts to control monopoly power by setting restrictions on allowable mergers or types of intergration.
   b) go for joint profit maximisation (by restraining output and holding price high), either explicitly or tacitly. Here also the state prohibits any form of contraeual form of collusive practice. Tacit collusions could work to an extent although

there is the problem that the members of the cartel have the change to chisel (i.e. to agree on collusive high price but then to discount below this). This type of chiselling destroys cartel trust and cohesiveness and its ability to hold prices up.

3. The firms may go for non-profit maximising collusions like price leadership.

The operation of a cartel (operating under tacit collusion, not contractually binding) can be studied in the framework of the game theory.

5.5.2 Cartel Instability : Application of Game Theory

Chamberlain (1929) was the first to suggest that the repeating nature of the oligopoly game meant that the firms could practice tacit collutions and coordinate higher prices than the competitive oligopoly models. If the collusions were legal, cartels would be contractually bound, whereas in case of illegal collusion, the agreements have no legal force and may prove unstable.

The decision to stay in a cartel will depend on the cost-benefit calculations of the individual firm. A firm secretly reducing the price below that agreed by cartel, will be able to steal the market share from the others. Chiselling is dominant strategy in a prisoner's dilemma game. This can be illustrated in the following numerical example.

Example 5.1 Suppose the industry demand function is $p = 12\text{-}q$, where q is the total output being the sum of outputs q_1 by firm 1 and q_2 by firm 2. The firms are identical and have marginal cost of 2 per unit and zero fixed cost. Under cournot assumption, applying the usual first order conditions for profit-maximisation, we would get the two reaction functions of the two firms :

$$q_1 = 5 - {}^1/_2 q_2 \qquad (5.8) \text{ and}$$

$$q_2 = 5 - {}^1/_2 q_1 \qquad (5.9)$$

The solution will be $q_1 = q_2 = 3^1/_3$. The market price will be $p = 12 - 2(3^1/_3) = 5^1/_3$. The individual profits at the equilibrium will be $\pi_1 = \pi_2 = (p - 2)q_1 = (5^1/_3 - 2)\, 3^1/_3 = 100/9$. Under the assumption of joint profit maximisation, would result in $q_1 = q_2 = 2.5$ and profit to each as $\pi_1 = \pi_2 = 12.5$. However, under this agreement, each firm has an incentive to cheat on this agreement (i.e. to produce 2.5 each). If the firm 2 produces 2.5, then from the reaction function, the optimal choice for firm I will be

$q_1 = 5 - {}^1/_2 q_2 = 5 - {}^1/_2(2.5) = 3.75$. The total output will be 6.25 and the price will be 5.75. Then the profit of firm I will be 14.1 and that of firm 2 will be 9.4. Table both the firms cheat and produce 3.75, then $q = 7.5$, $p = 4.5$ and $\pi_1 = \pi_2 = 9.4$. Table 5.2 gives the game strategy tableau associated with these outcomes. This is a classic example of prisoner's dilemma-each firm has a dominant strategy; whatever the other player does, it is better to cheat and produce. 3.75 than to stick to the joint profit maximising agreement. The consequence is that each cheats and produces 3.75. The outcome is that cash only gets 9.4.

Tables 5.2 Cartel Instability : The 'Prisoner's Dilemma'

	Firm2	
	stick to agreement $q_1 = 2.5$	Cheat on agreement $q_1 = 3.75$
Firm 1 stick to agreement	$\pi_1 = 12.5$	$\pi_1 = 9.4$
$q_1 = 2.5$	$\pi_2 = 12.5$	$\pi_1 = 14.0$
Cheat on agreement	$\pi_1 = 14.0$	$\pi_1 = 9.4$
$q_1 = 3.75$	$\pi_2 = 9.4$	$\pi_2 = 9.4$

Thus it can argued that cartels are inherently unstable, as there is always an incentive for the members to cheat on the cartel agreement and as such agreements are illegal and tacit is no legal redress from such chiselling behaviour. Of course, the assumption of the existence of the single period in the model is one of the reasons behind such instability. In reality, cartels are often sustainable in the long run,but they are far from profit maximising. The most common form of facit collusion is price leadership of different forms.

5.6 Monopsony and Bilateral Monopoly

We have discussed different market forms with the assumption that there are many buyers of the firm's product and so none of them has any market power. However, a significant amount of economic activity takes place where the customer is powerful enough to change the posted prices. In this section, we will discuss monopsony and bilateral monopoly.

5.6.1 Monopsony

In monopsony, there is a single buyer and a large number of sellers. The sellers are price takers and the buyer faces an upward-bending supply curve. It is a case of supply by price-taking agents. Different agents often have different reservation prices, so as the offer price rises, the supply increases. The monopsonist sets the price to obtain his desired amount. This idea is particularly applicable for the supply of specialised labour like nurses, teachers, i.e. higher the wage offered, it is easier to recruit and retain such staff.

Here the main problem is to find out the optimal price. If the monopsonist wants a fixed number of units, then if he faces a rising supply curve, the solution is quit simplistic, as shown in Figure 5.5 (a) More generally, the number of units the monopsonist desires to buy will be influenced by the price he has to pay.

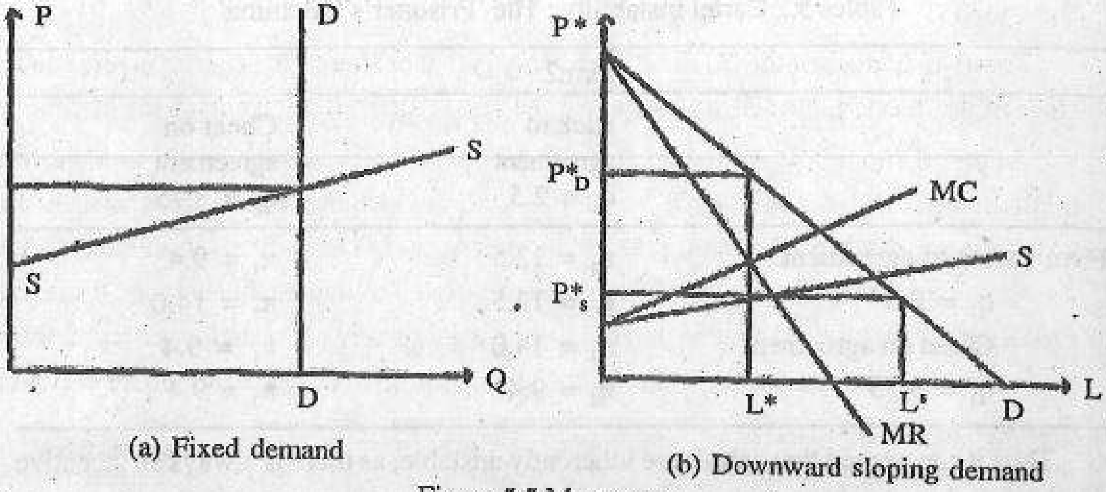


Figure 5.5 Monopsony

In figure 5.5 (b), the monopsonist faces an upuwared slopingsupply curve S for labour. Here we assume that one unit of labour produces one unit of product and there in no other cost of production. If the monopsonist also has some power in the market of the final product, he will face a downward sloping demand curve DD (instead of being horizontal, where the monopsonist is a price-taker). He offers P_s as the price for labour and gets a quantity of labour L = q and sells the output q at price p_d. With linear demand and supply curves, the MR curve will have the same vertical intercept and twice the slope of the demand curve and the MC curve will have same intercept and twice the slope as the supply curve. The profit maximixing condition will be as usual i.e equating marginal cost with marginal revenue. So, the optimal amount of purchase will be L* = q* and the price in the labour market will be P_s* and in the final demand market $P*_D$. The choice of employment and its price is part of a simultaneous solution, which includes the firm optimising the price of the final product. The result is comparable to that of monopoly. The monopsonist restricts his purchase below the socially optimal amount (L_s), irrespective or the fact that he has of does not have market power in the final market.

5.6.2 Bilateral Monopoly

The term 'bilateral monopoly' is used in a situation where one firm exclussively sells.

its products to another firm and the main issue would be how the two parties decide on how much to trade and at what price. There is also the related concept of successive monopoly. It occurs when a monopolist sells to several buyers, one or more of whom sells to several buyers. In each stage, only the sellers have the monopoly power and the buyers have none.

Another feature of the bilateral monopoly is that as there are several buyers at each stage of production, the seller connot practise price discrimination across the buyers.

Bilateral monopoly and successive monopoly are frequently found as a vertical relationship. It is like the river of production with raw material extractors upstream and proceeding downstream, through the processors, refiners and manufacturers of intermediate products, essential for the final product, finally to the retail selling establishments. There may exist a number of bilateral relationships within the whole process of manufacture and delivery processes. The two crucial questions for the identification of bilateral monopoly will be as follows :

i. If the selling firm holds up production, can the buying firm quickly and easily obtain the product from alternative suppliers?

ii. If the buying firm refuses to purchase, can the seller quickly and easily place the product elsewhere?

If the answer in no to both the question, then it is a case of bilateral monopoly. In successive monopoly, only the first question is relevent, but it is applicable to more than one stage in the chain of production.

Bilateral monopoly commonly arises because of switching costs. Even when there are many buyers and sellers in the market place, once a buyer and seller pair off to undertake a trade, there are certain implications.

(i) often, the seller needs to make buyer-specific investments in order to supply the appropriate design and quality. To get the seller to commit such investment, negotiations will typically be around the need to guarantee a period of ongoing trade.

(ii) repeat trading reduces searches and related trading costs, the firms get to know and trust each other, and so the efficiency of trade improves. To move out of the relationship would increase costs as it will involve the search cost, acquisition of new knowledge, building up of trust etc.

