MAECO-405

Micro Economic Theory-II

MA ECONOMICS

2nd Semester

Rajiv Gandhi University
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MICROECONOMIC THEORY - II

MA [Economics]

Second Semester

MAECO-405

RAJIV GANDHI UNIVERSITY

Arunachal Pradesh, INDIA - 791 112

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Ms. Kanchan Devi, Department of Economics, RGU
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About the University

Rajiv Gandhi University (formerly Arunachal University) is a premier institution for higher education in the state of Arunachal Pradesh and has completed twenty-five years of its existence. Late Smt. Indira Gandhi, the then Prime Minister of India, laid the foundation stone of the university on 4th February, 1984 at Rono Hills, where the present campus is located.

Ever since its inception, the university has been trying to achieve excellence and fulfill the objectives as envisaged in the University Act. The university received academic recognition under Section 2(f) from the University Grants Commission on 28th March, 1985 and started functioning from 1st April, 1985. It got financial recognition under section 12-B of the UGC on 25th March, 1994. Since then Rajiv Gandhi University, (then Arunachal University) has carved a niche for itself in the educational scenario of the country following its selection as a University with potential for excellence by a high-level expert committee of the University Grants Commission from among universities in India.

The University was converted into a Central University with effect from 9th April, 2007 as per notification of the Ministry of Human Resource Development, Government of India.

The University is located atop Rono Hills on a picturesque tableland of 302 acres overlooking the river Dikrong. It is 6.5 km from the National Highway 52-A and 25 km from Itanagar, the State capital. The campus is linked with the National Highway by the Dikrong bridge.

The teaching and research programmes of the University are designed with a view to play a positive role in the socio-economic and cultural development of the State. The University offers Undergraduate, Post-graduate, M.Phil and Ph.D. programmes. The Department of Education also offers the B.Ed. programme.

There are fifteen colleges affiliated to the University. The University has been extending educational facilities to students from the neighbouring states, particularly Assam. The strength of students in different departments of the University and in affiliated colleges has been steadily increasing.

The faculty members have been actively engaged in research activities with financial support from UGC and other funding agencies. Since inception, a number of proposals on research projects have been sanctioned by various funding agencies to the University. Various departments have organized numerous seminars, workshops and conferences. Many faculty members have participated in national and international conferences and seminars held within the country and abroad. Eminent scholars and distinguished personalities have visited the University and delivered lectures on various disciplines.

The academic year 2000-2001 was a year of consolidation for the University. The switch over from the annual to the semester system took off smoothly and the performance of the students registered a marked improvement. Various syllabi designed by Boards of Post-graduate Studies (BPGS) have been implemented. VSAT facility installed by the ERNET India, New Delhi under the UGC-Infonet program, provides Internet access.

In spite of infrastructural constraints, the University has been maintaining its academic excellence. The University has strictly adhered to the academic calendar, conducted the examinations and declared the results on time. The students from the University have found placements not only in State and Central Government Services, but also in various institutions, industries and organizations. Many students have emerged successful in the National Eligibility Test (NET).

Since inception, the University has made significant progress in teaching, research, innovations in curriculum development and developing infrastructure.

About IDE

The formal system of higher education in our country is facing the problems of access, limitation of seats, lack of facilities and infrastructure. Academicians from various disciplines opine that it is learning which is more important and not the channel of education. The education through distance mode is an alternative mode of imparting instruction to overcome the problems of access, infrastructure and socio-economic barriers. This will meet the demand for qualitative higher education of millions of people who cannot get admission in the regular system and wish to pursue their education. It also helps interested employed and unemployed men and women to continue with their higher education. Distance education is a distinct approach to impart education to learners who remained away in the space and/or time from the teachers and teaching institutions on account of economic, social and other considerations. Our main aim is to provide higher education opportunities to those who are unable to join regular academic and vocational education programmes in the affiliated colleges of the University and make higher education reach to the doorsteps in rural and geographically remote areas of Arunachal Pradesh in particular and North-eastern part of India in general. In 2008, the Centre for Distance Education has been renamed as "Institute of Distance Education (IDE)."

Continuing the endeavor to expand the learning opportunities for distant learners, IDE has introduced Post Graduate Courses in 5 subjects (Education, English, Hindi, History and Political Science) from the Academic Session 2013-14.

The Institute of Distance Education is housed in the Physical Sciences Faculty Building (first floor) next to the University Library. The University campus is 6 kms from NERIST point on National Highway 52A. The University buses ply to NERIST point regularly.

Outstanding Features of Institute of Distance Education:

(i) At Par with Regular Mode

Eligibility requirements, curricular content, mode of examination and the award of degrees are on par with the colleges affiliated to the Rajiv Gandhi University and the Department(s) of the University.

(ii) Self-Instructional Study Material (SISM)

The students are provided SISM prepared by the Institute and approved by Distance Education Council (DEC), New Delhi. This will be provided at the time of admission at the IDE or its Study Centres. SISM is provided only in English except Hindi subject.

(iii) Contact and Counselling Programme (CCP)

The course curriculum of every programme involves counselling in the form of personal contact programme of duration of approximately 7-15 days. The CCP shall not be compulsory for BA. However for professional courses and MA the attendance in CCP will be mandatory.

(iv) Field Training and Project

For professional course(s) there shall be provision of field training and project writing in the concerned subject.

(v) Medium of Instruction and Examination

The medium of instruction and examination will be English for all the subjects except for those subjects where the learners will need to write in the respective languages.

(vi) Subject/Counselling Coordinators

For developing study material, the IDE appoints subject coordinators from within and outside the University. In order to run the PCCP effectively Counselling Coordinators are engaged from the Departments of the University, The Counselling-Coordinators do necessary coordination for involving resource persons in contact and counselling programme and assignment evaluation. The learners can also contact them for clarifying their difficulties in then respective subjects.

SYLLABI-BOOK MAPPING TABLE

Microeconomic Theory - II

Syllabi	Mapping in Book
Unit-I : Alternative Theories of the Firm The traditional theory of firm and its critical evaluation – Baumol's revenue maximization model – Williamson's's model of managerial – Managerial firm vs. entrepreneurial firm – Marris's model of managerial enterprise – Limit pricing theory.	**Unit I:** Alternative Theories of Firm
Unit-II : Theory of General Equilibrium Principles of general equilibrium, existence, uniqueness and stability (Walrasian and Marshallian conditions of stability) – Walrasian general equilibrium system – Computable general equilibrium.	**Unit II:** Theory of General Equilibrium
Unit-III : Welfare Economics Pareto Optimality, Pareto Optimality conditions: Consumption, production and exchange, critical evaluation of Pareto Optimality – Compensation tests: Kaldor, Hicks and Scitovsky and Little's criterion – Social welfare function – Arrow's Impossibility Theorem.	**Unit III:** Welfare Economics
Unit-IV : Choice under Uncertainty and Risk Difference between Uncertainty and risk; classes of measures: associative measure, ordinal and cardinal measures, Axioms of Neumann-Morgenstern (N-M) utility, Characteristics of N-M utility index; relationship between the shape of the utility function and behaviour towards risk, elasticity of marginal utility and risk aversion; absolute and relative risk aversion.	**Unit IV:** Choice under Uncertainty and Risk
Unit-V : Economics of Imperfect Information Information and decision making under certainty and uncertainty – Asymmetric information, adverse selection, moral hazard and signalling – Applications to insurance and lemons markets.	**Unit V:** Economics of Imperfect Information

CONTENTS

UNIT III WELFARE ECONOMICS

3.0 Introduction
3.1 Objectives
3.2 Pareto Optimality: Its conditions - Consumption, production and exchange, critical evaluation of Pareto Optimality
3.3 Compensation tests: Kaldor, Hicks and Scitovsky and Little's criterion
3.4. Bergson's Social welfare function.

UNIT IV CHOICE UNDER UNCERTAINTY AND RISK

4.0 Introduction
4.1 Unit Objectives
4.2 Difference between Uncertainty and Risk
4.3 Classes of Measures: Ordinal and Cardinal Measures
    4.3.1 Axioms of Neumann-Morgenstern (N-M) Utility
4.4 Relationship between Shape of Utility Function and Behaviour Towards Risk
    4.4.1 Elasticity of Marginal Utility and Risk Aversion
    4.4.2 Absolute and Relative Risk Aversion
4.5 Summary
4.6 Key Terms
4.7 Answers to 'Check Your Progress'
4.8 Questions and Exercises
4.9 Further Reading

UNIT V ECONOMICS OF IMPERFECT INFORMATION

5.0 Introduction
5.1 Unit Objectives
5.2 Information and Decision Making Under Certainty and Uncertainty
    5.2.1 Investment Decisions under Certainty
    5.2.2 Investment Decisions under Uncertainty
5.3 Asymmetric Information
    5.3.1 Adverse Selection and Signalling
    5.3.2 Moral Hazard and its Application to Insurance
5.4 Summary
5.5 Key Terms
5.6 Answers to 'Check Your Progress'
5.7 Questions and Exercises
5.8 Further Reading

INTRODUCTION

NOTES

Economics has two major branches: (*i*) Microeconomics, and (*ii*) Macroeconomics. Both micro and macro-economics are applied to business analysis and decision-making—directly or indirectly.

Operational issues are of internal nature. Internal issues include all those problems which arise within the business organization and fall within the purview and control of the management. Some of the basic internal issues are: (*i*) choice of business and the nature of product, i.e., what to produce; (*ii*) choice of size of the firm, i.e., how much to produce; (*iii*) choice of technology, i.e., choosing the factor-combination; (*iv*) choice of price, i.e., how to price the commodity; (*v*) how to promote sales; (*vi*) how to face price competition; (*vii*) how to decide on new investments; (*viii*) how to manage profit and capital; (*ix*) how to manage an inventory, i.e., stock of both finished goods and raw materials. These problems may also figure in forward planning. Microeconomics deals with such questions confronted by managers of business enterprises. The following microeconomic theories deal with most of these questions.

Demand theory deals with consumers' behaviour. It answers such questions as: How do the consumers decide whether or not to buy a commodity? How do they decide on the quantity of a commodity to be purchased? When do they stop consuming a commodity? How do the consumers behave when price of the commodity, their income and tastes and fashions, etc., change? At what level of demand, does changing price become inconsequential in terms of total revenue? The knowledge of demand theory can, therefore, be helpful in making the choice of commodities, finding the optimum level of production and in determining the price of the product.

Production theory explains the relationship between inputs and output. It also explains under what conditions costs increase or decrease; how total output behaves when units of one factor (input) are increased keeping other factors constant, or when all factors are simultaneously increased; how can output be maximized from a given quantity of resources; and how can the optimum size of output be determined? Production theory, thus, helps in determining the size of the firm, size of the total output and the amount of capital and labour to be employed, given the objective of the firm.

Price theory explains how price is determined under different kinds of market conditions; when price discrimination is desirable, feasible and profitable; and to what extent advertising can be helpful in expanding sales in a competitive market. Thus, price theory can be helpful in determining the price policy of the firm. Price and production theories together, in fact, help in determining the optimum size of the firm.

Profit making is the most common objective of all business undertakings. But, making a satisfactory profit is not always guaranteed because a firm has to carry out its activities under conditions of uncertainty with regard to: (*i*) demand for the product, (*ii*) input prices in the factor market, (*iii*) nature and degree of competition in the product market, and (*iv*) price behaviour under changing conditions in the product market, etc. Therefore, an element of risk is always there even if the most efficient techniques are used for predicting the future and even if business activities are meticulously planned. The firms are, therefore, supposed to safeguard their interest and avert or minimize the possibilities of risk. Profit theory guides firms in the measurement and management of profit, in making allowances for the risk premium, in calculating the pure return on capital and pure profit and also for future profit planning.

NOTES

Capital like all other inputs, is a scarce and expensive factor. Capital is the foundation of business. Its efficient allocation and management is one of the most important tasks of the managers and a determinant of the success level of the firm. The major issues related to capital are (*i*) choice of investment project, (*ii*) assessing the efficiency of capital, and (*iii*) most efficient allocation of capital. Knowledge of capital theory can contribute a great deal in investment-decision making, choice of projects, maintaining the capital, capital budgeting, etc. This book deals with the theories of microeconomics.

This book, *Microeconomic Theory*, is written in a self-instructional format and is divided into ten units. Each unit begins with an Introduction to the topic followed by an outline of the Unit objectives. The content is then presented in a simple and easy-to-understand manner, and is interspersed with Check Your Progress questions to test the reader's understanding of the topic. Alist of Questions and Exercises is also provided at the end of each unit, and includes short-answer as well as long-answer questions. The Summary and Key Terms section are useful tools for students and are meant for effective recapitulation of the text.

UNIT I ALTERNATIVE THEORIES OF FIRM

NOTES

Structure

1.0 INTRODUCTION

This unit will discuss only those alternative theories of firm which have gained considerable ground in economic literature and have a greater relevance to business decision making on empirical grounds. The theories of this category include:

(i) Baumol's theory of sales revenue maximization

(ii) Marris's theory of maximization of firm's growth rate

(iii) Williamson's theory of maximization of managerial utility function

This unit will deal with the basic elements of these alternative theories of firm. The objective here is to make the readers aware of the recent developments in the theory of firm rather than dealing with the alternative theories at length.

1.1 UNIT OBJECTIVES

After going through this unit, you will be able to:

- Discuss the traditional theory of firm
- Explain Baumol's theory of sales revenue maximization
- Evaluate Williamson's model of managerial utility maximization

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- Analyse the differences between managerial and entrepreneurial firm
- Explain Marris' model of managerial enterprise
- Describe the limit pricing theory with special reference to Bain's model of limit pricing

1.2 TRADITIONAL THEORY OF FIRM AND ITS CRITICAL EVALUATION

Although the conventional theory of firm still holds its ground firmly, several *alternative theories of firm* were proposed during the early 1960s by economists, notably by Simon, Baumol, Marris, Williamson, Berle and Means, Galbraith, and Cyert and March. These economists have questioned the validity of the *profit maximization hypothesis* and the relevance of the conventional theory to modern business, mainly on empirical grounds.

Another major drawback of the conventional theory is that it does not recognize the dichotomy between the ownership and management and its role in setting the goal for the firm. Berle and Means were first to point out in 1932, the separation of management from ownership. The proponents of the recent theories of firm argue that the dichotomy between the ownership and management and the shift in decision-making powers from the owners (of the firm) to its managers give the latter an opportunity to exercise their discretion in setting the goals for the firm, especially in case of large business corporations. The managers of large business corporations set the goals for the firm which in their judgment are feasible and desirable for the firm's survival and growth. Based on this argument, some economists formulated their own hypotheses and studied extensively the objectives, motivations and behaviour of firms afresh and developed their own theory of firm. As a result, there are now a number of *alternative theories of firm* postulating different objectives of business firms. The alternative theories of the business firms are sometimes classified under the following categories.

- Managerial theories of firm
- Growth maximization theories of firm
- Maximization of managerial utility theories
- Behavioural theories of firm

Conventional vs Alternative Theories of Firm

A question that may be asked is: Do the alternative theories replace the conventional theory of firm? Or to what extent do the alternative theories really offer an alternative and more appropriate explanation to firms' behaviour? There are no simple answers to these questions. One thing is clear that the conventional theory of firm based on profit maximization hypothesis is not the only theory applicable to a multitude of firms—large and small, owner-managed and manager-managed, single-product and multi-product, local and multinational, private and public undertakings, and alternative theories do provide alternative explanations to the firm's behaviour.

As regards the validity and plausibility of the alternative theories, this issue can be examined on both theoretical and empirical grounds. The theoretical plausibility of a theory depends on its power to predict. There is a general consensus that the conventional theory has greater explanatory and predictive power than the alternative theories of firm. As regards the empirical validity, the empirical evidence in support of the alternative

theories is not unambiguous. In fact, the multitude of alternative theories is in itself an evidence against them. On the contrary, the empirical evidence against the conventional theory is not clear and strong. Hance, it can be said that the alternative theories of firm are still in a state of testable hypotheses and they do not offer a replacement to the conventional theory of firm.