5.7 Summary

In this unit, we started with the characteristics of the four basic forms of market structure-their similarities and differences. After that, we studied the concept of dominant firm and monopoly power and also calculation of welfare loss due to monopoly. Then, we went into the details of monopolistic competition, not only the traditional view but also the application of Lancaster's characteristic approach to a monopolistically characteristic market. After that, we studied another important form of market i.e. oligopoly. The tools of game theory was applied to show that the cartels (a special form of cooperative oligopoly) are inherently unstable. In the last sectin we studied two extreme forms of market namely, monopsony and bilateral monopoly.

5.8 Exercises

1. What is meant by the term market structure? What are the factors that determine the market structure?
2. Characterise the four main forms of market structure.
3. Construct a dominant firm model, where the market demand is linear. The fringe supply curve is also liner with positive slope, passing through the origin. If the dominant firm has constant marginal cost, show that its price must be less than if the firm had the whole market to itself Compare monopoly welfare loss for the two cases.
4. What is meant by 'monopoly welfare loss'? How the area of the welfare loss triangle can be estimated for the 'linear demand function' and the 'linear marginal cost' case? How is would differ in the general case?
5. Describe a monopolistically competitive market based on the Lancaster's characteristics approach. Is this any improvement over Chamberlain's traditional model of monopolistic competition?
6. Why firms agree to cooperate in an oligopolistic market?
7. How game theory can be applied to show the cartels and inherently unstable?
8. How a monoposonist can restrict his purchase below a socially optimum amount?

9. Why bilateral monopoly arises in a particular market? How the existence of bilateral monopoly and be identified?

5.9 Suggested Readings

Chamberlain, E (1933), *The Theory of monopolistic Competetion,* Cambridge mass, Harvard University Press.

Koutsoyiannis A (1979), *Modern Microeconomics*, 2nd edition. London : Macmillan.

Lancaster, K (1966a), 'A New Approach to consumer Theory' '*Journal of political Economy* 74 : pp 132-57

Unit-6 □ Theories of the Firm

Structure

6.0 Introduction

In this unit, we will study a number of topics, which are outside the purview of the mainstream neo-classical analysis of the firm. Firstly, We will study some alternative theories of the firm. Then, we will study the case of a multi-product firm and how it prices its products. Then we will go into some special pricing techniques, like peak-load and intertemporal pricing and the role of pricing in capacity planning. Special pricing policies like cost-plus and make-up pricing will also be discussed. Lastly, we will take up the economics of advertising.

6.1 Alternative Theories of the Firm

Neo-classical theories characterised the firm as a 'black-box', which transforms inputs into outputs to earn the maximum profit. This is convenient for tackling issues like pricing, output, entry etc. as it ignores the details about the internal structure of the firm, along with its contractual and organisational basis. It also suggests that the optimal size of the firm is simultaneously determined with the number of firms in the industry. In case of a free entry situation, the size and number are determined by the extent of demand for the product and the structure of technology. The economies of scale and scope are limited to that extent. if the question is asked what limits the size of the firm the focus on technology, demand, externalities suggest no obvious reason why the firm cannot monopolise the market. If there are diseconomics of scale associated with a single plant, the firm will surely go for multi-plant operation. So, it is necessary to open the 'black belt'. In fact, in the last twenty years, the neo-classical methodology has tried to open the box. The early works on managerial discretion focused on the organisational structure and the goal of the firm and its consequences. They recognised the seperation of ownership form control in the corporate enterprise. This section gives a brief review of the earlier work on managerial discretion and related theories.

6.1.1 Baumol's Sales Maximisation

Baumol (1958) argued that the goals pursued by managers (e.g. salaries, status, power, prestige, security etc.) are correlated with sales revenue. He suggested that the main objective of the firms is sales maximisation. For maximising sales revenue, the firm will set a lower price and produce a greater output than that would be under profit maximisation. The underperformance of a firm is visible by its decreasing level of profit and the firm has to take some action. If a firm earns below a minimum level of accepted profit (MALP), then the management is at a risk from either shareholder action or take-over raiders. Thus the pursuit of sales is tempered by the need to earn enough profit.

This model assumes that MALP has a defined value, above which there would be no chance of intervention. This assumption may not be realistic but it does away with sudden intervention.

In the absence of any profit constraint, the firm maximises revenue by choosing price P_R and output q_R such that MR=0, as per figure 6.1. This maximises revenue but pays no attention to the resulting profit. In this figure, the profit is π_R If MALP is $\bar{\pi}$ then the firm's objective is to choose P and q such as to maximise R subject to profit $\pi \geq \bar{\pi}$.

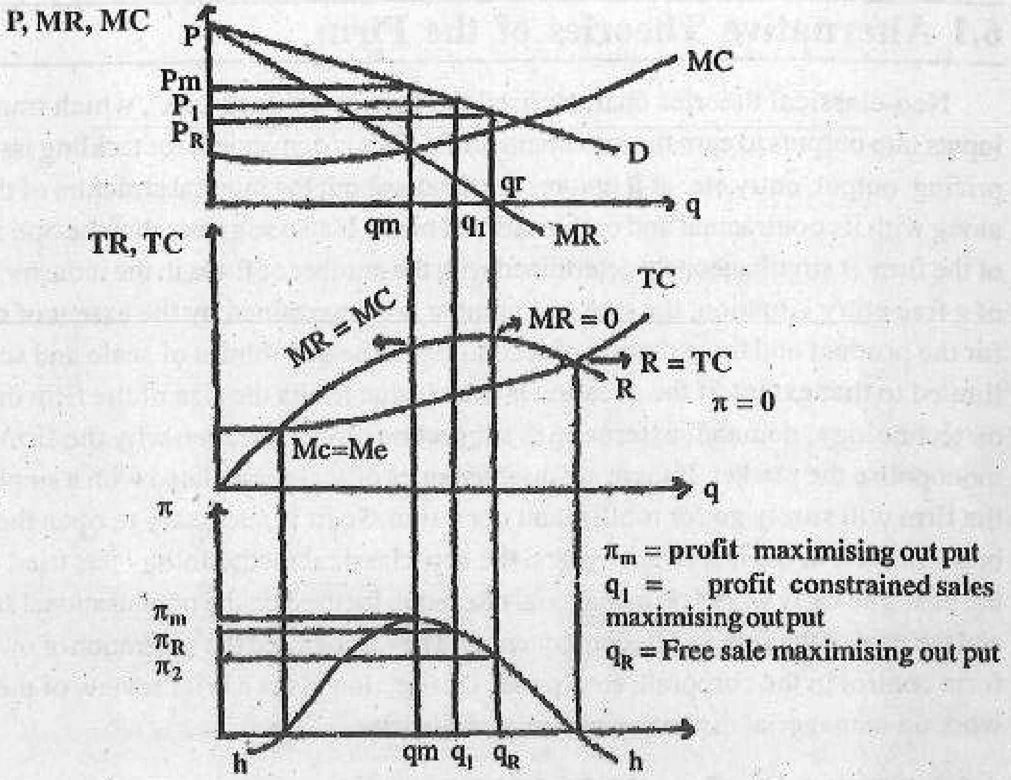
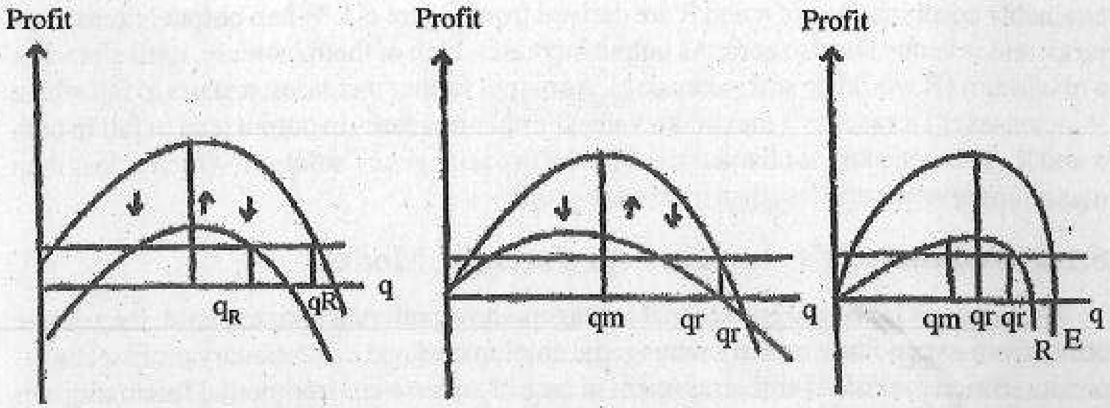


Figure 6.1 Baumol's Sales Maximisation

If MALP is at a level $\bar{\pi}_2$, then the solution is unconstrained, i.e., revenue is maximised by setting MR=0, where $P \geq \bar{\pi}_2$ and the profit. So long as the MAL$\pi_R$is less than the maximum attainable level of profit, the firm sets a price below the profit maximising level.

The sales revenue maximising firm (*a la* Baumol) and the profit maximising firm behave differently. When the environmental variables change. In figure 6.2, we will show some simple cases. In panel A, we have the consequence of an increase in fixed cost (or lumpsum tax); here the profit curve would fall everywhere by the amount of increase. Panel B shows the effect of an increase in corporate tax rate. In both of these cases, the Baumol firm reduces output and incresses Price. Lane C, on the other hand, shows the imposition of a per unit sales tax (or VAT); This leads to a fall in the would be net profit function which is proportional to the level of output. The impact of this same for both a profit maximising firm and a Baumol firm would be change in output, of course, and the Baumol firm would be more sensitive.



(a) Effect of in crease in fixed cost of increase in lumpsum tax

(b) Effect corporation tax increase

(c) Effect of sales tax in increase

Figure 6.2 Some Compatrative states of Baumol firm

The firm would be cost-efficient if the MALP constraint binds, otherwise not. This is again not at all realistic, the managers will always have some preference for more profit rather than less. From welfare perspective, the Baumol firm is likely to be cost-efficient, the set price would be lower than that of the profit-maximising firm.