NOTES

1.3 BAUMOL'S REVENUE MAXIMIZATION MODEL

Baumols's theory of sales maximization is one of the most important alternative theories of firm's behaviour. The basic premise of Baumol's theory is that *sales maximization,* rather than *profit maximization,* is the plausible goal of the business firms. He argues that there is no reason to believe that all firms seek to maximize their profits. Business firms, in fact, pursue a number of incompatible objectives and it is not easy to single out one as the most common objective pursued by the firms. However, from his experience as a consultant to many big business houses, Baumol finds that most managers seek to maximize sales revenue rather than profits. He argues that, in modern business, management is separated from ownership, and managers enjoy the discretion to pursue goals other than profit maximization. Their discretion eventually falls in favour of sales maximization.

According to Baumol, business managers pursue the goal of sales maximization for the following reasons.

First, financial institutions consider sales as an index of performance of the firm and are willing to finance the firm with growing sales.

Second, while profit figures are available only annually at the end of the final accounting year, sales figures can be obtained easily and more frequently to assess the performance of the management. Maximization of sales is more satisfying for the managers than the maximization of profits that go into the pockets of the shareholders.

Third, salaries and slack earnings of the top managers are linked more closely to sales than to profit. Therefore, managers aim at maximizing sales revenue.

Fourth, the routine personnel problems are more easily handled with growing sales. Higher payments may be offered to employees if sales figures indicate better performance. Profits are generally known after a year. To rely on profit figures means, therefore, a longer waiting period for both the employees and the management for resolving labour problems.

Fifth, where profit maximization is the goal and it rises in one period to an unusually high level, this becomes the standard profit target for the shareholders that managers find very difficult to maintain in the long run. Therefore, managers tend to aim at sales maximization rather than profit maximization.

Finally sales growing at a rate higher than the rate of market expansion indicate growing market share, a greater competitive strength and better bargaining power of a firm in a collusive oligopoly. In a competitive market, therefore, sales maximization is found to be a more reasonable target.

To formulate his theory of sales maximization, Baumol has developed two basic models: (i) static model and (ii) dynamic model—each with and without advertising. His static models with and without advertising are discussed next.

Check Your Progress

1. Name the economists who proposed the alternative theories of firm during the early 1960s.
2. How can the alternative theories of the business firms be classified?

NOTES

1.3.1 Baumol's Model without Advertising

Baumol assumes cost and revenue curves to be given as in conventional theory of pricing. Suppose that the total cost (*TC*) and the total revenue (*TR*) curves are given as in Figure 6.1. The total profit curve, *TP*, is obtained by plotting the difference between the *TR* and *TC* curves. Profits are zero where *TR* = *TC*.

Given the *TR* and *TC* curves, there is a unique level of output at which total sales revenue is maximum. The total sales revenue is maximum at the highest point of the *TR* curve. At this point, slope of the *TR* curve (i.e., $MR = \partial TR/\partial Q$) is equal to zero. The highest point on the *TR* curve can be obtained easily by drawing a line parallel to the horizontal axis and tangent to the *TR* curve. The point *H* on the *TR* curve in Figure 6.1 represents the total maximum sales revenue. A line drawn from point *H* to output axis shows that sales revenue is maximized at output OQ_3. It implies that a sales revenue maximizing firm will produce output OQ_3 and its price equals HQ_3/OQ_3.

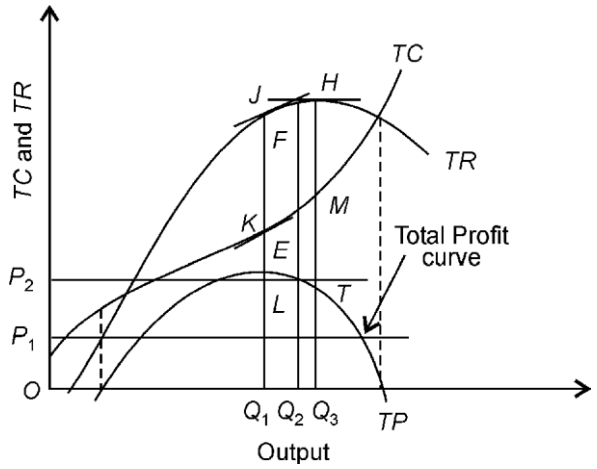

Fig. 6.1 *Sales Revenue Maximization*

Profit Constraint and Revenue Maximization

At output OQ_3, the firm maximizes its total revenue. At this output, the firm makes a total profit equal to $HQ_3 - MQ_3 = HM$. Since total *TP* curve gives the measure of total profit at different levels of output, profit $HM = TQ_3$. If this profit is enough or more than enough to satisfy the stockholders, the firm will produce output OQ_3 and charge a price $= HQ/OQ_3$. But, if profit at output OQ_3 is not enough to satisfy the stockholders, then the firm's output must be changed to a level at which it makes a satisfactory profit, say OQ_2, which yields a profit $LQ_2 > TQ_3$.

Thus, there are two types of probable equilibrium: one, in which the profit constraint does not provide an effective barrier to sales maximization, and second, in which profit constraint does provide an effective barrier to sales maximization. In the second type of equilibrium, the firm will produce an output that yields a satisfactory or target profit. It may be any output between OQ_1 and OQ_2. For example, if minimum required profit is OP_1, then the firm will stick to its sales maximization goal and produce output OQ_3 which yields a profit much greater than the required minimum. Since actual profit (TQ_3) is much greater than the minimum required, the minimum profit constraint is not operative.

However, if required minimum profit level is OP_2, OQ_3 will not yield sufficient profit to meet the profit target. The firm will, therefore, produce an output which yields

the required minimum level of profit OP_2 (= LQ_2). Given the profit target OP_2, the firm will produce OQ_2 where its profit is just sufficient to meet requirement of minimum profit. As can be seen in Figure 6.1, output (OQ_2) is less than the sales maximization output OQ_3. Evidently, the profit maximization output, OQ_1 is less than the sales maximization output OQ_2 (with profit constraint).

NOTES

1.3.2 Baumol's Model with Advertising

We have shown above how price and output are determined in a static single period model without advertising. In an oligopolistic market structure, however, price and output are subject to non-price competition. Baumol considers in his model with *advertising* as the typical form of *non-price competition* and suggests that the various forms of non-price competition may be analysed on similar lines.

In his analysis of advertising, Baumol makes the following assumptions.

- Firm's objective is to maximize sales, subject to a minimum profit constraint.
- Advertising causes a shift in the demand curve and hence the total sales revenue (*TR*) rises with an increase in advertisement expenditure (*A*) i.e., $\partial TR/\partial A > 0$.
- Price remains constant — a simplifying assumption.
- Production costs are independent of advertising. This is rather an unrealistic assumption since increase in sales may put output at a different cost structure.

Baumol's model with advertising is presented in Figure 6.2. The *TR* and *TC* are measured on the *Y*-axis and total advertisement outlay on the *X*-axis. The *TR* curve is drawn on the assumption that advertising increases total sales in the same manner as price reduction.

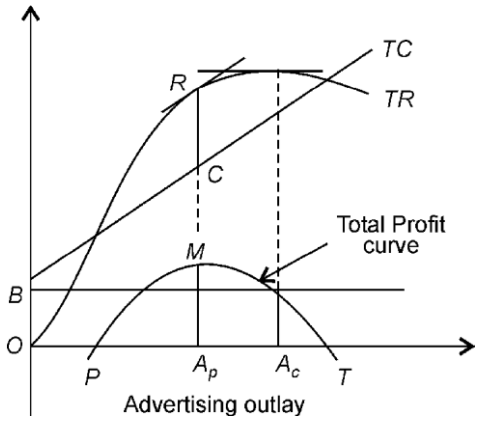

Fig. 6.2 *Sales Revenue Maximisation*

The *TC* curve includes both production and advertisement costs. The total profit curve is drawn by subtracting *TC* from *TR*. The profit so estimated is shown by the curve *PT*. As shown in Figure 6.2 profit maximizing advertisement expenditure is OA_p which maximizes profit at MA_p. Note that $MA_p = RC$. Assuming that minimum profit required is *OB*, the sales maximizing advertisement outlay would be OA_c. This implies that a firm increases its advertisement outlay until it reaches the target profit level which is lower than the maximum profit. This also means that sales maximizers advertise not less but more than the profit maximizers.

Check Your Progress

3. What is the basic premise of Baumol's theory?
4. Name the two basic models formulated by Baumol for his theory of sales maximization.
5. Give one reason for the criticism received by the Baumol's model.

NOTES

1.3.3 Criticism of Baumol's Model

Although Baumol's sales maximization model is found to be theoretically sound and empirically practicable, economists have pointed out the following shortcomings in his model.

First, it has been argued that in the long-run, Baumol's sales maximization hypothesis and the conventional hypothesis would yield identical results, because the *minimum required* level of profits would coincide with the *normal* level of profits.

Second, Baumol's theory does not distinguish between firm's equilibrium and industry equilibrium. Nor does it establish industry's equilibrium when all the firms are sales maximizers.

Third, it does not clearly bring out the implications of interdependence of the firm's price and output decisions. Thus, Baumol's theory ignores not onlyactual competition between the firms but also the threat of potential competition in an oligopolistic market.

Fourth, Baumol's claim that his solution is preferable to the solutions offered by the conventional theory, from a social welfare point of view, is not necessarily valid.

1.4 WILLIAMSON'S MODEL OF MANAGERIAL DISCRETION

Williamson's model of maximization of managerial utility function is a culmination of the managerial utility models. A. A. Berle and G. C. Means were the first business economists to point out, in 1932, that management is separated from ownership in the large multi-product business corporations and this influences the role of business managers in setting the goals of the large corporations. They argued that owners (the shareholders) look for high dividends and, therefore, they might be interested in profit maximization. But, for lack of corporate democracy, the owners have little or no role to play in policy decisions.

On the other hand, managers have different motives, desires and aspirations which they seek to maximize rather than maximizing profit. Besides, since corporate managers can generate the necessary capital internally by means of retained earnings and they do not need to venture into the capital market for debt capital, their decisions and actions are not subject to scrutiny. The managers, therefore, feel free to pursue their own interest in the corporate firms.

J. K. Galbraith developed Berle-Means hypothesis further and examined the issue extensively which is known as the Berle-Means-Galbriath hypothesis. It claims (i) that manager-controlled firms have lower profits than owner-controlled firms and (ii) that professional managers have no interest in maximizing profits. While some empirical studies support these claims, some others do not. The issue remains controversial.

However, Williamson made further improvements in the Berle-Means hypothesis. We discuss Williamson's hypothesis in some detail.

Williamson's model of maximization of managerial utility function is regarded as another important contribution to the managerial theory of firms' behaviour. Williamson argues that:

- Management is divorced from ownership
- Managers enjoy discretionary powers to set the goals of the firm they manage
- Managers maximize their own utility function rather than maximizing profit

Williamson's *managerial utility function* includes both quantifiable and unquantifiable variables. *Quantifiable variables* are also called *pecuniary variables* which include managers' salary, slack earnings and perks, and *unquantifiable variables* include power, prestige, job security, status, professional excellence and discretionary powers to spend money.

Williamson's model of managerial utility function (U_m) can be expressed as follows.

Maximize $U_m = f(S, M, I_D)$ ...(6.1)

subject to a minimum profit

where S = staff salary (management and administration), M = managerial monetary emoluments (including perks, etc.), and I_D = discretionary investment.

In Eq. (6.1), S, M and I_D are important decision variables in the managerial utility function and, therefore, need some elaboration. The variable S includes all payments to managerial and administrative staff on account of salary. It increases with expansion and promotion of the supporting staff for the top managers. It reflects the power, prestige, status and professional success of the management. Also, it enhances the market value of the managers. Variable M includes managers' gross emoluments which comprises salary and slack earnings in the form of luxurious residence, office, car, travel grants and entertainment. Variable I_D refers to the investment that managers make on their own discretion in addition to routine investment meant for the operation of the business to make a certain minimum profit. I_D reflects manager's powers, a sense of fulfillment and satisfaction.

Assumptions: Williamson makes the following assumptions in his model of managerial utility maximization.

(i) Demand function: $Q = f(P, S, e)$

where Q = output, P = price, S = staff expenses, and e = environmental factors causing an upward shift in the demand curve;

(ii) Cost function: $C = f(Q)$ where $dC/dQ > 0$;

(iii) Profit measures:

(a) Actual profit = $P = R - C - S$

where R = revenue, C = cost of production, and S = staff salary,

(b) Reported profit = $\Pi_R = \Pi - M$

where M = managerial emoluments,

(c) Minimum profit = $\Pi_0 = \Pi_R - T$

where T = tax and $(\Pi_0 + T) \leq \Pi_R$, and

(*d*) Discretionary profit = $\Pi_D = \Pi = \Pi_0 - T$

1.4.1 Simple Version of Williamson's Model

Given the assumptions and the parameters, we present here only the simple version of Williamson's model. The simple version of the model assumes that 'managerial emoluments' equal zero, i.e., $M = 0$. With this assumption, the managerial utility function (6.1) can be written as:

Maximize $U_m = f(S, I_D)$ ...(6.2)

Subject to $\Pi > \Pi_0 + T$

NOTES

The term I_D in Eq. (6.2) is defined as $\Pi - (\Pi_0 + T)$. That is,

$$I_D = \Pi - \Pi_0 - T \quad ...(6.3)$$

Equation (6.3) implies that managers set aside a part of *actual profit* (Π) as owners' 'minimum profit' (Π_0) and a part for tax payment (T). The balance of the actual profit is available to the managers for the purpose of 'discretionary investment' (I_D).

Note that I_D in Eq. (6.3) is the same as *discretionary profit* (Π_D) given in (*d*) above. It means that:

$$I_D = \Pi_D$$

By substitution, the managerial utility function (6.2) can be rewritten as:

Maximize $U_m = f(S, \Pi_D)$ ...(6.4)

where $\Pi_D = \Pi - \Pi_0 - T$

Equation (6.4) gives the final form of the managerial utility function in the simple version of the model. It must, however, be noted here that there is substitutability between S and Π_D. That is, given the actual profit (Π), S can be increased only by reducing Π_D, and *vice versa*. Therefore, in their attempt to maximize their utility function (6.4), the managers find an *optimum* combination of S and Π_D. This is the point of firm's equilibrium. The firm's point of equilibrium is shown below graphically.

1.4.2 Firm's Equilibrium: Graphical Presentation

Williamson's simple model of firm's equilibrium is presented graphically in Figure 6.3. To begin with, let us recall that there is *substitutability* between S and Π_D. This implies that managers can attain a certain level of utility (U) from the various combinations of S and Π_D. This possibility can be shown by an indifference curve as depicted by U_1 in Figure 6.3. The indifference curve U_1 presents the various combinations of S and Π_D that yield the same level of managerial satisfaction. By the same logic, an indifference map can be constructed assuming different levels of actual profits (Π) and the associated level of managerial utility, as shown by the indifference curves U_2, U_3 and U_4 in Figure 6.3. The higher the indifference curve, the higher the level of managerial satisfaction at different levels of actual profit.

The problem now is how to find the optimum point on the indifference map. This task is accomplished by finding the relationship between S and Π_D and the total actual profit (Π). We know that $\Pi = TR - TC$ and $TR = P \times Q$. Therefore, by assuming usual demand and cost functions, we can imagine that Π increases over some level of output and then it begins to decline. This behaviour of actual profit (Π) is shown by the curve marked Π in Figure 6.3. By combining manager's indifference map and the profit function, one can obtain the optimum combination of S and Π_D, i.e., the point of firm's equilibrium. The equilibrium of the firm lies at the point at which the highest indifference curve is tangent to the Π-curve. As shown in the figure, point E is the point of firm's equilibrium. Point E denotes a situation in which managerial utility function (U_m) is maximized subject to a minimum profit of EM.

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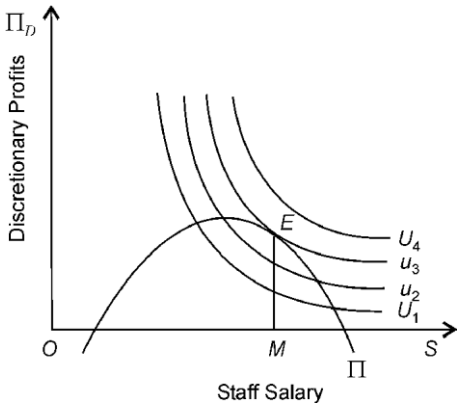

Fig. 6.3 *Equilibrium of the Firm: Willamson's Model*

Criticism: Williamson's model, like other models of this category, suffers from certain weaknesses of its own. This model does not deal satisfactorily with the problem of interdependence of firms under oligopolistic competition. Williamson's model is said to hold only where rivalry is not strong. In the case of strong rivalry, profit maximization hypothesis has been found to be more appropriate.