One of the weaknesses of the model is that it implies that the management prefers more sales to less and does not care about profit, till it falls below the MALP. At the point, the profit becomes all-important. In reality, of course, it is expected that the management would be concerned about both profit and revenue. So, this model can be modified by assuming that the managers maximise a utility function of the form $U(\pi, R)$. Here utility is increasing for both and R and the indifference curves have usual shape. In Figure 6.3, the locus of

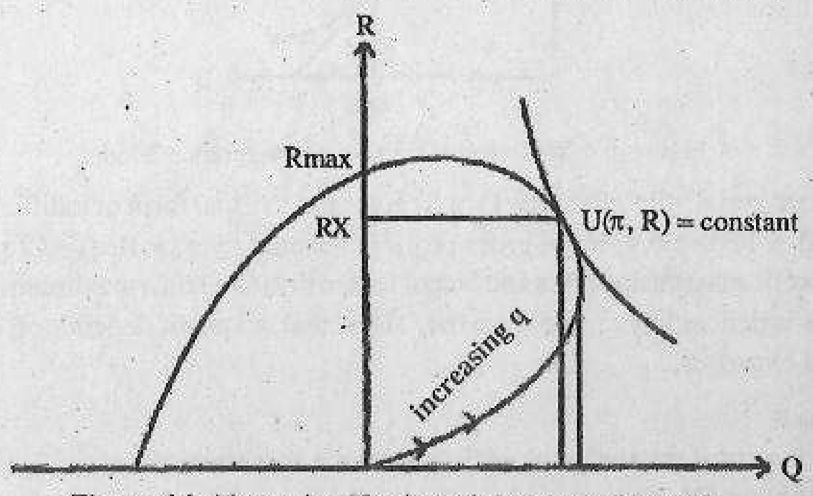


Figure 6.3 Alternative Version of the Baumol Model

attainable combinations of π and R are derived from Figure 6.1. When output is zero, both profit and revenue are also zero. As output increases, both of them increase, until π reaches a maximum (R would be still increasing). As output further increases, π starts to fall whilst R increases till it reaches a maximum value. Further increases in output lead to fall in both π and R. The optimum is characterised by the usual tangency solution, which is less than maximum revenue and less than maximum profit.

6.1.2 Williamson's Expense preference Model

Williamson (1964) suggested that managers show preference for expense; they derive utility from expenditure on staff, managerial emoluments and discretionary profits. Higher profits reduce the risk of embarrassment in case of adverse environmental fluctuations or take-over or profit-related payments. Excess may be partly attractive because not only it increases the dimensions of the managerial pyramid but also the pressure of the manager concerned.

Here we will present a compact version of the model by focusing simply on the profit and expenses S (S is the composite expenditure on perquisites, non-line staffing etc). The Williamson constraint of MALP necessary for survival and constraint on minimum expenditure necessary on staff are ignored.

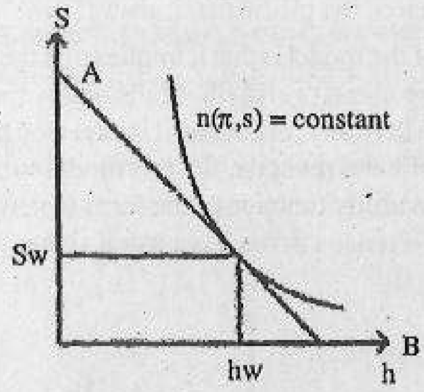


Figure 6.4 Williamson's Expence Preference Model

The managerial utility function U (π S) gives rise to usual form of indifference curves, as depicted in Figure 6.4. If the gross profit is denoted by $\pi_q = R(q) - C(q)$, then there must be a profit-maximising price and output for the firm to attain a maximum level of gross profit. This is denoted by π_m in Figure 6.4. The actual net profit depends on level of staff and related expenses :

$$\pi = \pi_m - S \tag{6.1}$$

As π_m is a constant, the graph of the attainable combinations of (π, S) is the straight line AB in Figure 6.4. The optimal choice (π_w S_w) is given by the point of tangency with the highest attainable managerial indifference curve. This implies cost inefficiency as expenditures on staff are positive but 'unnecessary'.

The original Williamson model is richer than this simplistic version, but the message remains the same. Managers have utility by spending resources on themselves and so, such firms will not be cost-efficient.

The welfare implications of such a firm are more difficult to assess than in the Baumol case. The firm is not maximising profit as it is cost-inefficient, for those who receive it. If S consists solely of staff perks and other payments, this would imply a simple transfer of money from shareholders to managers; the consequence would be welfare neutral. But if S includes the employment of excess staff, this involves loss of welfare.

6.2 Marris's Growth Maximisation Hypothesis

Marris (1963, 1964) developed a dynamic model of firm. He proposed that managers are concerned with growth maximisation, with expanding product demand and variety over time. Empirical evidences are there to show that managers prefer internal to external promotions as the latter implied adopting new working practices and less job security. Marris's model implies that a growing firm gives the managers the opportunity for internal promotions, career development and job security. It also examines the implication of the means of financing the growth.

We are not going into a detailed exposition of the model as it is quite complex and a number of *ad hoc* assumptions (specially with respect to pricing and demand for product, alignment of manager's and owners interest etc.) are also criticised. It's main merit lies in its focus on the dynamic factors.

6.2.1 Behavioural Theories

The behavioural theories (Simon 1957, Cyert and March 1963) viewed the firm as a coalition of participants of groups of participants (e.g. shareholders, creditors, suppliers, consumers and various categories of managers and workers), who work for the interest of the firm in exchange of a variety of payments. The goals of the firm result in an implicit bargain between the various interested parties. The influence of the parties on the overall direction of the firm is dependent on their bargaining power.

All these elements are consistent with the game-theoretic treatment of the firm, where the individuals are seen as self-interested utility-maximisers. But the behavioural theories do not agree to the neo-classical paradigm of *homo economicus*. As for example the employees may have aspiration levels rather than a reservation wage. Aspiration levels can increase upward with increase in experience but there will be no active job-seeking until the current wage is sufficiently below the aspiration level. The same idea applies to consumer behaviour, brand loyalty to mismatch between price and quality.

The difference between the payments required to keep the persons in their posts and the total possible revenues of the organisation is called organisational slack. In a stable environment, it may be thought that wages should converge on aspiration levels and competitive pressure may lead firms to zero (or close to it) organisational slack. As the environments are not stationary (business) cycles, technological progress), the firms must strive to maintain themselves to an ever-moving best-practice frontier.

The main features of the behavioural theory are :

(i) it argues that only individuals have goals (not firms);

(ii) it argues agents have bounded rationality (and satisfies rather optimise);

(iii) it recognises that information is costly;

(iv) it views firms as coalition of agents.

Many of these ideas are now incorporated in the 'optimising perspective' of neo-classical economics.

6.3 Multi-product Firm and Multi-product pricing

Most of the textbooks in economics focus on the single-product firm, whereas in practice most firms produce more than one product. The reasons for this can be traced to either technological or organisational advantages of the firm. Conglomerate firms may produce products which are not very related to one another, and whose production processes may be largely independent. In such cases, where there is independence of the products both on the demand and the production side, the problem of pricing and marketing of the products is almost the same as the single-product firm. However, usually firms produce a product line, where products are usually substitutes or complements. Apart from demand inter-dependencies, there are cost dependencies too. These arise when products utilise common production process, common inputs, common inventory etc. These interdependencies imply that theoretically, it is no longer possible to determine the profit-maximising price of each product in isolation. Pricing of the whole range of firm's product has to be undertaken simultaneously, in a system-wide solution.

6.3.1 Multi-product Firms

Multiple products are likely to be produced within a single organisational structure, if it is more profitable to do so than to produce the goods separately. The reasons can be loosely categorised as demand-related, cost-related of financial reasons.

(a) Demand-related reasons

The argument is that drawing products under umbrella of a single firm may help to facilitate price discrimination, to create barriers to entry and to leverage monopoly power.

(i) Price Discrimination

A firm with monopoly power could improve its profitability by designing non-linear schedules by which it sells its products. Typically it involves quantity discounts. Firms usually apply this technique when they bundle products. A car manufacturer will typically offer a model with wide range of specifications, such that the higher specification model is cheaper than the cost of buying a lower-specification model and buying separately the additional specifications. If we think of a situation where different firms provide different items having monopoly power over its item, then if they can be brought under the single umbrella, there may be no savings in cost, only in organisational benefits, pricing of different commodity bundles is likely to be better coordinated and controlled within a single firm.

(ii) Barriers to Entry and Monopoly Leveraging

Monopoly leveraging of exploit monopoly power in one market either to prevent others being able to enter, or to achieve a dominant position in another market. Microsoft forced PC manufacturers to install Internet Explorer (its internet browser software) as a condition of obtaining licenses for windows 95 operating system. This internet browser is not superior to the others in the market, but as Microsoft has a stranglehold over the market for operating systems, it is able to leverage a significant market share for that product. The dominant firm gains by setting the price above its marginal cost and earning additional profit. Thus, tying together can be beneficial for the multi-product firm. In principle, separate firms can also the their products too, and such practices are quite common. But generally such inter-firm collusive agreements are illegal and subject to government intervention. But if it happened within the firm, it becomes difficult of track such processes. So this is also another rationale for multi-product firms alongside other organisational economies.

(b) Cost-related Reasons

The cost based rationale for multi-product firm is based on the concept of economies of scope, which is a special case of cost-subadditivity. A cost function is sub-additive if it is cheaper to produce any given output vector in one batch than in a set of smaller batches. In the two-product case, this simply means that $C(q_1, q_2) < C(q_1) + C(q_2)$.