1.5 MANAGERIAL FIRM vs ENTREPRENEURIALFIRM

A thin line exists between a manager and an entrepreneur. An entrepreneur is often asked to perform his duties like a manager whereas a manager is always asked to perform his duties like an entrepreneur. A manager is advised to have the opportunism and drive like that of an entrepreneur whereas an entrepreneur is advised to discipline himself in a methodical manner similar to that of a manager (Heller, 2006). In the management literature, the two terms are sometimes used synonymously as both are associated with leadership. There are few researchers who have tried to merge both the terms in their findings of leadership and entrepreneurship (Gupta et al., 2004; Tarabishy et al., 2005), while there are others who have found connections between the concepts of leadership and entrepreneurship (for instance, Cogliser and Brigham, 2004; Vecchio, 2003). However, management and leadership are not necessarily corresponding, but they may be interconnected (Davidson and Griffin, 2000).

There are many differences between a manager and an entrepreneur: while a manager is appointed by a higher authority, an entrepreneur emerges out of the people. While managers have colleagues, entrepreneurs have helpers to assist them. Managers usually depend on their positional powers whereas entrepreneurs use their natural inherent powers like charisma, wisdom, cleverness and intuition. Mangers usually influence others on the basis of their authority whereas entrepreneurs influence others beyond formal authority.

Structuring on irrational decision-making models from behavioural decision theory, Busenitz and Barney (1997) proclaim that entrepreneurs are more vulnerable to decision-making prejudices and heuristics in comparison to managers. Thus, 'entrepreneurs are the people who notice opportunities and take risk and responsibility for mobilising the resources necessary to produce new and improved goods and services' (Jones and George, 2007, p. 42). Whereas, managers are more often responsible to make use of human resources and administering work to accomplish organizational goals effectually

Check Your Progress

6. Name the first business economists to point out, in 1932, that management is separated from ownership in the large multi-product business corporations.
7. Why is the Williamson's model of managerial discretion criticized?

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and proficiently (Jones and George, 2007). However, Griffin and Davidson (2000) are of the view that when performing of roles and duties are concerned, the differences between the duties and roles are more often that of degrees rather than of kind. Organizations require both managers and entrepreneurs or leaders as far as the lifecycle theory of organizational leadership is concerned (Baliga and Hunt, 1987). Furthermore, to achieve the best out of the two skill sets, both should supplement each other and their ability and talent should overlap (Davidson and Griffin, 2000). Therefore, when an organization is being set-up or is laying its foundation, entrepreneurial leadership is very important in fashioning a goal or idea that helps the organization in taking its first steps. Managerial or entrepreneurial leadership becomes significant in the collectivity and formalization stages in order to speed up growth of the organization. A heavy emphasis on entrepreneurial leadership is needed again at the amplification of the structural stage.

1.5.1 Entrepreneurial Firms

The term 'entrepreneur' is often used interchangeably with 'entrepreneurship'. But conceptually it typically means *to undertake*. It owes its origin to Western societies. But even in the West, the meaning has undergone changes from time to time. In the early sixteenth century they were different. An entrepreneur is a creator whereas entrepreneurship is the creation. Entrepreneurship is the tendency of a person to organize his own business and run it profitably, exploiting the qualities of leadership, decision making, managerial calibre, etc. Entrepreneurship is a role played by or the task performed by an entrepreneur. The central task of the entrepreneur is to take moderate risks and invest money to earn profits by exploiting an opportunity.

The word 'entrepreneurship' was used to refer to army leaders. In the eighteenth century, it represented a dealer who bought and sold goods at uncertain prices. In 1961, Schumpeter used the term 'innovator' for entrepreneur. Entrepreneurship is recognized all over the world in countries such as USA, Germany, and Japan and in developing countries like India.

Hans Schollhammer provides a classification of entrepreneurial firms describing them to be of five types. These are described as follows:

- **Administrative entrepreneurship:** In the administrative model, the firm moves beyond formal R&D projects to encourage greater innovation through a philosophy of corporate support to innovators by systematically providing resources for making new ideas commercial realities. An entrepreneurial team led by a champion is supported by contributions from all departments in implementation of these projects.
- **Opportunistic entrepreneurship:** Champions are given the freedom to pursue opportunities both for the organization and through external markets by the loosening of formal structural ties. For instance, Quad/Graphics Inc., the company that prints *Newsweek*, when printing technology began to change rapidly with computers, challenged its engineers to design state-of-the-art equipment for printing. Quad/ Graphics then created a separate subsidiary, Quad Tech, and gave its engineers executive control and the autonomy to sell technology openly to anyone.
- **Acquisitive entrepreneurship:** It is when corporate managers search for external opportunities, such as other firms and entrepreneurial start-ups that can enhance profits. This may be through mergers, acquisitions, joint ventures and licensing agreements. Rather than developing ideas internally, firms actively court other firms that have proprietary knowledge or promising products.

- **Imitative entrepreneurship:** Imitative entrepreneurship uses the ideas of other firms and then applies weight or corporate muscle to control markets. The Japanese, for example, during their initial period of growth, copied American products and produced them at lower costs, and exported them to American markets. Imitation shakes out less efficient producers and more capable firms who are able to provide consumers with value for their products or services take the initiative.
- **Incubative entrepreneurship:** The 'incubative' process is necessary for new ideas to be developed for commercialization. Project teams are created and are expected to put an innovation through its paces, and if warranted to push the implementation. The teams are often established as semi-autonomous new venture development units that often have seed capital, access to corporate resources, freedom of independent action, and responsibility for implementation from inception to commercialization. Corporate endeavour is to support these ideas so that they are successful. This process is reflective of risk-oriented entrepreneurship.

Each of these types has a different strategy and a distinct role for the innovator. Each classification implies a supportive environment that benefits not only the corporation, but also the innovative manager. This is easier to accomplish in small companies than in large ones, in part, because large companies have greater geographic differences and bureaucracies. Intrapreneurs embody the same characteristics as the entrepreneur—conviction, passion and drive.

Characteristics of a successful entrepreneurial firm

The National Business Incubation Association (NBIA) has identified the following characteristics of a successful entrepreneurial firm:

- An effective management team that works cooperatively and consists of members selected to provide a range of knowledge and skills
- Sound financing, the earlier the better; funding is directly related to a firm's success, and in some cases can be the deciding factor between a business venture's success and failure
- Principals who make business decisions based on a clear understanding of the market and the competition, rather than their own enchantment with their product or service
- Principals who keep on top of best business practices by surrounding themselves with knowledgeable people, remaining open to advice and ideas and being willing and ready to make changes based on new information
- A well-researched business plan that provides clear direction and focus
- Principals who are good money managers and remain in control of the venture's books
- Entrepreneurs who are passionate about their ventures and communicate that excitement to potential investors, customers and mentors

1.5.2 Cyert-March Model of Firms

The behavioural model of Cyert and March is an extension and modified version of Simon's 'satisficing behaviour' model of corporate firms. The Cyert-March model can be appreciated better in contrast to other alternative theories of firm. Traditional theory

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of firm assumes 'profit maximization' as the sole goal of business firms. Managerial utility models emphasize the role of the dichotomy between the ownership and the management in setting business goals and claim that managers maximize their utility function. They argue that managers use their discretion to set goals for themselves different from profit maximization. They set such goals for themselves as maximization of sales revenue, maximization of firm's growth rate, maximization of manager's own utility function, and so on.

In contrast, Cyert and March look at large multiproduct corporations not as an ordinary firm, but as a *coalition of different but related interest groups including owners, managers, workers, input suppliers, customers, bankers, and tax authorities.* All these groups have their own interest in the corporations and their interests are often in conflict with one another.

- Owners (the stockholders) are interested in maximum profit possible;
- managers aim at high salary, power and perks;
- workers are interested in high pay packets, bonus, safe working conditions, insurance and other facilities;
- customers are interested in high quality goods and lower prices;
- input suppliers are interested in continuity and growth in demand for their supplies at higher prices;
- bankers expect and want their loans and advances to be secure and repaid on time; and
- tax authorities expect honest and regular tax payments.

Obviously there is a conflict—more or less—between the interests of the different interest groups. One of the important managerial tasks is the goal formation for the firm reconciling these conflicting interests. Let us now look at the aspiration levels of different interest groups and the process of goal formation.

Aspiration Levels and Process of Goal Formulation

Goal formulation by reconciling conflicting interests is a complicated task. Cyert and March argue that managers have a crucial task in formulating a goal for the firm that reconciles the conflicting and competing interests of the different interest groups so as to ensure a smooth functioning of the corporation. In reconciling conflicting and competing interests, managers look at the factors that determine the demands of the various interest groups from the corporation. The demands of the various interest groups are determined largely by their 'aspiration levels', past performance of the firm, and information available to the interest groups. For example, managers' demand for a higher salary depends on the level of their aspirations, and their aspirations depend on their experience about the achievements of their aspirations. In a dynamic society, business environment and conditions continue to change. Environmental changes alter the achievements and, therefore, the level of their aspirations and their demands. That is, in a dynamic society—aspirations, achievements and goals of the corporations keep changing continuously.

Setting goals: The satisficing behaviour

Now the question arises: How are the goals set? The goals of large multiproduct corporations are set by the top management. Since interest groups are many and their aspirations and expectations are many and competing, a single goal cannot be set as it

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will not satisfy all concerned. Therefore, the top management sets a set of diversified goals. As mentioned already, according to Cyert and March, the top management sets the following five main goals:

(i) Production goal
(ii) Inventory goal
(iii) Sales goal
(iv) Market share
(v) Profit goal

These goals are determined through a process of continuous bargaining between the coalition groups. The top management attempts in the process of bargaining to bring about a reconciliation between the conflicting goals. However, so long as the firm is able to achieve the above goals, top management finds it helpful in reconciling the 'aspirations' of the interest groups. How the achievement of these goals satisfies the different coalition groups is described here briefly.

- Production goal aims at continuity in production irrespective of any seasonal variability of demand. This goal is achieved by preventing (*a*) underutilization of capacity in one period and its overutilization in another period and (*b*) lay-off of labour in one period and 'rush recruitment' in another. This helps in preventing undue variation in the cost of production and the problem of labour unrest and dissatisfaction. As a result, owners, managers and workers are satisfied.\
- Inventory goal aims at maintaining a balanced inventory of both raw materials and finished goods. A balanced inventory of inputs and raw materials ensures continuity of production and supply of goods to the customers and also keeps the suppliers of inputs satisfied.
- Sales and market share goals aim at promotion and enhancing the market share of the firm. Sales are promoted through competitive advertising and a pricing strategy. Sales promotion and increase in market shares keep top management and owners satisfied.
- Profit goal is so determined that it satisfies the owners (the shareholders), the bankers and other financiers of the firm. Besides, the profit goal aims at making adequate financial provision for future projects.

However, setting the goals is an extremely complicated and difficult task. What the top management aims at, in practice, is to achieve an overall satisfactory performance. This, they call the firms''satisficing behaviour'. This is, according to Simon, *a bounded rational behaviour*. The practical methods of the 'satisficing behaviour' are to bring a reconciliation between the conflicting and competing aspirations. The methods that are generally used include:

- Budget allocation and delegation of authority
- Regular payment of dues to related interest groups
- Allocation of funds for R&D as 'side payment'
- 'Slack payments' to deserving groups
- Allocation of priorities to demand from different groups and meeting them in the same sequence
- Decentralization of decision-making powers at different levels of managerial functions

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Shortcomings of the Cyert-March Model

The behavioural model of Cyert and March has been criticized on the following grounds.

(i) It provides only a simulation of managerial technique rather than providing a behavioural model.

(ii) It does not analyze and reveal how a firm reaches its equilibrium level in its 'satisficing behaviour'.

(iii) More importantly, it does not deal with the interdependence in the case of oligopolist firms.

(iv) This model has no predictive power whatsoever.

(v) At its best, it presents managerial behaviour rather than economic behaviour of the firms.

1.6 MARRIS' MODEL OF MANAGERIAL ENTERPRISE

Robin Marris' theory of firm assumes that the goal that managers of a corporate firm set for themselves is to maximize the firm's *balanced growth rate* subject to managerial and financial constraints. To prove his point of view, he developed a model of firm's growth rate maximization. Marris defines firm's growth rate (G_r) as:

$$G_r = G_D = G_c \qquad ...(6.5)$$

where G_D = growth rate of demand for firm's product and

G_c = growth rate of capital supply to the firm.

Equation (6.5) implies that a firm achieves a *balanced growth rate* when the *growth rate* of demand for its product equals the growth rate of capital supply to the firm. In maximizing firm's growth rate, managers are faced with two constraints: (*i*) managerial constraints and (*ii*) financial constraints.

Managerial constraints arise due to: (*a*) limits to managers' ability to manage and to achieve optimum efficiency and (*b*) managers' own job security. ***Financial constraints*** arise due to conflict between managers' own utility function which they attempt to maximize and owners' utility function. Marris defines managerial utility (U_m) and owners' utility (U_o) functions as follows.

Manager's utility function: $U_m = f$(salary, power, status, job security)

Owners utility function: $U_o = f$(profit, capital, output, market share, public reputation)

Apparently, there is a divergence and, to some extent, a conflict between the manager's and owner's utility functions. However, Marris argues that the divergence between U_o and U_m is not so wide as it is made out in managerial theories of firm. He claims that the two utility functions converge into one variable, i.e., *a steady growth in the size of the firm*, however defined. Nevertheless, Marris defines steady growth rate of the firm for managers and owners in terms of two different variables—for managers in terms of G_d, i.e., growth in demand for firm's product, and for owners in terms of G_c, i.e., the growth of firm's capital (G_c). Thus, he redefines manager's and owner's utility functions as follows.

Check Your Progress

8. State two differences between a manager and an entrepreneur.
9. List two characteristics of entrepreneurial firms as identified by National Business Incubation Association (NBIA).

$$U_m = f(G_d) \quad ...(6.6)$$

and $$U_o = f(G_c) \quad ...(6.7)$$

According to Marris, managers try to maximize utility functions (6.6) and (6.7) in such a way that $G_d = G_c$. This is what Marris calls the *'balanced growth rate'*. The firm reaches its equilibrium when '*balanced growth rate*' is achieved. This is what Eq. (6.5) implies. The manager's objective is to maximize *balanced growth rate* (G_r) such that $G_d = G_c$. Thus, the firm is in equilibrium where:

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$$G_{r(\max)} = G_d = G_c \quad ...(6.8)$$

Marris redefines G_d and G_c in Eq. (6.8) in operational terms as given below:

$$G_d = f(d, k) \quad ...(6.9)$$

where d = diversification of product, and k = success rate of new products,

and $$G_c = \bar{r}\,(\mathrm{P}) \quad ...(6.10)$$

where $\bar{r}$ = financial security ratio assumed to be a constant proportion of profit (Π).

In Marris's model, $\bar{r}$ is assumed to be determined subjectively by the managers. To elaborate on his theory, Marris has developed an elaborate model. We now turn to another aspect of Marris' theory of firm, i.e., the manager's financial policy.

1.6.1 Financial Policy for Balanced Growth

In their effort to strike a balance between their own and the owner's utility functions, managers adopt a *prudent financial policy*. In formulating a prudent financial policy, managers use the following three critical ratios.

(i) Debt ratio or Leverage $(r_1) = \dfrac{\text{Value of debts}}{\text{Total assets}}$

(ii) Liquidity ratio $(r_2) = \dfrac{\text{Liquid assets}}{\text{Total assets}}$

(iii) Profit retention ratio $(r_3) = \dfrac{\text{Retained profits}}{\text{Total profit}}$

Managers keep ***debt ratio*** (r_1) within a manageable limit by avoiding high debt liabilities including interest and debt repayment. The reason for this strategy is that a high debt ratio might lead to bankruptcy or insolvency and a low debt ratio means relying heavily on own resources which imposes a limit on capital growth. Likewise, high and low ***liquidity ratios*** (r_2) are avoided. The reason is a *high liquidity ratio* invites the risk of takeover by the dominant group of owners who could use the liquidity for their other ventures. *Low liquidity ratio* is avoided because it implies low financial leverage and low ability to meet payment obligations which often leads to loss of prestige and sometimes even to insolvency.