In general, economies of scope arise because input resources have the characteristics of a public good, i.e., the use of the input does not deplete its availability for other uses. Examples can be given of a database with many users of using electricity in night for other purposes, once it is installed for daytime production only. Of course there are examples of natural economies of scope associated with production such as beef and hide or refining oil in a multiplicity of products. Multi-product firm facilitate a fuller capacity utilisation over time by reducing indivisibilities or lumpiness in the production process.

Apart from overall firm economies of scope, one can distinguish the technological or plant economies of scope. These are associated with the production process itself while firm economies additionally include organisational economies.

(c) Financial Reasons

It is sometimes argued that by diversification and production of a wide range of outputs, the firm spreads its risks, specially if the products are not close substitutes and thus likely to be affected by same environmental products of market movements. This argument is not very tenable as such diversification does not add value to the company. As the shareholders are already diversified, they can get more advantage by diversifying their own portfolios, rather than the products of the firm. When real-world complexities are introduced, the picture becomes more hazy. At most, one can argue.

(i) there may be some tax advantages associated with such diversification;

(ii) diversification facilitate dividend smoothing;

(iii) Diversification would benefit managers as it reduces company's total risk;

(iv) larger the enterprise, the lower the costs of raising finance, thus benefiting the firm;

Thus, there is an assorted range of financial pressures, which tend to encourage the formation of multi-product firms.

6.3.2 Multi-product pricing

Till now, we have shown that when there are economies of scope, there is an incentive to set up a multi-product firm. With common provision and use of common facilities, the cost function will feature some degree of interdependency in the sense that the marginal cost of production of each product may be affected not only by its own output level, but also by that of the other products in the product range. Similarly, as the products in the product range are often related and hence substitutes, demand interdependence is also common. In such cases, profit-maximising prices cannot be determined independently. Table 6.1 shows the point.

Table 6.1 The Multi-product pricing problem

	Demand		
		Independent (zero cross-price elasticities)	Independent (non zero cross-price elasticities)
Cost	Independent	Price each product separately	System solution required
	Interdependent	System solution required	System solution required

If there is interdependence either on the cost or on the demand side, then the theoretical problem of setting prices in order to maximise profits requires the solution of a set of simultaneous equations (equal to the number of products). It is not possible to identify this optimum by setting prices for the various products either sequentially or independently. If there is independence on both cost and the demand side, then the products may be priced in isolation. Here for optimising prices for multiple products, the demand and cost functions for each product are necessary. Here we would assume that demand and cost functions (also how cost varies with changes in output mix and volume) are known with certainty.

Suppose the firm manufactures n products. Ordinary demand functions would be of the form :

$$q_i = f_i(p),\ i = 1, 2..........n \tag{6.1}$$

Where q_i, $i = l, ...n$ are the quantities demanded and

$$p = (p_1, p_2...........p_n) \tag{6.2}$$

are the prices set by the firm. The prices of each of the firm's n products may have influence on the sales of each product although typically the own price would be the major determinant of an individual's products sales. The total cost of producing output q is assumed to be a smooth cost function C(q). The firm's profits are thus given as

$$\pi = \left(\sum_{i=1}^{n} p_i q_i \right) - C(q) \tag{6.3}$$

Given the ordinary demand function (6.1), the first-order necessary conditions for maximum profits are more easily obtained through analysis in price space. This treats n prices as choice variables and the first order conditions are thus

$$\delta\pi / \delta p_j = q_j + \sum_{i=1}^{n} (p_i - \partial C(q) / \partial p_i)(\partial q_i / \partial p_j)$$

$= 0$, $j = 1.2, \ldots\ldots\ldots\ldots\ldots, n.$ (6.4)

In fact, so long as the demand and cost functions are reasonable well-behaved, in conjunction with the demand equation (6.1), are sufficient to identify the optimum prices, outputs and attainable profit for the firm.

6.4 Some Special Pricing Techniques

6.4.1 Peak-load pricing

Many firms face a systematically varying demand for their product. The most common examples are utilities like electricity, gas, telephone. Demand may fluctuate over a daily or weekly cycle or even an annual cycle. This implies that it may pay the firm to vary price systematically over time as well. The advantages of varying price will depend on.

(i) substitutability of demand : the extent to which consumers can substitute demand at one point in time to another,

(ii) the extent to which the firm has to produce for demand just in time (rather than through accumulation of inventory.

Here we can show the example of electricity, where demand during the daytime is considerably higher than at night. Consumers are unable to store electricity; if the firm charges a lower price for electricity at night (the off-peak rate), this gives the consumers an incentive to purchase at night to use it during the day. If storage was costless, then purchase would have done only at night at lower price (then it would no more be off-peak). So storage has to be difficult of costly for the consumers if peak load pricing has to be sustainable. These are special type of perishable goods. This difficulty also affects the producer. If it is costly for the producer to store the product, he will also go for just-in-time production. This implies that peak level demand has to be dealt directly, i.e the installed capacity needs to cope with the anticipated peak level of demand so, by opportunity cost resoning peak demand is more costly to provide than off peak. The marginal cost of providing one more unit of output at the peak is the sum of the marginal running costs plus the marginal cost of providing the additional unit of capacity, whereas since the capacity is already there, the marginal cost of off-peak period is simply the running cost. These differences in cost would also provoke the firm to differentiate in pricing between the peak and off-peak periods peak-load pricing differs depending on the objective of the firm. Usually peak-load pricing deals with the welfare-maximising objective as in most of the cases, the firm is a public utility. However, following extensive privatisation all over the world, the profit-maximising firm is also worth studying.

- **The profit-Maximising Case**

We start with the assumptions that there only two periods, peak (labelled 1) and off-peak (labelled 2), the capacity cost per unit is β, the marginal running cost for installed capacity is b per unit in both the periods. Once installed the capacity is available in both the periods. The problem is to determine the amount of capacity to install and the prices to charge for the product in the peak and off-peak hours.

Let p_1 and p_2 denote the prices charged in peak and off-peak periods respectively, with associated output (sales) q_1 and q_2 and let Q denote the capacity installed. Then, methematically, the problem is

$$\text{Maximise } \pi = R_1 + R_2 - C = p_1q_1 + p_2q_2 - bq_1 - bq_2 - \beta Q \quad (6.5)$$

$$\text{subject to } q_1 \leq Q \quad (6.6)$$

$$\text{and } q_2 \leq Q \quad (6.7)$$

This is an inequality-constrained problem whose mathematical solution is quite complicated. Here we would give an intuitive account of the nature of the solution.

There are two types of solution to his problem, either capacity is chosen in such a way that it is fully utilised in only in the peak period (**the firm peak case**) or it is chosen such that it is utilised in both the periods **(the shifting peak case)**.

If the off-peak sale is less than the capacity the pricing rule would be

$$MR_1 = b + \beta \quad (6.8)$$

$$\text{and } MR_2 = b \quad (6.9)$$

The rationale for this solution is simply that profit maxinisation requires equalisation of marginal revenue with marginal cost.

If both peak and off-peak sales equal to capacity, then the nature of the solution would changes. If $MR_i(Q)$ denote the level of marginal revenue at capacity output Q in period i, the rise in revenue from adding one more unit of capacity is simply $MR_1(Q) + MR_2(Q)$. The total cost of supplying this is $2b + \beta$ (two units worth of running costs, one for each period plus the capacity cost associated with expanding capacity by one unit). The solution would involve setting the marginal revenue equal to marginal cost, i.e.

$$MR_1(Q) + MR_2(Q) = 2b + \beta$$

Of these two cases, the actual solution would depend on the exact position of the demand curves, along with the capacity and marginal operating cost. The bigger the vertical difference between the peak and off-peak demand curves and smaller the capacity unit cost, it is more likely to be a firm peak solution, rather than the shifting peak. In either case, there will be a peak price, which will be higher than the off-peak price.

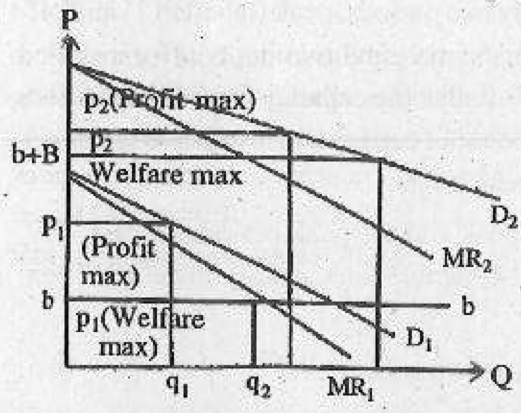


Figure 6.5 Peak Load firm peak

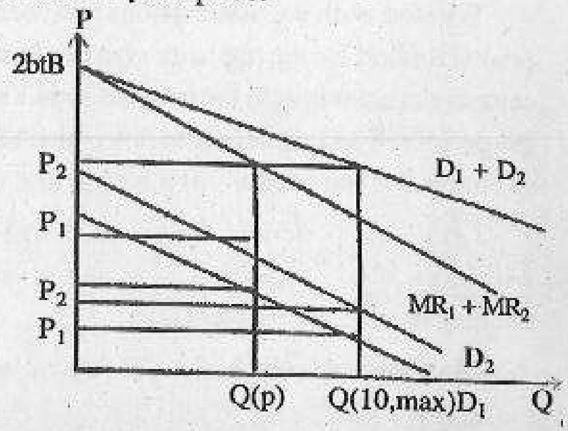


Figure 6.6 Peak Load Shifting peak

Figure 6.5 & 6.6

6.3.1.2 The Welfare-Maximising Case

Here the problem is identical except that the objective is to maximise welfare and not profit. Welfare is measured as the willingness to pay minus the cost, so the mathematical formulation of the problem would be

$$\text{Maximise } W = WTP_1 + WTP_2 - C$$
$$= WTP_1 + WTP_2 - bq_1 - bq_2 - \beta Q \quad (6.11)$$

where WTP_i is the willingness to pay by the consumers in period i (being measured by the area under the appropriate demand function) and is subject to the capacity constraints given by equations (6.6) and (6.7). We are not going for the formal mathematical solution of the inequality-constrained optimisation problem. The intuitive solution is similar to the profit-maximising case. Here, the price has to be set equal to the marginal cost. The solution will also involve the two cases as before.

When the off-peak sale is less than the capacity (i.e. the firm peak case), marginal revenue is substituted for price. Thus, we have the solution as

$$p_1 = b + \beta \quad (6.12) \text{ and}$$
$$p_2 = b \quad (6.13)$$

In the Second case, where peak and off-peak sales equal to capacity (the shifting peak case), replacing marginal revenue with prices, we get

$p_1 + p_2 = \beta + 2b$ (6.14) and as we know $q_1 + q_2 = Q$, (6.3.2.4) implies

$$p_1(Q) + p_2(Q) = 2b + \beta \quad (6.15)$$

The function $p_1(Q) + p_2(Q)$ is the vertical sum of the two demand curves. The intersection of this with the marginal cost line $2b + \beta$ gives the solution for Q in this shifting peak case. The associated prices are related with the individual demand curves associated with this level of output. The level of price depends on the relative strength of the speak and off-peak demand. Ultimately, it boils down to checking that the capacity constrints are satisfied and whether the calculated prices in both the periods at least cover the marginal operating cost.

6.4.2 Pricing and Capacity Planning

This section deals with the capacity planning problem and its relationship with optimal pricing. Most of the firms have to invest in capacity prior to production and selling of products. Thus the decision of how much capacity to be installed would involve not only the costs of installing capacity but also of expected net profitability of the product in each year over the economic life of the plant. Consideration of optimal capacity thus requires some assessment of forecast of expected future sales over the life of the product. This type of information is very difficult to confirm with any degree of confidence. So, in this section, we would show the principles involved in conducting such analysis. Let us assume for simplicity, there are just two periods. At time 0, the forecast is made about the demand curves the firm is expected to face at period 1 and 2, and the firm thus chooses to install a capacity Q. Here, obviously a major consideration would be whether the product is storable or not, so that the firm can manufacture for inventory. Again for simplicity, we assume the product as perishable. As before, we take the installed capacity as Q, sales in period 1 and 2 as q_1 and q_2 and the prices being set at p_1 and p_2. There is a constant operating cost of b per unit in both the periods and the capacity coat per unit is β. The problem now becomes quit similar to the peak-load pricing problem except that the demand curve in period I can lie above or below that for period 2. Another distinguishing feature of this problem is that here capacity is chosen on the basis of expected future demands. After the installation of the capacity, the actual demand may be very different from the expected. The capacity cannot be varried in the short run, so the short run pricing problem comes down to choosing the best, given the capacity. In the short run, the capacity is a sunk cost and the short run marginal cost (SRMC) is flat at level b, turning vertical at capacity output level Q. The pricing problem, with installed capacity, is simply to set the marginal revenue equal to marginal cost in each of the period. The following two cases may arise :

a. If the demand curve is at a level such as D_A, so that the marginal revenue cuts the horizontal part of the SRMC, then for profit maximisation, the price is set at P_A.

b. If the demand is sufficiently high for the marginal revenue curve to cut the vertical portion of the SRMC, as for the demand curve D_B then the price is set at p_B so that demand is restrained to be just equal to capacity.

If the objective of the firm is welfare maximisation, then the price is to be set equal to marginal cost. Thus, for maximum welfare, the optimum pricing policy involves :

(a) setting price equal to marginal running cost ($p = b$) if, at this price, there is spare capacity, and

(b) only if demand reaches capacity should the price start to rise above level b. In this case, price is chosen simply to restrict demand to available capacity.

The problem of choosing capacity depends on the expected demand curves for the two periods. Let r denote the riskless rate of interest appropriate for discounting riskless cash flows; the profit-maximising problem may then be written as

$$\text{Maximise } \pi = \frac{R_1 - bq_1}{1+r} + \frac{R_2 - bq_2}{1+r} - \beta Q \qquad (6.16)$$

$$\text{subject to } q_1 \leq Q \qquad (6.17)$$

$$\text{and } q_2 \leq Q \qquad (6.18)$$

The first two terms on the right of (6.15) represent the discounted operating profits earned in period 1 and 2, whilst βQ represent the cost of installation of capacity Q at period 0 once installed, this capacity cannot be exceeded, as per the equations (6.16) and (6.17). This assumes that the firm cannot produce something in one period and store it as an inventory for demand in future periods. Thus, the problem is quite identical to the peak-load pricing problem, except for the discount factors and the fact that here any period can be peak period. Thus, we will have three possible regimes :

a. $q_1 = Q$. $q_2 < Q$ (firm peak in period 1)

b. $q_1 < Q$. $q_2 = Q$ (firm peak in period 2)

c. $q_1 = q_2 = Q$ (shifting peak)

The following pricing rules can be easily established

(a) for the first case

$$MR_1 = b + \beta(1 + r) \qquad (6.19)$$

$$MR_2 = b \qquad (6.20)$$

(b) forthe second case

$$MR_1 = b \qquad (6.21)$$

$$MR_2 = b + \beta (1+r)^2 \qquad (6.22)$$

(c) for the third case

$$\frac{MR_1(Q) - b}{(1+r)} + \frac{MR_2(Q) - b}{(1+r)^2} = \beta \qquad (6.23)$$

The economically relevant solution requires that the capacity constraint is taken care of in both the periods and the marginal revenue never falls below the marginal operating cost b. The firm peak in period 1 indicates declining demand over time and that in period 2 indicates expanding demand. Though the general problem of capacity choice is more complex than the simplified two period case, it is sufficient to illustrate the complexities involved. Furthermore, it shows that once capacity is installed, pricing becomes a short run decision. If demand keeps on rising than it becomes economic to install new capacity. The discussion of the welfare-maximising case is dropped here, the solution incolves replacing marginal revenue by price in the equations (6.19) - (6.23).

6.4.3 Inter-temporal pricing

In the preceding two sections, we were dealing with two special types of intertemporal pricing problems, namely peak-load pricing and pricing related to capacity constraint and demand variation. Now, we will discuss the idea of price skimming a special form of intertemporal price discrimination.

In price skimming scheme, the price is reduced period by period in order to capture greater revenue than can be obtained by setting a single uniform fixed price over time. We will discuss this stratege for two group of consumers namely, the naive ones and then the sophisticated ones.

Price skimming is possible for a durable commodity, which is a monopoly product. It involves setting an initially high price and then systematically reducing this price over time. The classic example in Indian case is Teflon-coated non-stick cookwares.

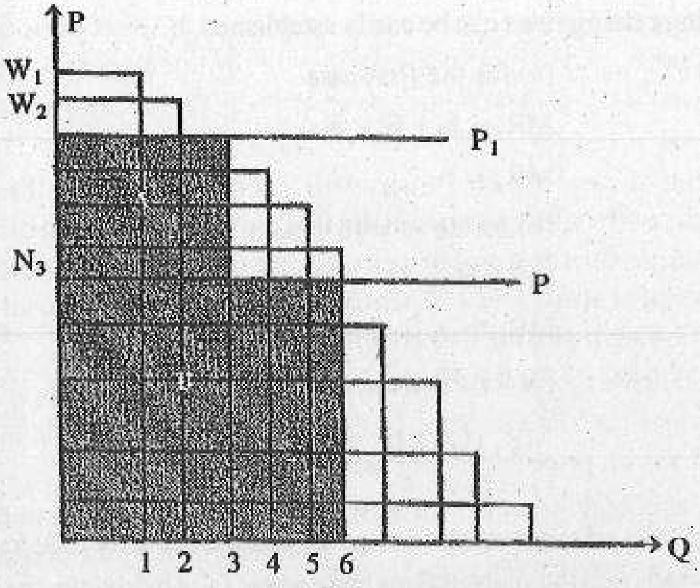


Figure 6.7 Price Skimming strategies

- **Skimming with naive consumers**

We assume, for simplicity, each individual desires only one unit of the product (which is the usual case with durable goods). Different individuals are willing to pay different amounts (for differences in individual preferences, income and wealth). An individual will purchase the good only if the price is set below an individual's willingness to pay. The excess of reservation price over the actual price is the consumer surplus. In Figure 6......, individuals are rank-ordered by their willingness to pay (highest first and so on); these are labelled w_1, w_2 and so on for individuals 1, 2 etc. If the firm sets price at p, it will sell a quantity q = 5 and obtain a revenue R = pq = 5p, the shaded area b in the figure. The *i*th consumer who buys gets consumer's surplus CS_i equal to willingness to pay w_i minus the price p, i, e $CS_i = w_i - P$. This can be contrasted with the case where the firm first sets the price p_1 and later the price p. At p_1, the firm will sell 3 units. Once, these three comsumers are out of the market, if the firm reduces the price to p, it will be able to sell another 2 units. Thus, the firm again ends up by selling 5 units, but gains in terms of increased revenue.

- **Price Skimming with Sophisticated Consumers**

Let us consider a monopolised market for durable goods with no depreciation of product development. Let the firm produce output at constant marginal (equalling average) cost. If the firm sets the price at p and sticks to it for a long time, it will make some levels of sale immediately, but none after that. Having sold the initial quantity at a price above marginal cost, the firm has a strong incentive to reduce price in the next period in order to sell further units at further profit. The incentive may imply that the expectation may be that the monopolist would keep on reducing price period by period until price falls below the marginal cost.

From the point of view of a consumer, even if he/she has high willingness to pay for the product, he/she will understand rationally that the price will fall to marginal cost. He/she will not buy the product at any other price. So, the monopolist has to set the price equal to marginal cost straight away. This idea was originally suggested by Ronal Coase implying that price-skimming strategies are unworkable.