The ***retention ratio*** is maintained at a level which prevents the change of top management (i.e., job security aspect) and keeps share prices reasonably high. *Low retention ratio* is avoided because it means high distribution of profits which may attract takeover by raiders. *High retention ratio* is avoided because it involves the risk of replacement of the top management.

In brief, a prudent financial policy is devised by constructing 'a financial security ratio' $\bar{r}$, which is a weighted average of the three *financial ratios*.

1.6.2 Shortcomings of Marris's Theory

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Marris's theory is regarded as an important contribution to the theory of firm in so far as it introduces financial ratios as decision variables in determining the firm's goal. Besides, his theory provides a reconciliation between the conflicting utility functions of the managers and owners. However, Marris's theory has its own shortcomings.

One, Marris assumes cost structure and price to be given. Therefore, he assumes implicitly that profit is given too. This assumption is not realistic. If fact, price determination has been the major point of contention in the theory of firms whereas Marris ignores this aspect completely. This is one of the serious drawbacks of his theory.

Two, most industries are oligopolistic and hence firms' business decisions are interdependent. Marris's theory does not account for this interdependence in firms' decisions. This implies that product differentiation by rival firms goes unnoticed or is ignored in the firm's decision-making. His theory has, therefore, a limited applicability.

Three, in an oligopolistic industry, if all the firms seek simultaneously to maximize their growth rate, it imposes a serious limitation on the growth in demand for firms' product and the supply of capital. Marris's theory does not account for this factor.

1.7 LIMIT PRICING THEORY

Limit price can be defined as the maximum price that existing firms charge with the objective of limiting the number of firms and preventing the entry of new firms to the industry. *Limit pricing* is a practice of charging a price lower than the profit maximising one. The objective behind this practice is to prevent the entry of new firms to the industry. Limit pricing is thus an entry-preventing-pricing policy.

Over time, many economists have developed the limit pricing models. Bain was the first to formulate limit pricing theory in 1949. Later Sylos-Labini (1957), Franco Modigliani (1958), Pashigian (1968), and J. N. Bhagwati (1970) formulated their own theories of limit pricing. In this section, we will briefly describe only Bain's model of limit pricing—the most famous model.

1.7.1 Bain's Model of Limit Pricing

Bain has attempted, in his model, to explain why oligopoly firms maintain their prices over a long period of time at a level which is lower than the price that would maximize their profits. This price lies somewhere between the long-run competitive price (i.e., $P = LAC$) and monopoly price (determined where $MR = MC$). He calls the price so determined as *limit price,* i.e., the highest price which the established firms believe they can charge without inducing entry of new firms. We present here the simplest form of his model.

In his model, Bain assumes: (a) that long-run *AR*, *MR* and *LAC* curves are determinate and known; (b) that existing firms are in effective collusions; (c) that there exists a *limit-price* of which existing firms are aware; and (d) that existing firms seek to maximize their *long-run* profits.

Check Your Progress

10. What are the two constraints faced by managers in maximizing a firm's growth rate?
11. Why do managers adopt a prudent financial policy?

The model which Bain has developed on the basis of these assumptions is presented in Figure 6.4.

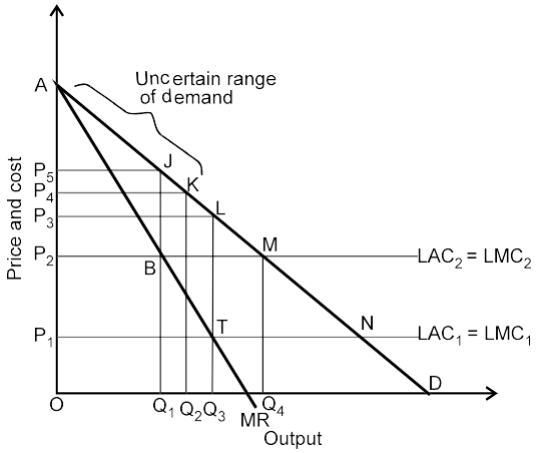

Fig. 6.4 *Determination of Limit Price*

The long-run average and marginal revenue conditions are given by *AD* and *A-MR* curves, respectively, and long-run average and marginal cost conditions are given by the horizontal line $LAC_2 = LMC_2$. Given the revenue and cost conditions, profit-maximizing monopoly price is OP_5 (= JQ_1) which is given by intersection of *MR* and LMC_2 at point *B*. Since LMC_2 and *AD* intersect at point *M*, competitive price is OP_2. Thus, the existing firms have monopoly price OP_5 at point *J* on the demand curve and competitive price OP_2 determined by point *M*. The limit price lies between these two prices. By assumption, existing firms can estimate the limit-price. They will therefore determine the limit price a little below the monopoly price, say at OP_4 at point *K* on the demand curve. Limit price OP_4 prevents the entry of new firms and existing firms maximize their long-run profits. Any price above OP_4 makes profit uncertain because it will attract new firms whose behaviour is uncertain. Therefore, *AK* part of the demand curve is the *uncertain range* of demand curve.

In case firms are able to decrease their cost of production and their $LAC_2 = MC_2$ shift downward to $LAC_1 = MC_1$, competitive price will be OP_1 and monopoly price will be OP_3 as determined by point *T* where $LAC_1 = MC_1$ intersects the *MR* curve. In that case, the limit price will be determined somewhere between OP_1 and OP_3. For example, limit price may be determined at $OP_2 = MQ_4$. This explains how limit price is determined.

1.8 SUMMARY

In this unit, you have learnt that,

- Although the conventional theory of firm still holds its ground firmly, several alternative theories of firm were proposed during the early 1960s by economists, notably by Simon, Baumol, Marris, Williamson, Berle and Means, Galbraith, and Cyert and March.
- Another major drawback of the conventional theory is that it does not recognize the dichotomy between the ownership and management and its role in setting the goal for the firm.

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Check Your Progress

12. Define limit price.
13. What has Bain attempted to explain in his model of limit pricing?

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- The alternative theories of the business firms are sometimes classified under the following categories:
  - Managerial theories of firm
  - Growth maximization theories of firm
  - Maximization of managerial utility theories
  - Behavioural theories of firm
- One thing is clear that the conventional theory of firm based on profit maximization hypothesis is not the only theory applicable to a multitude of firms—large and small, owner-managed and manager-managed, single-product and multi-product, local and multinational, private and public undertakings, and alternative theories do provide alternative explanations to the firm's behaviour.
- There is a general consensus that the conventional theory has greater explanatory and predictive power than the alternative theories of firm. As regards the empirical validity, the empirical evidence in support of the alternative theories is not unambiguous.
- Baumols's theory of sales maximization is one of the most important alternative theories of firm's behaviour. The basic premise of Baumol's theory is that sales maximization, rather than profit maximization, is the plausible goal of the business firms.
- To formulate his theory of sales maximization, Baumol has developed two basic models: (*i*) Static Model and (*ii*) Dynamic Model—each with and without advertising.
- There are two types of probable equilibrium: one in which the profit constraint does not provide an effective barrier to sales maximization, and second in which profit constraint does provide an effective barrier to sales maximization.
- In an oligopolistic market structure, however, price and output are subject to non-price competition. Baumol considers in his model with advertising as the typical form of non-price competition and suggests that the various forms of non-price competition may be analysed on similar lines.
- Baumol's theory does not distinguish between firm's equilibrium and industry equilibrium. Nor does it establish industry's equilibrium when all the firms are sales maximizers.
- Williamson's model of maximization of managerial utility function is a culmination of the managerial utility models. A. A. Berle and G. C. Means were the first business economists to point out, in 1932, that management is separated from ownership in the large multi-product business corporations and this influences the role of business managers in setting the goals of the large corporations.
- Williamson's model does not deal satisfactorily with the problem of interdependence of firms under oligopolistic competition. Williamson's model is said to hold only where rivalry is not strong. In the case of strong rivalry, profit maximization hypothesis has been found to be more appropriate.
- A thin line exists between a manager and an entrepreneur. An entrepreneur is often asked to perform his duties like a manager whereas a manager is always asked to perform his duties like an entrepreneur.
- There are many differences between a manager and an entrepreneur: while a manager is appointed by a higher authority, an entrepreneur emerges out of the

people. While managers have colleagues, entrepreneurs have helpers to assist them.

- Structuring on irrational decision-making models from behavioural decision theory, Busenitz and Barney (1997) proclaim that entrepreneurs are more vulnerable to decision-making prejudices and heuristics in comparison to managers.
- The term 'entrepreneur' is often used interchangeably with 'entrepreneurship'. But conceptually it typically means to undertake. It owes its origin to Western societies.
- In the administrative model, the firm moves beyond formal R&D projects to encourage greater innovation through a philosophy of corporate support to innovators by systematically providing resources for making new ideas commercial realities.
- The behavioural model of Cyert and March is an extension and modified version of Simon's 'satisficing behaviour' model of corporate firms. The Cyert-March model can be appreciated better in contrast to other alternative theories of firm.
- Goal formulation by reconciling conflicting interests is a complicated task. Cyert and March argue that managers have a crucial task in formulating a goal for the firm that reconciles the conflicting and competing interests of the different interest groups so as to ensure a smooth functioning of the corporation.
- Robin Marris's theory of firm assumes that the goal that managers of a corporate firm set for themselves is to maximize the firm's balanced growth rate subject to managerial and financial constraints.
- In maximizing firm's growth rate, managers are faced with two constraints:
  1.8.1 managerial constraints and (*ii*) financial constraints.
- In their effort to strike a balance between their own and the owner's utility functions, managers adopt a prudent financial policy.
- Marris's theory is regarded as an important contribution to the theory of firm in so far as it introduces financial ratios as decision variables in determining the firm's goal. Besides, his theory provides a reconciliation between the conflicting utility functions of the managers and owners.
- Limit price can be defined as the maximum price that existing firms charge with the objective of limiting the number of firms and preventing the entry of new firms to the industry. Limit pricing is a practice of charging a price lower than the profit maximising one.
- Bain has attempted, in his model, to explain why oligopoly firms maintain their prices over a long period of time at a level which is lower than the price that would maximize their profits.

1.9 KEY TERMS

- **Limit price:** It can be defined as the maximum price that existing firms charge with the objective of limiting the number of firms and preventing the entry of new firms to the industry.
- **Limit pricing:** It is a practice of charging a price lower than the profit maximising one.

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1.10 ANSWERS TO 'CHECK YOUR PROGRESS'

1. Although the conventional theory of firm still holds its ground firmly, several alternative theories of firm were proposed during the early 1960s by economists, notably by Simon, Baumol, Marris, Williamson, Berle and Means, Galbraith, and Cyert and March.
2. The alternative theories of the business firms are sometimes classified under the following categories:
   - o Managerial theories of firm
   - o Growth maximization theories of firm
   - o Maximization of managerial utility theories
   - o Behavioural theories of firm
3. The basic premise of Baumol's theory is that sales maximization, rather than profit maximization, is the plausible goal of the business firms.
4. To formulate his theory of sales maximization, Baumol has developed two basic models: (i) static model and (ii) dynamic model—each with and without advertising.
5. Baumol's theory does not distinguish between firm's equilibrium and industry equilibrium. Nor does it establish industry's equilibrium when all the firms are sales maximizers.
6. A. A. Berle and G. C. Means were the first business economists to point out, in 1932, that management is separated from ownership in the large multi-product business corporations and this influences the role of business managers in setting the goals of the large corporations.
7. Williamson's model does not deal satisfactorily with the problem of interdependence of firms under oligopolistic competition. Williamson's model is said to hold only where rivalry is not strong. In the case of strong rivalry, profit maximization hypothesis has been found to be more appropriate.
8. There are many differences between a manager and an entrepreneur: while a manager is appointed by a higher authority, an entrepreneur emerges out of the people. While managers have colleagues, entrepreneurs have helpers to assist them.
9. The National Business Incubation Association (NBIA) has identified the following characteristics of a successful entrepreneurial firm:
   - An effective management team that works cooperatively and consists of members selected to provide a range of knowledge and skills
   - Sound financing, the earlier the better; funding is directly related to a firm's success, and in some cases can be the deciding factor between a business venture's success and failure
10. In maximizing firm's growth rate, managers are faced with two constraints:
    (i) managerial constraints and (ii) financial constraints.
11. In their effort to strike a balance between their own and the owner's utility functions, managers adopt a prudent financial policy.
12. Limit price can be defined as the maximum price that existing firms charge with the objective of limiting the number of firms and preventing the entry of new firms to the industry.

13. Bain has attempted, in his model, to explain why oligopoly firms maintain their prices over a long period of time at a level which is lower than the price that would maximize their profits.

NOTES

1.11 QUESTIONS AND EXERCISES

Short-Answer Questions

1. What lies at the foundation of the alternative theories of business firms? Do the alternative theories really offer an alternative explanation to firms' behaviour?
2. What was the conventional theory of firm based on?
3. According to Baumol, why do business managers pursue the goal of sales maximization?
4. In what way is Baumol's theory superior to the conventional theory based on profit maximization hypothesis?
5. Does Baumol's model offer a more appropriate explanation to price and output determination than the conventional theory?
6. How does Williamson's model of managerial utility maximization explain the equilibrium of the firm?
7. How does Marris define the balanced growth of the firm? How do managers arrive at the balanced growth? What kind of financial policy do the managers adopt to secure their stake in the firm?
8. Write a short note on limit pricing theory.

Long-Answer Questions

1. Discuss the traditional theory of firm.
2. Explain Baumol's theory of sales revenue maximization.
3. Assess Baumol's model of price and output determination with and without advertisement.
4. Evaluate Williamson's model of managerial utility maximization.
5. Critically analyse the differences between managerial and entrepreneurial firm.
6. Explain Marris' model of managerial enterprise.
7. Describe the limit pricing theory with special reference to Bain's model of limit pricing.

1.12 FURTHER READING

Dwivedi, D. N. 2002. *Managerial Economics*, 6th Edition. New Delhi: Vikas Publishing House.

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UNIT II THEORY OF GENERAL EQUILIBRIUM

NOTES

Structure

2.0 INTRODUCTION

General equilibrium approach recognises the interdependence of constituent parts of the economic system. It recognises the interrelations and interdependence of economic variables and seek to answer the question how all the segments of the economy reach an equilibrium position simultaneously. General equilibrium shows, by using the tools of partial equilibrium analysis, how prices and outputs are simultaneously determined in all segments of the economy.

Basically, general equilibrium is concerned with three questions:

(i) Is there really any equilibrium?

(ii) Does the equilibrium meet certain optimal criteria?

(iii) Is the equilibrium stable?

This unit discusses general equilibrium and their various approaches.

2.1 UNIT OBJECTIVES

After going through this unit, you will be able to:

- Assess the principles of general equilibrium
- Discuss existence, uniqueness and stability of a general equilibrium
- Analyse the Walrasian approach to general equilibrium
- Discuss Walrasian approach to general equilibrium assuming a two-commodity-two-consumer-two firms-two inputs model

- Illustrate graphicallyhow economic system reaches the general equilibrium position
- Explain the Arrow-Debreu model and the computable general equilibrium

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2.2 PRINCIPLES OF GENERAL EQUILIBRIUM

A fundamental feature of an economic system is the interdependence and interrelatedness of economic activities—production and consumption—of its various constituents—individuals, households, firms, banks and other kinds of financial institutions. The working mechanism of economic system is unimaginably complex. It is not possible to trace the behaviour of each economic element and its interaction with the rest of the economy and trace equilibrium of each and every element of the economy. The economists, therefore, adopt two kinds of approaches to economic analysis: (i) Partial equilibrium approach, and (ii) General equilibrium approach. Partial equilibrium approachignores the interdependence of the various segments of the economy. It isolates the segment or the phenomenon of the study from the other segments and assumes non-existence of influences of the changes occurring outside the area delimited for the study. For example, in the analysis of utility-maximization behaviour of the households, their incomes are assumed to remain constant even if incomes change due to change in factor prices in factor markets; prices of related goods (substitutes and complements) are assumed to remain constant even if they change due to change in demand and supply conditions; and the consumer's taste and performance are assumed to be given even if they are not. Similarly, in the analysis of profit maximizing behaviour of the firms, the factor prices, technology, and commodity-prices are assumed to remain constant even if these variables continue to change.