This would indicate that at least for durable commodities, monopoly power does not lead to monopoly welfare loss. But it can be shown that this conjecture holds only in special cases. In the real world, price skimming can work.

This particular conjecture relies on consumer rationality. If consumers are myopic a skimming policy would work. The extent will be determined by the consumers, how they will pick up the price-skimming trends and defer their purchases. Actually consumers are ignorant about the marginal cost and also the time when the monopolist will actually set the price equal to marginal cost. Products are being continuously developed and durable commodities physically depreciate over time. Consumers are mortal and impatient. They have their own time preference. In such circumstances, some rational consumers will buy at the initial higher prices. So, price-skimming policies require a carefully judged rate of price discount.

6.4.4 Cost-plus and Mark-up Pricing

This Section deals with cost-based pricing. This is a single product model, so there is no problem of joint cost allocation. In essence, the method simply involves adding a percentage of absolute mark-up to the cost of the item. The cost is usually the average cost or average variable cost based upon historic accounting data.

Cost-plus pricing is the general term used for cost-based pricing, where price is determined by adding a mark-up to some measure of the cost of production.

Mark-up pricing is the special case where mark-up is applied to average variable cost.

Full-cost (or average cost) pricing is the special case where the mark-up is applied to average total cost.

The subtle difference between mark-up and full-cost pricing requires overheads to be allocated across the products a firm produces or sells. For firms with many product lines, the preference is for mark-up pricing. It is easier to estimate the average variable cost, so the mark-up pricing rule is much more straightforward to apply. From the perspective of pricing decision, the problem with full cost pricing rule is that full cost requires overheads to be allocated to products. Overheads are often non-attributable and the allocation is often arbitrary.

Let C = total cost

F = fixed of overhead cost

VC = variable cost

AC = average cost

AVC = average variable cost

M = mark-up on AC

m = mark-up on AVC

Then the mark-up may be applied in the form of an absolute mark-up

$$P = AC + M \text{ or } P = AVC + m \tag{6.24}$$

or as a proportionate or percentage mark-up

$$P = AC\,(1 + M) \text{ or } P = AVC\,(1 + m) \tag{6.25}$$

The object of the pricing exercise is thus to choose a mark-up in order to achieve a satisfactory level of profitability. In particular, with the separation of ownership from control, managers of the firms typically have some scope to pursue objectives other than short-run profit maximisation. In this approach, the key point is that there is no role of demand analysis in price setting. Of course, absolute ignorance about price-sensitivity of demand to price may lead to the choice of an inappropriate mark-up and leading to unpleasant consequences for the firm. There is a well-known debate about the superiority of marginalism and cost-plus pricing, the scope of which is beyond this treatise.

6.5 Advertising

In this section, we will explore the nature and characteristics of advertising. It then explores how market structure influences the level of advertising by the firms. Without going into the models determining the level of advertisement, in the last section, we will discuss advertising from the point of view of social welfare.

6.5.1 The Nature and Characteristics of Advertising

Advertising is simply a part of the overall selling or promotional effort. In the modern business scenario, it is the job of the sales representative or the marketing executive to inform the potential customer about the firm's products and try to persuade them to make a purchase. Advertising is concerned with exactly the same function, i.e. to inform and persuade. In contrast to other selling activities, it involves spreading a message across a mass audience.

According to the simple model of consumer theory, advertising has to purpose at all. If individuals have full knowledge about all existing and potential products and have their preferences fully defined. But the recognisable presence of advertisements in modern business world, proves the fact that something is missing in the naive version of consumer behaviour theory. In reality, the consumer may not be aware of many commodities, never having previously experienced of consumed them. Moreover, there may some products with hidden and uncertain characteristics at the time of purchase and thereafter : for example, durable goods specially which are resaleable (a second hand car may reveal its true quality only in the fullness of time. Advertising performs two types of function, namely.

(i) inform-to provide information about the products and services (about the existence of the product, its price, where it can be bought, its quality and other characteristics etc.)

(ii) persuade-to transform the individual's preferences about known goods.

Information can affect a consumer's preference ordering : if, before buying one gets a second hand car checked by a competent mechanic, that does not change the characteristics of the car, but it changes the perception of the buyer about the car. However, for fashion wear, advertisements can be persuasive, it can create bandwagon\herd effects for a particular product, levis jeans can be taken as an example.

The following classifications can provide a useful way analysing the likely role of advertising. **A search characteristic** is one that can be understood without being experienced, whilst an **experience characteristic** is one that has to be tried before it is appreciated. Taking into account these characteristics, goods can also be classified into **search goods and experience goods.** Secondly, goods can also be classified into **convenience** and **shopping (or non-convenience) goods. A convenience good** is one with a relatively low unit, frequently purchased by the consumers form outlets with easy access. On the other hand, a **non-convenience good** is with a relatively high unit price, infrequently purchased. Of course, this categorisation is quite loose, most of the goods in reality are mixture of these characteristics. Advertising on search goods in reality are mixture of these characteristics. Advertising on search goods in more likely to be informative, for experience goods, it is more likely to be persuasive. This leads to the view that advertisements imparting information is better done through newspapers, journals and magazines, whereas persuasive advertising is better done through television and related media. Some economists argue that advertising usually co-centrates on convenience goods whereas for shopping goods, it is direct dealing with the sales force in the shop that is more likely to determine the exact purchase of a consumer so, convenience good are more likely to be more sensitive to advertisements. Advertisements are likely to be more cost-effective.

1. where buyer awareness of the product is low; that is particularly for new products and services;
2. where the product has features or characteristics which are not immediately discernible to the potential customer, i.e. the product is an experience good rather than a search good.
3. where there are good opportunities to differentiate the product from the similar products

Again advertisements are more likely to be important for final consumption goods and services, rather than for intermediate goods being sold between the firms, mostly done by the purchase departments of the firms.

6.5.2 Advertisement and market structure

The empirical evidence all over the world suggests that there is a weak positive correlation between advertisement intensity and the level of concentration in the industry. Advertisement is sen as a strategic variable controlled by the firm which has a feed back influence on market structure, it can be used to build monopoly power but also to create a barrier to new ent.y into the industry. Thus, one may dispute the direction of causation but the theoretical expectation of positive correlation between advertising intensity and concentration does seem to be consistent with the empirical facts.

Advertising is likely to vary across the four major types of market structure as follows :

a. Perfect Competition

The product in this type of market is homogeneous, by definition. So, there is no role of advertising. But, advertising may be used to differentiate between what was previously thought of as a homegeneous product like coffee.

b. Monopoly

Advertising can be used to increase the demand for the product at any given price. The general principle is to spend on advertising and promotion until the extra profit generated by advertising is just balanced by the extra cost of the advertising. Usually, a monopolist wants to advertise to deter entry and increase his ability to exploit his monopoly power without fear of entry.

c. Monopolistic Competition

In this market structure, advertising is likely to play an important role. First, it can be used to increase the perceived product differentiation. This, in turn, increases the monopoly power of the firm. As in this case, each firm is in direct competition with a relatively small number of near neighbours, advertising may be necessary to maintain or increase the market share of the firm.

d. Oligopoly

Advertising is likely to be most prevalent in this type of market. Given the interdependence of the firms, each firm faces a prisoner's dilemma, not only in choosing level of output or price but also the level of advertising. Every firm feels that it will do better if they advertise more by stealing market share from the competitors. However, the heavy advertising of each firm neutralises each other and the firms are worse off. Such advertising leads to social waste of resources.

6.5.3 Advertising and Economic Welfare

Without going into any formal analysis, we may reasonable conclude that

- in so far as advertising provides information that helps people make informed choices and fewer mistakes, it is likely to have social value, whilst
- in so far as it is concerned to persuade, it is quite unclear. Advertising could represent a waste of resources, in the extreme case where advertising is mutually self-cancelling.
- in so far it increases monopoly power, it will tend to increase prices. It may lead to lower prices to the extent it is informative, by increasing the amount of price information available to the consumers.
- in so far it is informative, it will increase customer awareness of the higher quality products on offer, and increase competition among the firms to supply quality at a competitive price, or to reduce prices on pro rate basis.

6.6 Summary

Though the neo-classical approach based on the marginalist principle has become synonymous with mainstream economic analysis, there is a considerable volume of literature, which is outside the purview of this. In this unit, we had a glance of some of these discourses. We started with two well-known alternative theories of the firm, namely those of Baumol and Williamson. In both of these, goals other than profit-maximisation are considered. Then we had an overview of the behavioural theories of Simon and Cyert & March, where the neo-classical paradigm of *homo-economicus* is questioned. After this, we dealt with the firm producing more than one product the problem of pricing in such a case. In the next section, some special pricing techniques like peak-load pricing price skimming, and full-cost pricing are considered. In the last section, we had a detailed discussion on the economics of advertising.

6.7 Questions

1. Consider a single-product firm for which the demand function is p = 100 – q and total costs are $C(q) = q^2$. Find out the profit-maximising price, output and profitability for firm. If the firm is a Baumol sales revenue maximiser, what is the choice of price and output if the MALP is 450. What is the difference in economic welfare in the two cases?
2. Critically discuss Williamson's Expense preference Model.
3. Do you think Marris's growth Maximisation Hypothesis gives a sufficient explanation of a firm's objective?
4. Why a firm decides to produce multiple products?
5. Discuss the problem of multi-product pricing for demand-independent and demand-interdependent products. What are the problems of getting a solution for cost-dependent and cost-interdependent products?
6. Why peak-load pricing is adopted? Discuss the achievements of peak-load pricing for the profit-maximising case and welfare-maximising maximising case.
7. Discuss the relation between capacity planning and pricing
8. Discuss the problems and prospects of price-skimming for naive consumers and sophisticated.
9. What are functions of advertisement? How advertisement is related to market structure? How advertisement affects economic welfare?