The general equilibrium approach, on the other hand, recognizes the interdependence of constituent parts of the economic system. It recognizes the interrelations and interdependence of economic variables and seeks to answer the question how all the segments of the economyreach an equilibrium position simultaneously. General equilibrium shows, by using the tools of partial equilibrium analysis, how prices and outputs are simultaneously determined in all segments of the economy.

We have noted that various parts of the economy are mutually interdependent and function in close relationship with each other. In fact, in an economy everything depends on everything else. In such a system, price of a single commodity or factor cannot, in principal, be determined unless all other prices are known. Furthermore, prices are not determined one by one. If at all, they are determined simultaneously. The general equilibrium approach seeks to answer such questions as: Does the market mechanism produce a general equilibrium solution wherein each market or segment of the economy is in equilibrium? Is the equilibrium in product markets necessarily consistent with the equilibrium in factor markets? Is the behaviour of each consumer consistent with that of every other consumer, with that of every producer, and with that of each factor supplier? If so, is this solution unique, or are there several other set of prices that will satisfy an equilibrium solution? In other words, does there exist a unique equilibrium solution? Even if it exists, will it be stable in the sense that a disturbance which causes a departure from equilibrium sets up automatic forces that bring the system back again to equilibrium?

Thus, the task of general equilibrium theory is to find out whether there exists a general equilibrium in an economy. Ageneral equilibrium is defined as a state in which all economic units maximize their respective objective function and all prices are simultaneously in equilibrium, and all markets are cleared. General equilibrium theory explains how this state can, if ever, be attained. If attained, whether it remains stable.

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Leon Walras (1834–1910), a French economist, was the first to attempt to answer these questions in his book *Elements of Pure Economics* (1874). Although long before Walras, Cournot had realized that 'for a complete and precise solution of the partial problems of the economic system, it is inevitable that one must consider the system as a whole.' In their opinion, the problem of general equilibrium was beyond the resources of mathematical analysis. However, Walras showed, by using a system of simultaneous equations, that all prices and quantities in all markets are simultaneously determined through their interaction with each other.

2.3 EXISTENCE, UNIQUENESS AND STABILITY

In this section, we answer the questions (i) does there exist a general equilibrium solution? (ii) if it does, is it unique? (iii) is the solution stable?

2.3.1 Existence

If number of equations and the number of 'unknowns' are equal, it may sometimes make one think that there exists a general equilibrium solution. But, the equality of number of equations with that of unknowns is neither a sufficient nor a necessary condition for the existence of a general equilibrium solution. That it is not a sufficient condition is easy to prove. It is possible to find a system of two equations with two unknowns that has no solution in the realm of real numbers, for only real numbers have economic meaning. For instance, suppose we have two equations.

$$x^2 + y^2 = 0$$
$$x^2 - y^2 = 1$$

Solving for x and y, we get $x = \sqrt{1/2}$ and $y = i\sqrt{1/2}$, where the imaginary number i satisfies $i^2 = -1$.

It can also be shown that equality of equations and unknowns is not a necessary condition. Consider the equation:

$$x^2 + y^2 = 0$$

This single equation with two unknowns offers a unique solution for x and y in the domain of real number, i.e., $x = 0$ and $y = 0$.

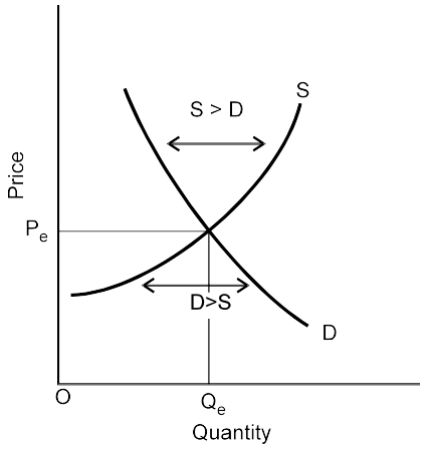

Fig. 7.1 *Unique and Stable Equilibrium*

Check Your Progress

1. Why have economists adopted the two kinds of approaches to economic analysis? What are they?
2. What is the task of general equilibrium theory?

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The example suggests that a unique general equilibrium may exist at zero prices and even at negative prices. These may be the cases of certain 'free goods' or 'nuisance goods'. The problems of zero or negative price could be solved by eliminating free goods or nuisance goods. But, as Car Menger pointed out, there may be a tendency of free goods to decrease as economic development takes place. Therefore, all kinds of goods must be included in Walrasian system. This is something which Walras did not realize. Hence, his demonstration of existence of general equilibrium solution is unsatisfactory.

Furthermore, it is mathematically possible to show the existence of general equilibrium solution involving zero and negative prices. But, while negative prices and quantities of consumer goods is understandable, it is difficult to imagine zero or negative factor prices and quantities. One can hardly imagine a worker paying for his employment.

2.3.2 Uniqueness

The uniqueness of general equilibrium solution requires that, at all partial equilibrium levels, demand and supply schedules intersect at only one point giving a positive price. At any other price higher than the price so determined, $S > D$, and at any lower price $D > S$, as shown in Figure 7.1. But if demand schedule of a commodity is backward bending, as in case of inferior goods, there will be no unique equilibrium. Instead there will be multiple equilibria. As shown in Figure 7.2, there are two equilibrium points, e_1 and e_2.

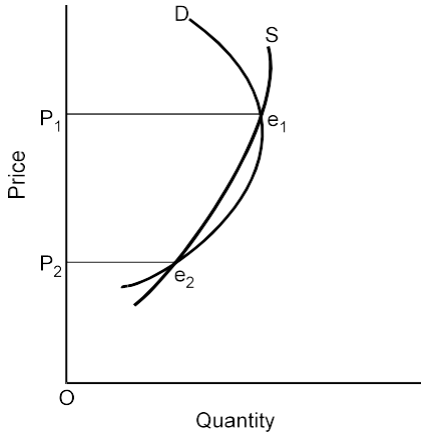

Fig. 7.2 *Multiple Equilibria*

However, Wald and, later, Arrow and Debreu have shown that 'the Walrasian system does possess a unique and economically meaningful solution, provided returns to scale are constant or diminishing and there are no joint products or external effects either in production or in consumption.' Obviously, the unique solution exists under restrictive assumptions.

2.3.3 Stability

Walras also tried to show that general equilibrium is stable. 'Walras' stability analysis was based on the assumption that the rate of price changes varies directly with the amount of excess demand. Walras, like Marshall, treated instability in the context of multiple equilibria; the unstable position is invariably found between two stable positions. But unstable equilibria in Walras arise from the intersection of a backward bending supply curve of a productive service with a more steeply falling demand curve. This implies the possibility but certainly not the necessity of multiple equilibria because the supply curve may never bend back again no matter how high factor price rise.'

Walras attempted to show not only stability in a single market but also a multimarket stability. Hicks has also attempted to show, in his *Value and Capital*, that the multimarket does not exist provided there are no strong income effects. It is however difficult to establish that the general equilibrium solution is determinate and stable.

2.3.4 Evaluation

Walrasian general equilibrium model has many shortcomings. Many of its assumptions are highly restrictive and unrealistic. The uniqueness and stability of solution that it offers are doubtful. It is also alleged sometimes that the Walrasian general equilibrium model has little economic content.

Despite its shortcomings, the Walrasian general equilibrium model has its own merits.

First, Walras was the first to recognize and formalize the mutual interdependence of various prices and quantities in an economic system. Although it is widely known that in economics every-thing depends on everything else, the full implications of this generalisation were not grasped before Walras.

Second, general equilibrium approach has a wide applicability to the analysis of various economic phenomena. Modern theories of money, international trade, employment, and economic growth are general equilibrium theories in a simplified form. Also, the 'new' welfare economics is an outgrowth of general equilibrium theory. The modern macroeconomics and micro-economics can be viewed as different ways of giving operational relevance to general equilibrium analysis.

2.4 WALRASIAN APPROACH TO GENERAL EQUILIBRIUM

In the Walrasian system of general equilibrium, the behaviour of each decision-maker is presented by a set of equations. Since each decision-maker functions simultaneously in two different capacities—as a buyer and as a seller, his behavioural equations consists of two subsets of equations. One subset describes his demand for different commodities (or factors); it contains as many equations as the number of commodities (or factors) supplied. Thus, demand side of the commodity market is described by as many equations as the number of commodities multiplied by the number of consumers demanding the commodities. Similarly, supply side of the market is described by as many equations as the number of commodities multiplied by the number of firms supplying the commodities. Factor market is similarly described, in Walrasian model, by two sets of equations—one each on demand and supply sides. In this system of describing working of an economy through equations, there are as many'unknown' variables to be determined as independent equations. The 'unknowns' are the quantities of all commodities and factors purchased and sold by each individual, and prices of all commodities and factors.

To illustrate Walrasian system, let us consider a simple two-consumer-two-commodity-two-factor model for general equilibrium analysis. Assume that there are only two consumers, *A* and *B*; only two commodities, *X* and *Y* and only two factors, *K* and *L*. Assume also that factors *K* and *L* are owned by the consumers, and commodities *X* and *Y* are produced by the two firms. Let us now specify the number of equations and of 'unknowns', assuming the existence of perfect competition in both commodity and factor markets.

Check Your Progress

3. What does the uniqueness of general equilibrium solution require?
4. State one merit of Walrasian general equilibrium.

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Note that the number of equations (20) is the same as the number of unknowns (20). It is necessary, though not sufficient, condition for the general equilibrium solution that the number of independent equations must be the same as the number of unknowns. Another requirement of general equilibrium solution is that all equations must be simultaneously solved. The above example satisfies this condition of general equilibrium solution.

No. of equations		*No. of unkowns*	
1. Demand functions of two goods by two consumers,	2 × 2 = 4	1. Quantities of 2 goods demanded by 2 consumers	2 × 2 = 4
2. Supply functions of two goods by two firms	2 × 2 = 4	2. Quantities of 2 goods supplied by 2 firms	2 × 2 = 4
3. Demand functions of two factors by two firms	2 × 2 = 4	3. Quantities of 2 factors demanded by 2 firms	2 × 2 = 4
4. Supply functions of two factors by 2 suppliers (*A* and *B*)	2 × 2 = 4	4. Quantities of 2 factors supplied by 2 firms	2 × 2 = 4
5. Market clearing equations of commodities	2	5. Prices of 2 commodities	2
6. Market clearing equation of factors	2	6. Price of 2 factors	2
Total No. of Equations	20	Total no. of unknowns	20

The fulfillment of this condition however does not necessarily guarantee the existence of a general equilibrium solution. First, let us formally describe the Walrasian general equilibrium model.

2.4.1 Walrasian General Equilibrium Model

Let us suppose that an economy has *n* commodities, *h* households (or individuals) and *m* inputs (or factors) and describe the commodity and input sectors.

Commodity sector: The demand for each commodity is expressed by a demand function which depends on prices of all commodities, $P_1, P_2, \ldots, P_n$, and on the level and distribution of consumer incomes $M_1, M_2, \ldots, M_n$, which consumers earn by supplying their factor services. Thus, the demand function for each commodity may be expressed as:

$$Q_i^d = D_i (P_1, P_2, \ldots, P_n, M_1, M_2, \ldots, M_n) \quad \ldots(7.1)$$

There are $n \times h$ demand functions in the general system. The supply of each commodity is similarly expressed through supply functions. The quantity supplied of a commodity depends on the prices of all commodities, $P_1, P_2, \ldots, P_n$, and prices of all inputs $V_1, V_2, \ldots, V_3$. Thus, supply function is given as:

$$Q_i^s = S_i (P_1, P_2, \ldots, P_n, V_1, V_2, \ldots, V_3) \quad \ldots(7.2)$$

There are $n \times f$ supply functions of *n* commodities for *f* firms.

Input sector: Resources (or inputs) are owned and supplied by the households and demanded by firms. Let *R* represent the amount of resource *K* owned by an individual

2.4.1.1 The actual amount supplied R_k of a resource *K* will depend on all input prices and thelevel and distribution of ownership. Thus supply function of a resource is given as:

$$R_k^s = S_k (V_1, V_2, \ldots, V_n; R_{k1}, R_{k2}, \ldots, R_{kn}) \quad \ldots(7.3)$$

There will be $m \times h$ equations.

The actual amount demanded (R_k^d) of each resource will depend on output levels, output prices, and input prices. Thus,

$$R_k^d = D_k (Q_1, Q_2, \ldots, Q_n; P_1, P_2, \ldots, P_n;$$

$$V_1, V_2 \ldots V_n) \qquad \ldots(7.4)$$

where $Q_1, Q_2, \ldots, Q_n$ represent output levels.

There will be $n \times m$ equations.

Besides, resource constraints should also be incorporated into the model. It may be expressed as:

$$\sum_{j=1}^{n} \bar{R}^{d}_{k} \leq R_{k_1} \qquad \ldots(7.5)$$

Identities: An important identity which emerges from the circular flows of incomes is that values of all outputs, i.e., P_iQ_i must equal the total income of the society, i.e., $M_1 + M_2, \ldots, M_h$. That is,

$$\sum_{j=1}^{n} P_iQ_i = \sum_{j=1}^{h} M_j \qquad \ldots(7.6)$$

Secondly, the total expenditure equals total income. Income of each individual is calculated by multiplying the amount of resource K supplied by an individual j, which equals $\bar{R}_{kj}{}^{s}$ time the resource price V_k. That is,

$$M_j = \sum_{k=1}^{m} V_k \bar{R}^{s}_{kj} \qquad \ldots(7.7)$$

Finally, the fundamental identity for the economy as a whole can thus be expressed as:

$$\sum_{i=1}^{n} P_iQ_i = \sum_{j=1}^{h} \sum_{k=1}^{m} V_k \bar{R}^{s}_{kj} \qquad \ldots(7.8)$$

Equation (7.8) shows that the prices of resources are directly linked to the prices of output. Prices and quantities of resources supplied cannot be determined without determining the price of commodities. The Walrasian model therefore requires that all the equations must be solved simultaneously. A general equilibrium occurs at $n + m$ prices when all the equations are simultaneously solved.

Graphical Illustration of Tendency Towards General Equilibrium

Assuming a $2 \times 2 \times 2$ model, we show in this unit that the model economy has a tendency towards general equilibrium under the following assumptions.

Assumptions

- There exists perfect competition in both commodity and factor markets.
- There are only two commodities, X and Y, which are substitutes for each other, and two firms produce one commodity each.
- Consumers' utility functions are given and they maximize their utility subject to income constraint.
- There are only two factors of production, L and K, which are available in fixed supply. Factors are homogeneous and perfectly divisible.

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- Production functions show diminishing marginal rate of technical substitution (MRTS) and decreasing returns.
- Firms maximize their profits subject to resource constraint.

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To begin with, let us assume that both commodity and factor markets are in equilibrium. Prices in both the markets are in equilibrium. Demands for commodities, *X* and *Y*, are equal to their respective supplies. Similarly, demand for each factor is equal to its supply.

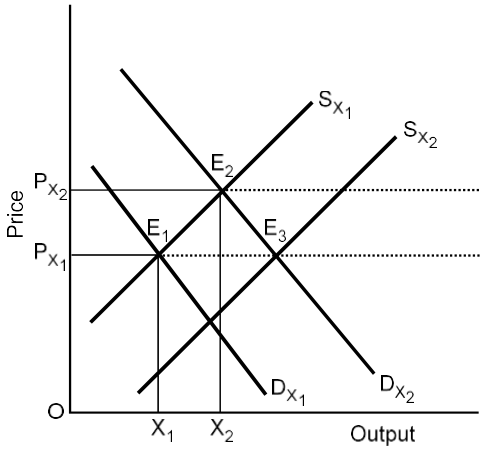

Fig. 7.3 *Market for Commodity X*

The equilibrium in commodity *X* market is illustrated in Figure 7.3. The initial demand and supply curves for commodity *X* are represented by D_{x1} and S_{x1} respectively. The demand and supply curves intersect at point E_1 determining price of *X* at OP_{x1}. At this price, demand for X (i.e., OX_1) equals its supply. The market for commodity *X* being in equilibrium, the one-firm industry *X* would also be in equilibrium. The equilibrium of firm *X* is illustrated in Figure 7.4. The firm (or industry) produces OX_1 at which *AC* = *MC* = Price = *MR*.