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Unit-7 □ Market Failure : Externalities and Public Goods

Structure

7.1 Introduction

In this unit, we will learn why markets can not deal with all goods and bads equally well. This leads to the issue of state intervention. We will also learn why and under what circumstances, problems of pollution and congestion need state intervention. Lastly, we will take up the issue of imperfectly competitive industries and the alternative mechanisms for state intervention in that situation.

7.2 Public Goods

Public goods are characterised by one or more of the following features :

1. **Non-rivalry in consumption. A private good** is one, which once consumed by one individual, is no longer available for consumption by others (e.g. a food item). **A pure public good** is one for which consumptions by an individual does not diminish the amount available for consumption by the others (e.g. pollution, television or radio programmes, national defence etc.) Some goods are intermediate between pure private and pure public goods, for example library books and football matches. If someone borrows a particular book from the library, no other individual will be able to read it, at least for the time being. If the football stadium is half full, then individual's decision to go there, does not exclude others. However, if the capacity is reached, then his decision does exclude others.

2. **Non-excludability.** Once the good is provided for some individuals, it is impossible, or at least very expensive, to prevent others from consuming it. This

is true for national defence, to some extent for television programmes (of course cable television and use of decoders provide the technology for excluding consumers).

3. **Non-rejectability.** This occurs when, once provided, the good has to be consumed by everyone. One has to get it whether he wants it or not (at least, it is very expensive to avoid). This is the case with many types of pollution.

   Thus, non-rivalry in consumption is an essential characteristic for both public goods and public bads, while non-excludability is important for public goods, and non-rejectability for public bads. Thus, focussing on goods, we have :

If a good features non-rivalry in consumption and non-excludability, then market provision is not possible. But if a good features non-rivalry in consumption along with excludability, then market provision is possible. When a public good has the characteristic of non-excludability, the problem of free riding occurs. No rational consumer is willing to pay for a public good, since they know if someone else pays for it, they will get it free. As a consequence, either the market under-provides it or does not provide it at all. On the other hand, a good may feature non-rivalry in consumption but still be excludable, as for example a cricket match. The market can always provide such good. By contrast, for public bads, it is the non-rejectability that matters. A non-rejectable public bad impinges on everyone whether they like it or not. In bargaining with the provider of public bad, those affected by pollution will have a tendency to free ride. They will understate their willingness to pay if asked for a contribution to force the polluter to reduce emissions. Ultimately, the market over-provides the public bad. So, in practice, the public goods tend to be provided by the state and the public bads are to be controlled by the state.

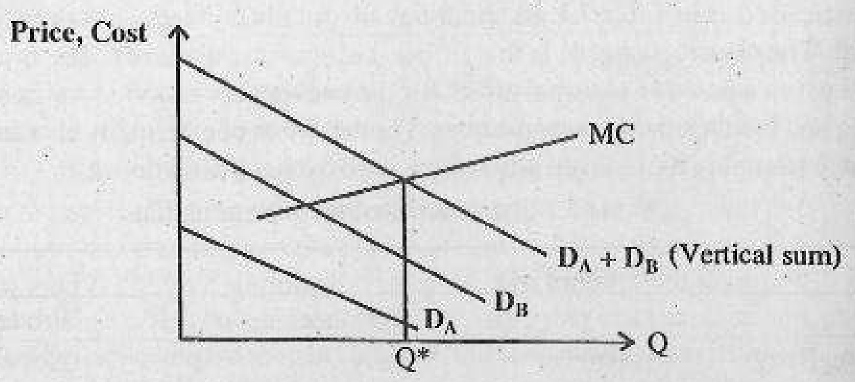

Figure 7.1 Optimal Provision of a public good

Even when a public good is state-provided there is the problem of aggregation. Theoretically, summing up every individual's marginal willingness to pay and equating it with marginal cost, would give the optimum quantity, as shown in Figure 7.1. But there is problem is making such a solution operational, as we have already stated that the individuals have a tendency to understate or overstate there willingness to pay depending on whether they are going to be taxed or the amount of provision is related or not to the amount of payment. This requires the design of a mechanism which reveals the true intention of the individuals.

7.3 Externalities

An externality is said to exist when one agent's action directly affects the welfare of one or more other agents, where the effects are outside any form of exchange relationship. An externality is said to be positive (negative) if the effect is beneficial (adverse).

To illustrate the concept of externality suppose if there are two firms located on the river bank require clean water for their production processes. However, the upstream firm discharges polluted water in the river, rather than spending money on its treatment. the polluted water not only increases the cost of production of the downstream firm but also affects the quality and quantity of catch of downstream fishermen. This example amply shows that there must be at least two parties to any external effect. When one of the parties are removed, the external effect disappears. On the other hand, if the two firms comes to a deal in which the upstream firm reduces pollution levels in exchange for a cash payment, one can think it as the establishment of a market for the external effect. Apart from this type of technological externality, one can think of pecuniary externality also. If a big broker in the share market purchases a large volume of a thinly traded equity stock, then such a trade moves the price upwards. However, this type of pecuniary externality does not lead to under-or over-provision of goods.

If the agents are classified as either consumers or producers, then externalities may also be characterised as in Table 7.1. Externalities are usually unilateral but sometimes they are bilateral. The classic example is that of bee-keepers and orchards. The proximity of an orchard gives a positive external effect for the beekeepers and vice-versa as the bees in foraging and feeding, pollinate apple trees. The definition of externality also emphasises the idea that externality exists even when there is no exchange relationship.

Table 7.1 The Classification of Externalities

	Affected Party		
		Consumer	Producer
Affecting Party	Consumer	Envy Altruism	Not so important
	Producer	Smoke Noise Air & waterborne Pollution	Smoke Water Abstraction Air & waterborne Pollutants Fishing

7.3.1 Optimum Externality and the Coase Theorem

Let us consider to classic examples of externality. The first is of a factory emitting smoke through its chimney and the business of the nearby laundry affected by that. The second is about two passengers travelling in the same train compartment, where one is a smoker and another is not. In both the situations, we can think of a marginal benefit curve of the producer and a marginal damage curve of the pollutee (i.e. the affected party). The area under the marginal benefit curve represents the smoker's willingness to pay to be allowed to smoke, whereas the area under the marginal damage curve is the amount the affected person wants to pay to eliminate the smoke. The optimum level of pollution is the level of intersection of these curves. Of course, this is the simplest representation of the situation. Firstly, if either of the party leaves the scene, the relationship breaks down. Secondly, the implicit assumption that both of them are working in a price-taking environment may not work everywhere. This takes us to the issue of property rights.

A property right is defined as a socially enforced right to be able legally to do something or use something. This right is said to be alienable if it is sellable. Some rights, like citizenship, are not alienable at all. Property rights are of significance for externalities in the following manner. Suppose there is no law against either the firm or the smoker in the railway compartment. Then they would choose to pollute to the point where there is no more marginal benefit from smoking. It follows that economic welfare is equal to the difference in the area under the two curves and that is maximised by choosing the level E*. Total economic welfare rises up to that point, but falls thereafter. The market appears to fail as $E_m > E^*$.

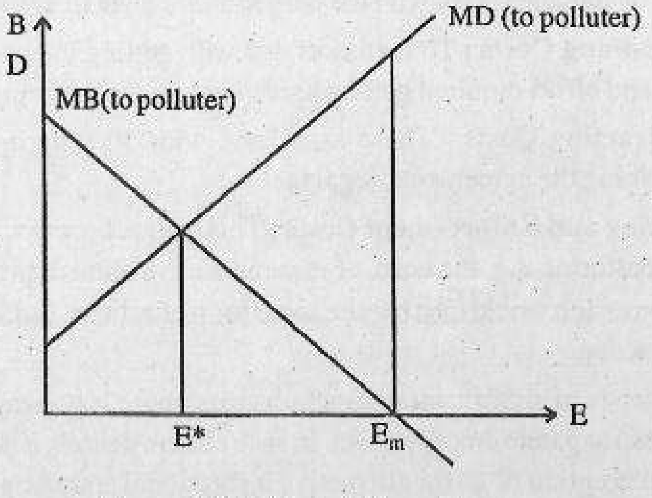

Figure 7.2 Optimum Externality

Ronald Coase, however, showed that in the absence of transaction cost, the optimum level of externality can be achieved. He argued that at E_m, there is a big incentive on the part of the non-smoker to have a deal with the smoker. There are gains from this trade. It will pay the non-smoker to offer a bribe to the smoker if he agrees to cut back production (i.e. emit smoke) by one unit. So long as the payment is less than the marginal damage to the non-smoker to offer a bribe to the smoker if he agrees to cut back production (i.e. emit smoke) by one unit. So long as the payment is less than the marginal damage to the non-smoker, and the greater than the marginal benefit foregone by the smoker, this deal makes both the parties better off. This argument is valid to each and every unit of smoke all the way back to E*. Coase argued that if there is no transaction cost, there is an incentive to create a market for externalities and that, will solve the problem. If the initial property rights were different, i.e. there was no right to pollute, the outcome would have been different. Here the smoker would derive a larger benefit from a single unit of smoke and he would pay the non-smoker to generate smoke to the level E*.

Thus, we can have a formal definition of the Coase Theorem, i.e. Resource allocation is pareto-efficient so long as there is a clear assignment of property rights and so long as transaction costs are zero. In the absence of income effects, the optimum level of externality realised is independent of the initial disposition of property rights.

In spite of Coase's argument, transaction costs cannot be assumed to be absent. The types of transaction cost involved in externality situation are as follows :

- **Search and Information Acquisition Costs :** These are the costs associated with finding out the nature of the circumstances, the extent of the damage, etc, and the way damages vary with the perpetrator's level of activity.
- **Bargaining Costs :** Those associated with getting the parties together and the time and effort required getting agreement on the appropriate outcome.

  Contracting Costs : Those associated with drawing up of legal documents describing the agreements, legal fees etc.
- **Policing and Enforcement Costs :** This is the cost associated with some form of monitoring e.g. the costs of running a environment protection agency. Any transgression would then require some form of actions, further negotiations and\or legal actions.

In the presence of significant transaction costs, there is no way to undertake a trade which would lead to pareto-improvement. In such circumstances, it is better to ask for some sort of state intervention or go for alternative institutional arrangement. This is discussed below.

Once external effect is identified, the options of different levels of state intervement from non-intervention, to may be considered regulation.

- **Non-intervention :** There is no implementation cost, and can be the optimal solution if intervention costs, outweigh the benefits of intervention.
- **Internalise the Externality :** Where the transaction costs are significant, there are clear benefits to internalising the externality through merger. This is not always a meaningful option, it is hard to think of a merger between the factory emitting smoke and the laundry. However, in case of producer-producer externality, merger is an option, as the merged firm will take account of all the benefits and costs associated with the externality in question. Mergers may increase monopoly power in the market place (increasing welfare loss) but may also reduce negative externalities and the associated costs (so reducing welfare loss).
- **Pigovian Taxes (or Subsidies) :** If the internalisation of externality, either through individual negotiation or through merger, is not feasible, then according to Pigou, the agent causing nuisance may be required to pay damages. If the law is unable to do that or the process is too costly, then it is better for the state to levy a tax (termed as Pigovian tax), in order to achieve the Pareto-efficient outcome. This is the basis of the so-called polluters-pays principle.
- **Regulation :** A major problem of imposing the Pigovian tax is that the state may not have the all necessary, information to determine the level of tax. In such a situation, it is better to regulate the production smoke in out example.

7.4 Second Best and Arbitrary Standards

The focus of the above discussion is on optimum externality. Even in the absence of knowledge about the optimum level, it may be clear that some reduction in the level of some type of pollution is socially desirable. This brings us to the question of the best methods of pollution control. One common option is the imposition of per unit of effluent tax. Firms are free to choose the level of pollution as long as they can pay for it. If the aggregate level of pollution is too high tax can be increased. Consequently the firms will reduce their level of pollution and theoretically, it is possible to adjust the tax so that a target pollution level can be reached.

Direct regulation of the quantity of pollution by individual firms is difficult to implement because of problems in assessing the fair level of abatement for each firm. The issue and sell of tradable permits can be one solution. The firms which derive most benefit from pollution will be able to outbid those which derive lower value if a fixed number of permits are auctioned. This fixed number of permits implies the target quantity of pollution will be realised.

All these tax and permit schemes have some efficiency properties for a heterogeneous group of firms, as they offer the prospect of attaining a given target for the total level of pollution at minimum cost.

7.5 Role of Property Markets

The property market operates to minimise the external effects, at least when they are local in character. Let us go back to the example of the smoky factory and the laundry. If either firm relocates, the externality between them disappears. Ceteris Paribus, the laundry is willing to pay higher prices for premises located in smoke-free areas. Similarly, a bee-keeper will be willing to pay a higher price for a location in close proximity of an orchard. The same holds true for the orchard-grower.

Thus the property market tends to maximise the positive externalities and minimise negative ones. Agents with heterogeneous preference are led by property prices in particular geographic locations. Property prices tend to reflect the value of the externalities that remain. The market tends to minimise negative external effects, but may not eliminate them. The smoky factory and the laundry need to locate close together if they serve the same community and cannot make sales without being in the close neighbourhood of the community. Hedonic pricing is one of the techniques used to value external effects. Here the property values vary as function of the level of externalities present and property prices reflect the whole bundle of characteristics offered, the impact of all other determinants of site value are to be controlled.

7.6 State Interventions in Imperfectly Competitive Industries

Under certain restrictive assumptions, the market mechanism delivers a Pareto-optimal state of affairs. The existence of externalities, public goods and imperfect competition indicate some degree of suboptimality and there may be some merit in state intervention. Dominant firms and oligopolies are far more prevalent than competitive markets and in equilibrium price is above marginal costs with an associated dead-weight welfare loss. Then the question arises whether the state would try to do something about mitigating this loss of welfare and/or try to prevent other firms getting such power.

The state has a variety of regulatory options available to deal with monopoly power.

1. **Public provision.** The state runs the industry in public interest, by setting prices, outputs and investments so as to maximise economic welfare. In the absence of distortions elsewhere, this results in setting prices equal to marginal costs. The take-over by the state of previously private sector firms is termed nationalisation. The

opposite action, of returning public firms to the private sector, is termed privatisation.

2. **Regulation.** The firm is left in, or moved back into the private sector, but its behaviour is restricted through state-imposed constraints on observable features of firm performances such as prices, profits, return on sales, and return on capital and some other non-financial regulatory controls like environmental pollution.

3. **Promotion of workble competition.** The state alters the number of player in the game. Monopolies can be broken into smaller units which are then encouraged to compete against one another.

The benefits of intervention have to outweigh the likely costs of intervention for the intervention to be worthwhile. If not, then no intervention is useful and it is best to leave the industry alone. Apart from existing monopoly power, the firms may also try to acquire or create monopoly power by any means, and it is possible to limit this behaviour by anti-trust practices. Such policies are designed to reduce the ability of firms to acquire monopoly power.

7.6.1 Dealing with Existing Monopoly Power

This section deals very briefly with the merits and demerits of different forms of intervention.

- Non-intervention

We would like to treat non-intervention as the benchmark from which all the above-mentioned policies are examined. We have already said that intervention is worthwhile if its benefits outweigh the implementation costs. This policy is likely to be optimal if the unregulated private sector monopoly is unable to exploit its position significantly, either because of its threat of entry or the lack of product demand or if in spite of monopoly power, the profit not is ploughed back to R & D or innovation of new product.

- Promoting competition

(a) Competition for the market

At least for some cases, franchise bidding might be used to circumvent the natural monopoly problem. Firms can be made to compete for the right to supply. The contract is offered to the firm offering the best deal. The contract has to include a promise to set a particular price and to deliver a satisfactory quality. If there are enough bidders, then at least in principle, the price will be close to average cost. There are many problems with getting the process working satisfactorily and there may be problems with enforcement of the contract.

(b) Creating a Competitive market

If an element of monopoly features constant returns to scale, then is may be possible to create competition in that element. Privatisation may be used to promote workable competition. As for example in electricity, it may be possible to retain the national grid, but to have many generating companies. Though the general idea is that competition promotes more efficiency, lower costs and lower prices, in order to create competition, some economies of scale are sacrificed.

- Public provision

This involves nationalisation of the industry and then operating that in the public interest. Of course, there are advantages and disadvantages of this system.

(a) Advantages

When the service is entirely under the control of the government, everything like prices, investment in capacity, output can be chosen to maximise social welfare. There are difficulties in implementation, primarily because of the problem of second-best.

(b) Disadvantages

The public firms do not have to face the market and thus they will never go bankrupt as their debts are usually underwritten by the government. So, there will be lower chances for the management being disciplined for poor performances. Again in the absence of a defined criterion like profit-maximisation as in case of private firm, it is very difficult to judge performance. Consequently, the firms generally manifest X-inefficiency and sometimes more cost-inefficient than the private sector firms. Countervailing political power may pose greater problem here.

- Regulation

In this case the firm remains in the private sector, but the performance is being monitored and regulated. Regulation usually focuses on the observable statistics of the firm's performance. The declared objective of the firm may be maximisation of welfare but the regulator's job may be to control profitability. To judge the performance on the basis of absolute profit may be difficult, so usually the focus is on the firm's rate of return. Again the profitability is restrained either by a direct profit constraint or a rate of return constraint or a price cap.

Obviously, there are drawbacks of the regulatory system. We can consider a few of them.

1. Regulation involves standard-setting, monitoring and enforcement and all these activities are costly. It is a bureaucratic activity, conferring power on the regulators. On the other hand, the firms try to dupe the regulators and to bypass the regulation. So, it is worthwhile to set a regulatory agency only when there may be substantial gains.
2. The state does not run the firm, it does not have full information about the performance of the firm. The state has to depend on the data of the declared indicators of performance. These data may be distorted by the firms and they can get away with it in the short run.
3. There may be difficulties in predicting the target and this may lead to regulatory uncertainty. The firms, in such a situation, may not go for cost-reducing investments.

4. The firms may enter into tacit arrangements with the regulators for not pressing hard on the firm. This is an intrinsic problem in all sorts of centralised control, planning and bureaucracy.

5. As the markets are becoming more and more international, free riders problems arise in attempts to establish transtate or transnational regulatory arrangements. If an individual country imposes tighter regulations. Production may shift to other countries. This is true for all types of regulation like financial, environmental, regarding factor market and so on.

7.6.2 Controlling Anti-competitive Practices

In this section, the economic problems associated with deciding whether interventionist policy is beneficial and identifying the anti-competitive practices are discussed.

- Merger policy

Usually, merger often increases concentration which may not be the case in case of conglomerate merger. So, it leads to increased monopoly power in someway or other, either through reductions in the number of competitors in the market or by increasing the scope for tying or bundling of products. Apparently, this seems to reduce economic welfare. Sometimes it also reduces costs. Competitive firms spend a lot in a advertising and merger can decrease this necessity. Likewise, other marketing cost, cost of reducing excess capacity, budget on R & D can be reduced substantially. So, here the consideration is to balance between the increase in concentration and savings in costs.

- Policy\Detection of Collusion

There may be explicit or implicit collusion in the market. Explict collusion involves legally enforceable contract between the parties, whereas implicit or tacit collusion is an informal agreement, which cannot be legally enforced. In most of the countries of the world, both types of collusion are illegal. Explicit collusion is easier to detect because of the presence of the legal contract. This form of conllusion is hardly attempted anywhere.