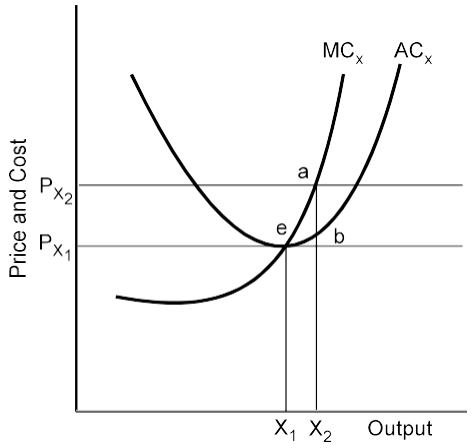

Fig. 7.4 *Industry X*

Similarly, the initial equilibrium positions of commodity market *Y* and of the firm producing *Y* are illustrated in Figs. 7.5 and 7.6, respectively. The commodity market *Y* is in equilibrium at price OP_{y1} at which demand for *Y* equals its supply, OY_1. Industry *Y* is in equilibrium at output OY_1. At this output, *AC* = *MC* = Price = *MR* in industry *Y*.

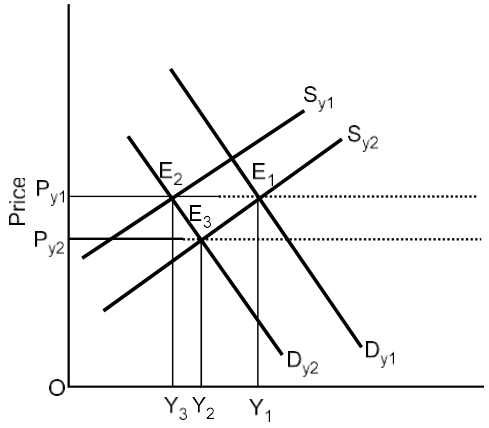

Fig. 7.5 *Market for Commodity Y*

Let us now suppose that, due to some exogenous factor, consumers' taste changes in favour of commodity *X*. As a result, demand curve for *X*, i.e., D_{x1} shifts upward to the position of D_{x2} (see Figure 7.3). Consequently, price of *X* rises from P_{x1} to P_{x2}. The output of *X* rises to OX_2 and the industry makes an abnormal profit of *ab* per unit of output (see Figure 7.4). The supernormal profits attracts firms from industry *Y* to industry *X* and the existing ones increase their output. As a result, demand for factors increases. This causes a rise in demand for factors *L* and *K*, in industry *X*. Since factors are fully employed, where do the factors come from? To find an answer to this question, let us examine what is happening in industry *Y*.

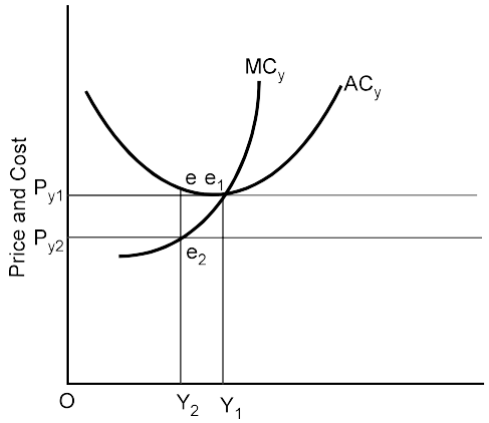

Fig. 7.6 *Industry Y*

Since we have assumed a shift in consumer's taste other things remaining the same, the additional demand for *X* comes only from a shift in demand from *Y* to *X*. This shift occurs because *X* and *Y* are substitutes for each other. Due to shift in demand from *Y* to *X*, the initial demand curve for *Y*, i.e., D_{y1} shifts downward to the position of D_{y2}. Output of *Y* falls to OY_2 and price falls from OP_{y1} to OP_{y2}. (Figure 7.5). As a result, the equilibrium of industry *Y* shifts from E_1 to E_2 and firms incur a loss of ee_2 per unit (Figure 7.6).

Effect of Change in Factor Demand

Let us now examine the effect of change in consumer demand on factor demand and changes in factor market. In order to analyse the effects in a somewhat wider framework,

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let us drop the assumption that there is only one firm in each industry and assume, instead, that there are several firms in each industry. Recall that the firms in industry *X* are making supernormal profits while firms is industry *Y* are incurring losses. Some firms in industry *Y* are therefore forced to quit the industry and some are induced to transfer their resources to industry *X*. Besides, the demand factors in industry *X* would increase. This tendency in the commodity markets affects the factor markets with respect to each industry. Consider first the increase on demand for factors in industry *X* and its effect on factor prices.

The entry of new firms to industry *X* and expansion of production by the existing firms increases demand for labour and capital in this industry. The effect of increase in demand for labour is illustrated in Figures 7.7 and 7.8. Suppose that the labour market for industry *X* was initially in equilibrium at point E_1. Due to the increase in demand for labour, the demand curve D_{L1} shifts to D_{L2} causing increase in the employment of labour in industry *X* from OL_1 to OL_2 and increase in wage rate for the industry from OW_1 to OW_2. The increase in demand for labour by an individual firm of the industry is illustrated in Figure 7.8. It shows that the demand curve for labour by an individual firm shifts rightward from d_{l1} to d_{l2}. At new wage rate OW_2, an individual firm employs Ol_2 workers or $l_1\ l_2$ additional workers at the ruling wage rate (Note that $l_1\ l_2$ multiplied by the number of firms in the industry equals $L_1\ L_2$ in Figure 7.7).

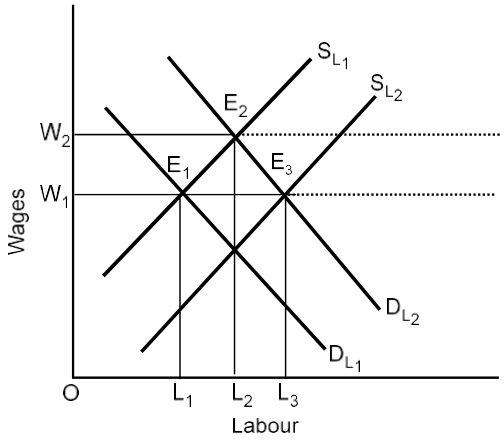

Fig. 7.7 *Labour Market for Industry X*

Let us now see what happens in the capital market. The changes in the capital market for industry *X* is illustrated in Figures 7.9 and 7.10. Demand for capital increases in this industry, and the initial capital demand curve D_{k1} shifts upward to the position of D_{k2} causing equilibrium point of capital market to shift to E_2 and return on capital to rise to O_{r2} (Figure 7.9). The capital-demand curve for an individual firm in industry *X* shifts from d_{k1} to d_{k2} as return on capital increases and the employment of capital by an individual firm increases from O_{k1} to O_{k2} (Figure 7.10). The total demand for capital in industry *X* increases by K_1K_2 (Figure 7.9) which equals k_1k_2 multiplied by the of firms in the industry.

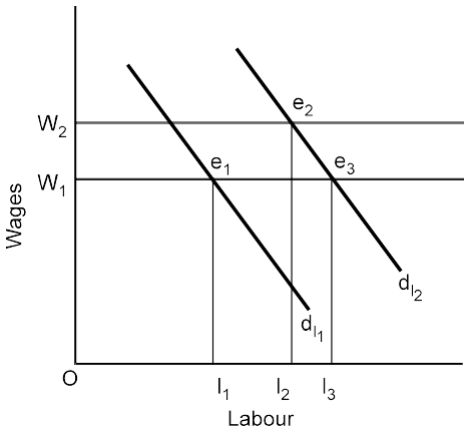

Fig. 7.8 *Demand for Labour by a Firm in Industry X*

Let us now see what has happened in the factor markets in respect of industry *Y*. First let us consider the labour market. The changes in the labour market in respect of industry *Y* are illustrated in Figures 7.11 and 7.12. Let the labour market for industry *Y* to be in equilibrium at point E_1. Recall from Figure 7.6 that firms in industry *Y* incur losses. Therefore, the demand for labour decreases and labour demand curve shifts downward from its initial position D_{L2} to D_{L1}. Consequently, the wage rate decreases from OW_2 to OW_1 and employment of labour in the industry decreases from OL_3 to OL_1. The decrease in demand for labour by an individual firm of industry *Y* is shown in Figure 7.12 by a downward shift in labour demand curve from d_{l2} to d_{l1}. Each firm employs less of labour even though wage rate has gone down from OW_2 to OW_1.

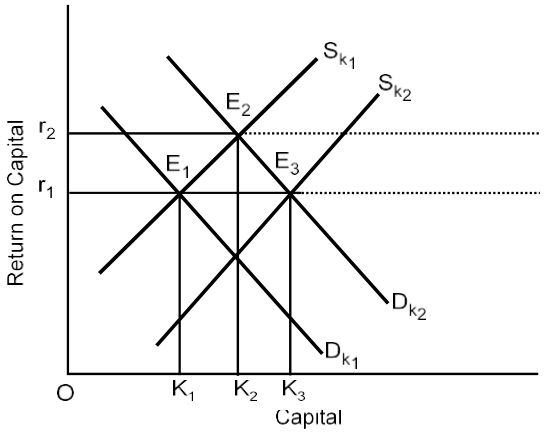

Fig. 7.9 *Capital Market for Industry X*

Let us now turn to the capital market for industry *Y*. A condition similar to the labour market for the industry *Y* takes place in the capital market too for industry *Y*. Demand for capital decreases as shown by the downward shifts of capital demand curve of both individual firms (Figure 7.14) and industry (Figure 7.13) because return on capital in the industry decreases.

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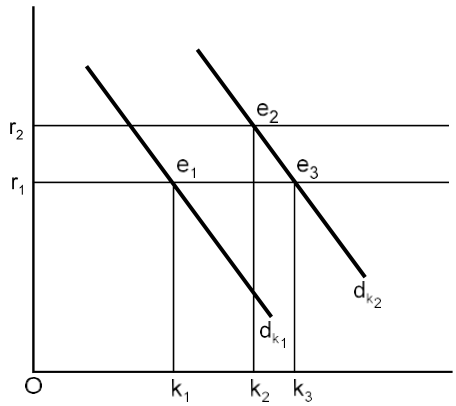

Fig. 7.10 *Demand for Capital by a Firm in Industry X*

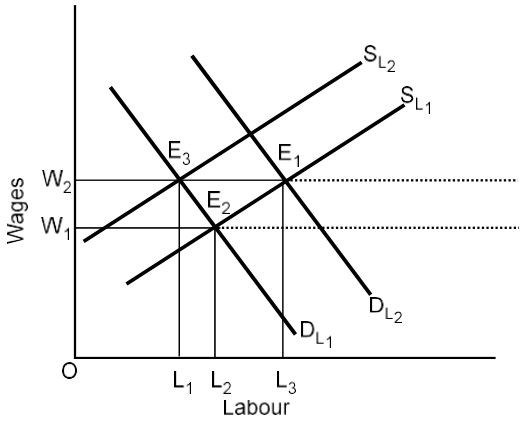

Fig. 7.11 *Labour Market for Industry Y*

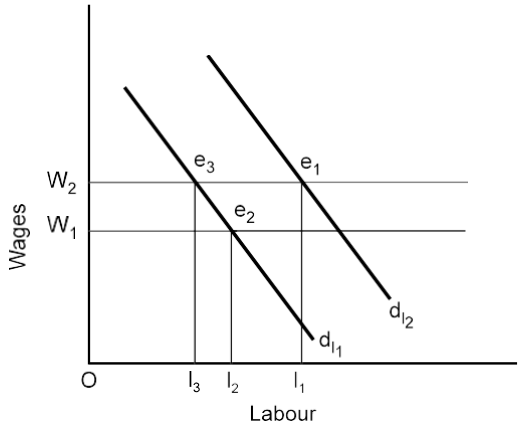

Fig. 7.12 *Demand for Labour by a Firm in Industry Y*

To sum up, due to the change in consumer's preference in favour of commodity *X* caused by an exogenous factor, demand for commodity *X* has increased and for commodity *Y* decreased. As a result, price of *X* increases and that of *Y* decreases. Factor price remaining the same, profitability of industry *X* increases while that of industry *Y* decreases. This leads to increase in demand for *L* and *K* in industry *X* and to decrease in demand for *L* and *K* in industry *Y*. These changes in demand for factors have led to disequilibrium in the system since firms in industry *X* are earning supernormal profits

which is in consistent with perfect competition. In a perfectly competitive system, however, the disequilibrium is self-correcting. Let us now see how the process of automatic adjustment begins and where it ends.

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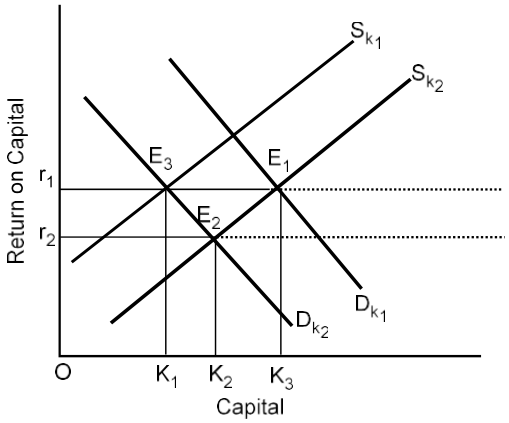

Fig. 7.13 *Capital Market for Industry Y*

2.4.2 Process of Automatic Adjustment

We have noted that both wages and returns on capital increase in industry X and decrease in industry *Y*. This will cause factors (labour and capital) to move from industry *Y* to industry *X*. Consequently, in the long-run, factor supply to industry *X* would increase and to industry *Y*, it would decrease. The increase in supply of labour and capital to industry *X* is shown by a rightward shift in the labour supply curve from SL_1 to SL_2 (Figure 7.7) and in capital supply curve from S_{k1} to S_{k2} (Figure 7.9).

With increased supply of labour and capital to industry *X*, the supply of commodity *X* increase causing supply curve to shift to S_{x2} and new equilibrium is reached at point E_3 (Figure 7.3). As shown in Figure 7.3, new equilibrium is gained at the original price OP_{x1} but at a greater output of *X*. In industry *Y* reverse happens. Since factors move out of industry *Y*, the factor supply to the industry is reduced as shown by downward shift in factor supply curves in Figures 7.11 and 7.13. Besides, since firms of this industry have a tendency to move out, industry's production declines. Consequently, the market supply curve of commodity *Y* shifts backwards to S_{y1}. Anew equilibrium is reached at point E_2 at original price OP_{y1} (Figure 7.5) and level of output (OY_3) falls much below the original output OY_1.

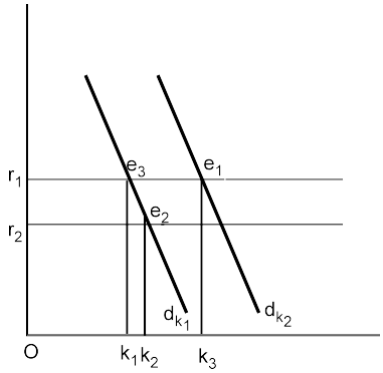

Fig. 7.14 *Demand for Capital by a Firm in Industry Y*

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Thus, in the long-run, markets of both the commodities, *X* and *Y*, return to a stable equilibrium at the original price level, though at different levels of output: while output of *X* increases, that of *Y* decreases. An important point to be borne in mind is that new equilibrium is not necessarily gained at the original price. Whether new equilibrium is gained at original price or not depends on the extent of increase (decrease) in the supply of the commodity, i.e., the extent to which supply curve shifts forward (backward). The original equilibrium is regained only if supply of commodity increases (decreases) and supply curve shifts forward (backward) exactly to the extent of excess (shortfall) in demand. If shifts in the supply curve are greater or smaller than excess of deficit in demand, the new equilibrium price will be different from the original price.

Once the commodity markets reach new equilibrium and stabilize, the inward and outward flows of factors ends. For example, as shown in Figures 7.3 and 7.4, industry *X* and its firms are in equilibrium. Price is refixed at OP_{x1} at which all firms are earning only normal profits, since price = *AC* = *MC* = *MR* (Figure 7.4). There is no incentive for the existing firms to expand their output. Nor is there any incentive for new firms to enter the industry. Under these conditions, there is no incentive for the factors to move to this industry. This leads to saturation in the factor markets for industry *X*. It simultaneously stops the flow of resources out of industry *Y*. This leads to saturation in factor markets for both the industries.

The new equilibria in labour and capital markets for industry *X* are presented in Figures 7.7 and 7.9. The labour supply curve for industry *X* finally shifts to S_{L_2} and a new equilibrium is set at point E_3 (Figure 7.7). Similarly, the capital supply curve for industry *X* shifts to Sk_2 (Figure 7.9) and a new equilibrium is set in capital market for industry *X* at original wage rate Or_1. Thus, both labour and capital markets reach a new equilibrium.

The new equilibria in labour and capital markets are presented in Figures 7.11 and 7.13. The labour supply curve for industry *Y* shifts backward to S_{L_2} and a new equilibrium is set at point E_3 (Figure 7.11). As to capital market for industry *Y*, capital supply curve shifts backward to S_{k1} and new equilibrium is set at E_3 at original rate of return, Or_1. Thus, both factor markets for industry *Y* reach a new equilibrium, though at a much lower level of employment of both labour and capital. In industry *Y* labour employment decreases from O_{L_3} to O_{L_1} and capital employment decreases from O_{K_3} to O_{K_1}.

As in case of commodity markets, whether factor markets reach new equilibrium at the original level of factor prices or not depends on the extent to which factor supply curve shift forward (or backward).

We may now sum up the above discussion. We started by assuming the whole system to be in equilibrium. The system was then assumed to be disturbed byan exogenous factor, i.e., change in consumer's taste. This led to a chain of actions and reactions in commodity and factor markets. These actions and reactions led the system to stabilize at a new equilibrium. The attainment of new equilibrium is however certain only under perfect competition and continuous production function with diminishing returns to scale.

The above illustration does not provide a formal proof of existence of a stable general equilibrium solution. It simplydescribes the tendencytowards a general equilibrium under perfectly competitive conditions.

Check Your Progress

5. How is the factor market described in the Walrasian model?
6. When is the original equilibrium regained?

2.5 COMPUTABLE GENERAL EQUILIBRIUM

NOTES

Computable general equilibrium (CGE) models are a class of economic models that use real economic data to evaluate how an economy might react to changes in policy, technology or other external factors. CGE models are also referred to as AGE (applied general equilibrium) models.

In mathematical economics, applied general equilibrium (AGE) models were established by Herbert Scarf at Yale University in 1967, in two papers, and a follow-up book with Terje Hansen in 1973, with the object of empirically assessing the Arrow–Debreu model of general equilibrium theory with empirical data, to provide 'a general method for the explicit numerical solution of the neoclassical model' (Scarf with Hansen 1973: 1).

The model developed by Arrow-Debreu is a basic and fundamental model of general equilibrium in economics and finance. The model developed by Arrow-Debreu model has generalized the notion of commodity by differentiating the commodities on the basis of time and place of delivery. For example, 'apples in Singapore in the month of June' and 'apples in Malaysia in the month of July' are considered as two different commodities rather than one. Under given set of assumptions, the first thorough evidence of the subsistence of a market clearing equilibrium was propounded by Kenneth J. Arrow and Gerad Debreu (1951).

The impact and significance of the model developed by Arrow and Debreu cannot be separated from that of mathematical economics. They both developed a chain of extraordinary papers (of which two papers were produced by Arrow and Debreu individually in 1951 and third one by Arrow-Debreu in 1954). The research done by both of them has great significance not only in the field of economic science but also for the financial markets, institutions and business across the world. Their model is frequently used in microeconomics as a model of general reference. The revolutionary work of Arrow and Debreu has had a continuing effect on the study of financial facets of the economy in a general equilibrium framework.

The relevance of the model can be understood from the fact that fifteen years later since the birth of the model in 1969, it was still applicable and reinterpreted to yield new economic insights. And twenty years later, i.e., Debreu 1970, 1974, the same model was still competent in yielding fresh and fundamental properties in mathematics. The relevance of the model increased with the introduction of time and uncertainty in the general equilibrium models. Since 1950s, many researchers have extended the model developed by Arrow-Debreu in the field of economics in general and also in the field of financial economics. Despite the significance and relevance of their model in economics and finance, many eminent researchers have criticized their model. But the contribution of Arrow-Debreu model is everlasting in the history of economics.

The Arrow-Debreu model is also known as Arrow-Debreu-McKenzie model (ADM model). This model is a fundamental model used in general (economic) equilibrium theory. The ADM model is named after Kenneth J. Arrow (b. 1921) and Gerard Debreu (1921-2004) on 'existence of an equilibrium for a competitive economy' as well as Lionel W. McKenzie (b. 1919) who are the originators of this model. As per Farlex Financial Dictionary (2009), this model is one of the most general models of competitive economy and is a crucial part of general equilibrium theory, as it can be used to prove the existence of general equilibrium (or Walrasian equilibrium) of an economy. Once we

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can prove the existence of such an equilibrium, it is possible to show that it is unique under certain conditions, but not in general.

Further, the model was extended by Arrow to deal with the issues relating to stability of equilibrium, uncertainty and efficiency of competitive equilibrium.

2.5.1 Arrow-Debreu Model and Polynomial Time Algorithm

Given linear markets with a bounded number of divisible goods, there, in fact, is a polynomial time algorithm for finding equilibrium. There is a poly-time algorithm for computing a Є-Pareto curve in linear markets with *indivisible commodities* and a fixed number of agents.

With a bounded number of goods, there is a poly-time algorithm which, for any linear indivisible market for which a price equilibrium exists, and for any Є>0, finds a Є-approximate equilibrium.

The Arrow-Debreu model has great impact on economics and financial economics. The key applications of this model can be narrated as under:

- It resolves the long-standing dilemma of proving the existence of equilibrium in a Walrasian (competitive) system. Their model has analyzed the exact situations of the most competitive markets. The model has suggested that under certain assumptions in economic conditions (like perfect competition and independence of demand), a given set of prices such as aggregate supplies will be equal toaggregate demand of every commodity.
- If discussed on purely mathematical logics, the Arrow-Debreu model can be simply tailored into spatial or inter-temporal models with appropriate definition of the commodities based on the commodity's location or time of delivery.
- The Arrow-Debreu model can easily implement the conditions of expectations and uncertainty in itself to analyse commodities specific to the conditions of various states of the world.
- Theoretically, the model can be applied and extended to the models used in financial economics, money markets, international trade and related subjects.
- In general equilibrium structure, the Arrow-Debreu model can be applied in evaluating the overall effect on resource allocation of policy changes in areas such as taxation, tariff and price control.
- In general, the model can be applied to all general equilibrium models which are dependent on mathematical accuracy and evidences.
- In case of financial economics, this model represents a particular type of securities product which is known as Arrow-Debreu security. This tool is effectively used to understand the pricing and hedging related aspects in derivative analysis.
- This model is also used in financial engineering.
- But the model has limited application in multi-period or continuous markets.

Despite the above implications of the model, it has been criticized for the assumptions on which it is based. Critics of the view that the model is not fit for the real economy. But economists in favour of this model say that the Arrow-Debreu framework is significant for derivative industry and can help in rapid growth of this industry.

2.5.2 Arrow-Debreu Pricing: Equilibrium

NOTES

The Arrow-Debreu pricing and equilibrium has been discussed in the following six sections:

- Arrow-Debreu vs CAPM
- Arrow-Debreu economy
- Optimal risk sharing
- Competitive equilibrium and Pareto optimum
- Euler equations
- Equilibrium and no-arbitrage

1. Arrow-Debreu equilibrium

The modern portfolio theory and (MPT) and capital asset pricing model (CAPM) are considered the two basic models for asset pricing and analysis. These models are generally accepted the way the pricing of risk and cash flows are considered under it. Markowitz, Lintner, Sharpe and Mossin considered σ^2 on horizontal axis and μ on vertical axis. By considering these two parameters, the results obtained in portfolio management and asset pricing were found more progressive. But the generalization of these results became a complicated task. For this, the returns must show a quadratic utility of normal distribution pattern.

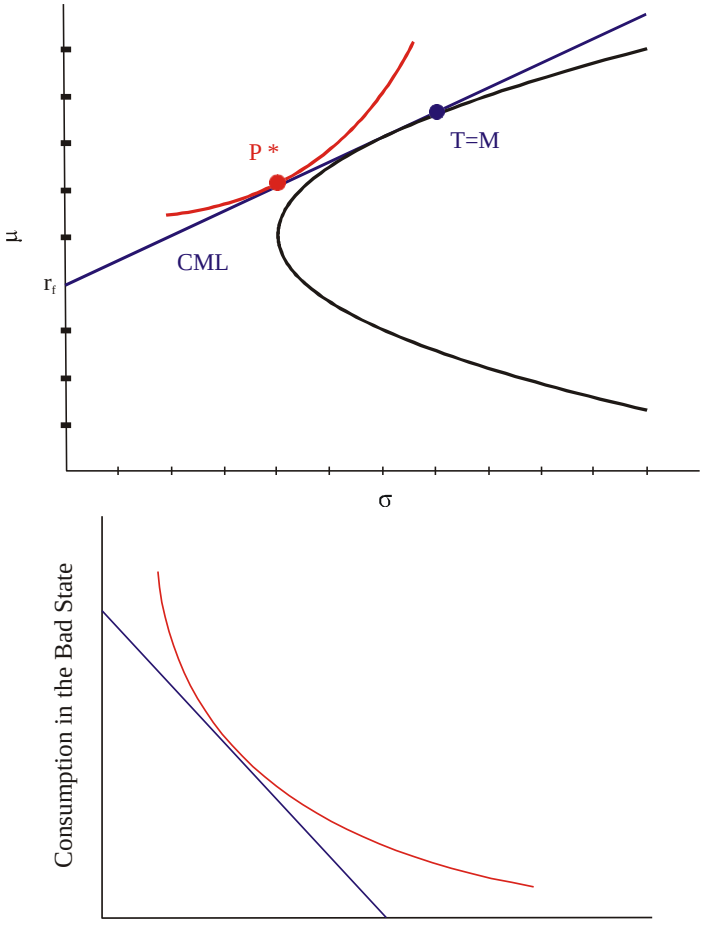

Fig. 7.15 *Arrow-Debreu Equilibrium*

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Arrow and Debreu considered the consumption of good state on horizontal axis and consumption in bad state on vertical axis. Arrow-Debreu model does not require a restrictive assumption of capital asset pricing model. But their model is considered for the generalized results provided by it. The benefits of considering Arrow-Debreu model of asset pricing are:

- There is no need of returns to be normally distributed.
- The investors need not have a quadratic utility function.
- Their model also draws explicit linkage between asset pricing and rest of the economy.

But both the models are considered significant in asset pricing.

2. Arrow-Debreu economy

The key features of Arrow-Debreu economy are:

(i) There are two dates: t = 0 (today, when assets are purchases) and t =1 (the future, when payoffs are received). This can be generalized.

(ii) There are N possible states at t =1, with probability π_i, where I = 1, 2, …..N.

(iii) There is one perishable good at each date. The more goods can be added and the possibility of storage can be introduced at the cost of more notional complexity.

(iv) At the initial stage, individuals receive goods as endowments. Again at a cost of notational complexity, production can be introduced.

(v) Different investors (K investors, j = 1,2,…K) may have different preferences and endowments.

Let

w^0_j = agent j 's endowment at t = 0

w^i_j = agent j 's endowment in state i at t = 1

c^0_j = agent j 's consumption at t = 0

c^i_j = agent j 's consumption in state i at t = 1

The consumption at t = 0 is used as the '**numeraire**,' that is, the good in terms of which all other prices are quoted. Let q^i be the price at t = 0, measured in units of t = 0 consumption, of a contingent claim that pays off one unit of consumption in a particular state i at t = 1 and zero otherwise.

For further simplicity, let's assume that each investor first uses the contingent claims market to sell off his or her endowments at t = 0 and in each state at t = 1, then uses the same markets to buy back consumption at t = 0 and in each state at t = 1.

Then we would not need additional notation to keep track of purchases and sales of contingent claims: purchases coincide with consumption and sales with endowments. Therefore, investor *j* in A-D economy faces the constraint of budget.

$$w^0_j + \sum_{i=1}^{N} q^i w^i_j \geq c^0_j + \sum_{i=1}^{N} q^i c^i_j$$

Note that in Arrow-Debreu economy one can always go back and compute net sales:

$$w^0_j - c^0_j \text{ and } w^i_j - c^i_j \text{ for all } i = 1, 2, ..., N$$

or purchases

$c^0_j - w^0_j$ and $c^i_j - w^i_j$ for all $i = 1, 2, ..., N$ of contingent claims if these turn out to be of interest.

But if the assumption of investors having different utility functions is withdrawn from the model, then more sharper results can be obtained. In that case, the investors will be assumed to have a utility function of maximizing vN-M expected utility. But they are allowed to have a different Bernoulli utility function which says that possibly different investors have different attitude towards risk.

So, the investor j opts c^0_j and c^i_j for all $i = 1; 2; : : : ; N$ in order to maximize:

$$u_j(c^0_j) + \beta E[u_j(c_j)] = u_j(c^0_j) + \beta \sum_{i=1}^{N} \pi_i u_j(c^i_j)$$

In the above, the discount factor β is a measure of patience subject to constraint of budget.

$$w^0_j + \sum_{i=1}^{N} q^i w^i_j \geq c^0_j + \sum_{i=1}^{N} q^i c^i_j$$

It is worth noting that the mathematical structure of the investors' problem is identical to the problem faced by consumers who must divide their income into amounts to be spent on oranges, apples and banana. If the model is expanded and more than two periods are included, then obviously more notions are required. But conceptually and mathematically this expansion will include only the inclusion of more goods, i.e., mangoes and pears. In Arrow-Debreu economy the investors take the prices because of existence of perfectly competitive market. And the investor is able to purchase as little of each good at the prevailing competitive prices. But in microeconomics, in a more general way, all markets must clear that the quantity demanded for a good is equal to quantity supplies. Therefore, in Arrow-Debreu economy, market clearing calls for:

$$\sum_{j=1}^{K} w^0_j = \sum_{j=1}^{K} c^0_j$$

And

$$\sum_{j=1}^{K} w^i_j = \sum_{j=1}^{K} c^i_j$$

For all $i = 1, 2, \ldots. N$. These conditions simultaneously explain the equilibrium in the market for goods and contingent claims as well.

Thus, a competitive equilibrium in an Arrow-Debreu economy consists of a set of consumptions c^0_j for all $j = 1; 2; : : : ; K$ and c^i_j for all $i = 1; 2; : : : ; N$ and $j = 1; 2; : : : ; K$ and a set of prices q^i $i = 1; 2; : : : ; N$ such that, all markets are clear and at given prices; each investor's consumption maximizes the utility considering the budget constraints.

3. Optimal risk sharing

This approach is used to understand how investors can share risk optimally while keeping in mind that the competitive-equilibrium model of Arrow-Debreu economy will use financial markets to do this. Imagine that the economy consists of two types of investors

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(type 1 and type 2, in equal numbers). Suppose, there are only two possible states at t=1: state 1 which occurs with probability π_1, and state 2 which occurs with a probability of $\pi_2 = 1 - \pi_1$

The aggregate endowments are w^0 at t = 0 , w^1 in state 1 at t = 1, and w^2 in state 2 at t = 1. The two agent types have expected utility but they may differ in their Bernoulli utility functions and hence in terms of risk aversion:

$$u_j(c_j^0) + \beta[\pi_1 u_j(c_j^1) + \pi_2 u_j(c_j^2)]$$

The social planner chooses $c_1^0, c_2^0, c_1^1, c_2^1, c_1^2$ and c_2^2 to maximize

$$\theta\left\{u_1(c_1^0) + \beta\left[\pi_1 u_1(c_1^1) + \pi_2 u_1(c_1^1)\right]\right\}$$

$$+ (1-\theta)\left\{u_2(c_2^0) + \beta\left[\pi_1 u_2(c_2^1) + \pi_2 u_2(c_2^2)\right]\right\}$$

Subject to the aggregate resource constraints

$$w^0 \geq c_1^0 + c_2^0$$
$$w^1 \geq c_1^1 + c_2^1$$
$$w^2 \geq c_1^2 + c_2^2$$

4. Competitive equilibrium and pareto optimum

The first requirement for a competitive equilibrium is investor j opts c_j^0 and c_j^i for all $i = 1, 2, 3 \ldots\ldots N$ to maximize,

$$u_j(c_j^0) + \beta \sum_{i=1}^{N} \pi_i u_j(c_j^i)$$

Subject to constraints of budget,

$$w_j^0 + \sum_{i=1}^{N} q^i w_j^i \geq c_j^0 + \sum_{i=1}^{N} q^1{}_j^i$$

The Lagrangian for the investor's problem,

$$u_j(c_j^0) + \beta \sum_{i=1}^{N} \pi_i u_j(c_j^i) + \lambda_j \left(w_j^0 + \sum_{i=1}^{N} q^i w_j^i - c_j^0 - \sum_{i=1}^{N} q^i c_j^i \right)$$

It leads to the first order conditions,

$$u_j'(c_j^0) - \lambda_j = 0$$
$$\beta \pi_i u_j'(c_j^i) - \lambda_j q^i = 0 \text{ for all } i = 1, 2, ..., N$$
$$u_j'(c_j^0) - \lambda_j = 0$$
$$\beta \pi_i u_j'(c_j^i) - \lambda_j q^i = 0 \text{ for all } i = 1, 2, ..., N$$

It implies,

$$\beta \pi_i u_j'(c_j^i) = u_j'(c_j^0) q^i \text{ for all } i = 1, 2, ..., N$$

Or

$$q^i = \frac{\beta\pi \mu'_j(c^i_j)}{u'_j(c^0_j)} \text{ for all } i = 1, 2, ..., N$$

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As an actor of the economy, the investor takes the price q^i as given and uses it to choose c^0_j and c^i_j optimally. But as an observer, this condition of optimality can be used to see what the investors' choices of c^0_j and c^i_j explain about the contingent claim price q^i and by extension regarding asset prices in a broader sense.

$$q^i = \frac{\beta\pi_i u'_j(c^i_j)}{u'_j(c^0_j)} \text{ for all } i = 1, 2, ..., N$$

The price q^i tends to be higher when:

1. β is larger, indicating that investors are more patient
2. π_i is larger, indicating that state i is more likely
3. $u'_j(c^i_j)$ is larger or $u'_j(c^0_j)$ is smaller

$$q^i = \frac{\beta\pi \mu'_j(c^i_j)}{u'_j(c^0_j)} \text{ for all } i = 1, 2, ..., N$$

tends to be higher when N is larger or is smaller.

If u_j is concave, that is, if investor j is risk averse, then a larger value of it corresponds to a smaller value of c^i_j and a smaller value of corresponds to a larger value of c^0_j .

$$q^i = \frac{\beta\pi_i u'_j(c^i_j)}{u'_j(c^0_j)} \text{ for all } i = 1, 2, ..., N$$

tends to be higher when $u'_j(c^i_j)$ is larger or $u'_j(c^0_j)$ is smaller. That is q^i is higher if investor j's consumption falls between $t = 0$ and state i at $t = 1$.

The same condition must be taken as it is for all investors in the economy. Hence, q^i is higher if everyone expects consumption to fall in state i .

$$q^i = \frac{\beta\pi_i u'_j(c^i_j)}{u'_j(c^0_j)} \text{ for all } i = 1, 2, ..., N$$

During recession when consumption by all is expected to fall.

Hence, the A-D model associates a high contingent claim price q^i with a recession, drawing an explicit link between asset prices and the rest of the economy that is, at best, implicit in the CAPM.

5. Euler equations

Before moving on, it will be useful to use a no-arbitrage argument to derive an equation that will lie at the heart of the CCAPM. Consider an asset that, unlike a contingent claim, delivers payoffs in all N states of the world at $t = 1$. Let X denote the random pay-offs as it appears to investors at $t = 0$, and let X_i denote more specifically the payoffs made in each state $i = 1; 2; : : : ; N$ at $t = 1$.

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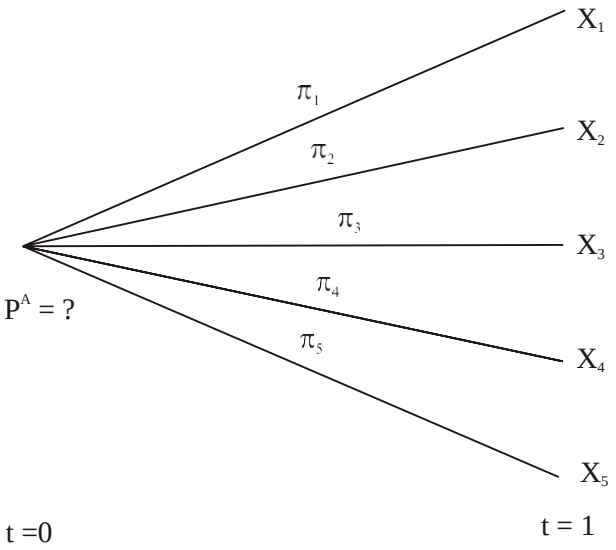

The random payoffs Xequals X_i in each state i = 1; 2; 3; 4; 5.

The payoffs from this asset can be replicated by purchasing a bundle of contingent claims:

X_1 contingent claims for state 1

X_2 contingent claims for state 2

: : :

X_N contingent claims for state N

The payoffs from this asset can be replicated by purchasing a bundle of contingent claims:

X_1contingent claims for state 1 at cost q^1X_1

X_2contingent claims for state 2 at cost q^2X_2

: : :

$X_N$contingent claims for state N at cost q^NX_N

A no-arbitrage argument implies that the price of the asset must equal the price of all the contingent claims in the equivalent bundle.

- If the price of the asset was less than the price of the bundle of contingent claims, investors could profit by buying the asset and selling the bundle of claims.
- If the price of the bundle of contingent claims was less than the price of the asset, investors could profit by buying the bundle of claims and selling the asset.

Hence, the asset price must be:

$$P^A = q^1 X_1 + q^2 X_2 + \ldots q^N X_N = \sum_{i=1}^{N} q^i X_i$$

In an A-D equilibrium, however,

$$q^i = \frac{\beta \pi_{ij} u'\left(c^i_j\right)}{u'^i\left(c^\vartheta\right)} \text{ for all } i = 1, 2, \ldots, N$$

must hold for all $j = 1; 2; : : : ;K$

Substitute the A-D equilibrium conditions:

$$q^i = \frac{\beta\pi_i u'_j\left(c^i_j\right)}{u'^j\left(c^\vartheta\right)} \text{ for all } i = 1, 2, ..., N$$

into the no-arbitrage pricing condition:

$$P^A = \sum_{i=1}^{N} q^i X_i$$

$$= \sum_{i=1}^{N} \left[\frac{\beta\pi_i u'_j(c^i_j)}{u'_j(c^0_j)} \right] X^i$$

$$P^A = \sum_{i=1}^{N} \left[\frac{\beta\pi_i u'_j(c^i_j)}{u'_j(c^0_j)} \right] X^i$$

Implies,

$$u'_j(c^0_j)P_A = \beta \sum_{i=1}^{N} \pi_i u'_j(c^i_j)\, X_i$$

Or, using definition of expected value:

$$u'_j(c^0_j)P_A = \beta E\left[u'_j(c_j)X\right]$$

6. Equilibrium and No-arbitrage

The Arrow-Debreu model is known as an explicit equilibrium model of asset prices. Through the equilibrium condition:

$$q^i = \frac{\beta\pi_i u'_j(c^i_j)}{u'_j(c^0_j)}$$

Which must hold for all states I =1, 2, ……, N and all investors $j = 1, 2, …..K$. The Arrow-Debreu model links asset prices to aggregate, undiversifiable risk in the economy as a whole.

The generality of Arrow-Debreu model is both a strength as well as a weakness. The strength of this is that it makes no specific assumptions about the preferences or distribution of asset returns. The weakness is that it seems difficult to apply in on the products of financial markets, viz., stocks, bond, and options.

2.5.3 General Equilibrium Under Uncertainty

In general equilibrium theory, the 'allocation' of a given quantity of each commodity implies its final consumption with its corresponding utility score under uncertainty. The final consumption of a given allocation will depend on the state of nature in such a way that equal quantities of the same commodity could produce different utility scores.

Consider an economy with 2 consumers and 1 consumption good. There are 2 periods, $t = 0$ (today) and $t = 1$ (tomorrow). The agents do not know the state of the

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world at $t = 1$. To simplify, we will assume that there are two possible states (alternatives), $e = e_1, e_2$. The probabilities of each state are:

$$p(e_1) = \pi, p(e_2) = 1 - \pi$$

We consider that there is a unique good in the economy that may be consumed only at $t = 1$ (that is, there is no consumption at $t = 0$.) Let us use the following notation:

X^s_i is the amount of the good that agent i consumes in state e^s.

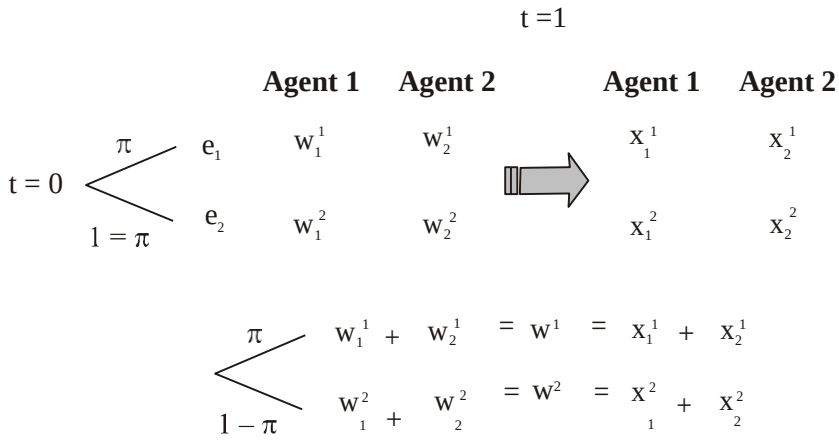
w^s_i are the initial endowments that agent i has in state e^s.

$$w^s = w^s_1 = w^s_2, s = 1, 2.$$

The utility functions of agents are as follows:

$$u_j\left(x^1_i, x^2_i\right) = \pi u_i(x^1_i) + (1 - \pi)\, u_i(x^2_i)\ i = 1, 2$$

i.e., the agents maximizes the utility



This situation can also be presented using Edgeworth's Box. In **economics**, an Edgeworth box is named after Francis Ysidro Edgeworth, who was an Anglo-Irish philosopher and political economist. It is a way of representing various distributions of resources.

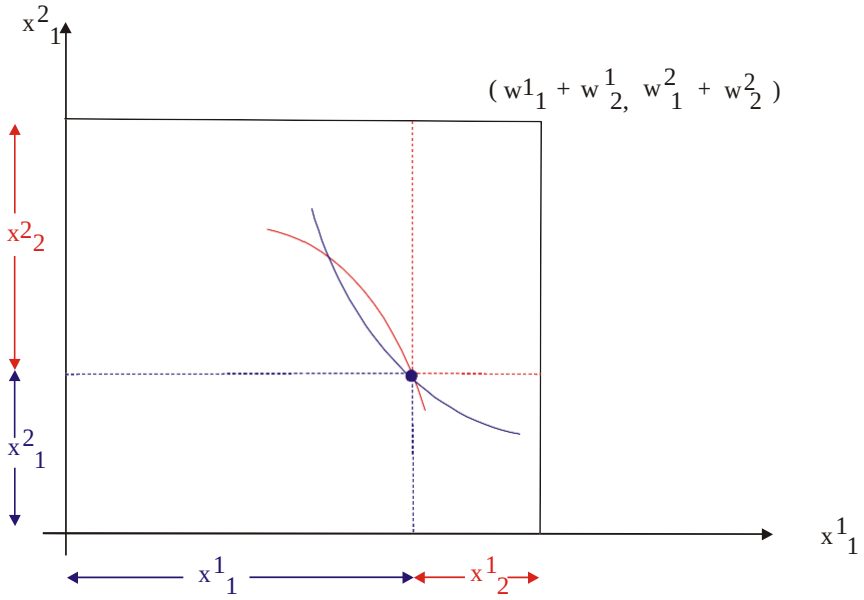


Fig. 7.16 *Edgeworth Box*

Criticisms of General Equilibrium Theory

The general equilibrium theory of economic welfare has been criticized on the following grounds:

- It is less applicable to real world problems. This is the reason that it has been called as the celestial mechanics of a non-existent world.
- The major limitation of multiple equlibria of general equilibrium theory has been resolved only by Arrow and Debreu.
- The use of the concept of 'tatonnment' is also another limitation of general equilibrium theory. According to it an auctioneer:
  (i) Processes all bids and offers
  (ii) Determines which prices that clear all markets
  (iii) Then allows trades
- No empirical evidences are provided by this theory.

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2.6 SUMMARY

In this unit, you have learnt that:

- A fundamental feature of an economic system is the interdependence and interrelatedness of economic activities—production and consumption—of its various constituents—individuals, households, firms, banks and other kinds of financial institutions.
- Partial equilibrium approach ignores the interdependence of the various segments of the economy. It isolates the segment or the phenomenon of the study from the other segments and assumes non-existence of influences of the changes occurring outside the area delimited for the study.
- The general equilibrium approach, on the other hand, recognizes the interdependence of constituent parts of the economic system. It recognizes the interrelations and interdependence of economic variables and seeks to answer the question how all the segments of the economy reach an equilibrium position simultaneously.
- The task of general equilibrium theory is to find out whether there exists a general equilibrium in an economy.
- A general equilibrium is defined as a state in which all economic units maximize their respective objective function and all prices are simultaneously in equilibrium, and all markets are cleared.
- If number of equations and the number of 'unknowns' are equal, it may sometimes make one think that there exists a general equilibrium solution. But, the equality of number of equations with that of unknowns is neither a sufficient nor a necessary condition for the existence of a general equilibrium solution.
- The uniqueness of general equilibrium solution requires that, at all partial equilibrium levels, demand and supply schedules intersect at only one point giving a positive price.
- Walras was the first to recognize and formalize the mutual interdependence of various prices and quantities in an economic system. Although it is widely known

Check Your Progress

7. Fill in the blanks with appropriate words.
   (i) The Arrow-Debreu model has great impact on economics and _____.
   (ii) The Arrow-Debreu model is known as an _____ model of asset prices.
8. Mention one limitation of general equilibrium theory.
9. What is an Edgeworth's box?

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that in economics, everything depends on everything else, the full implications of this generalisation were not grasped before Walras.

- In the Walrasian system of general equilibrium, the behaviour of each decision-maker is presented by a set of equations. Since each decision-maker functions simultaneously in two different capacities—as a buyer and as a seller, his behavioural equations consists of two subsets of equations.
- Factor market is described, in Walrasian model, by two sets of equations—one each on demand and supply sides.
- An important point to be borne in mind is that new equilibrium is not necessarily gained at the original price. Whether new equilibrium is gained at original price or not depends on the extent of increase (decrease) in the supply of the commodity, i.e., the extent to which supply curve shifts forward (backward).
- The original equilibrium is regained only if supply of commodity increases (decreases) and supply curve shifts forward (backward) exactly to the extent of excess (shortfall) in demand.
- As in case of commodity markets, whether factor markets reach new equilibrium at the original level of factor prices or not depends on the extent to which factor supply curve shift forward (or backward).
- Given linear markets with a bounded number of divisible goods, there, in fact, is a polynomial time algorithm for finding equilibrium.
- The Arrow-Debreu model has great impact on economics and financial economics.
- The Arrow-Debreu model can easily implement the conditions of expectations and uncertainty in itself to analyse commodities specific to the conditions of various states of the world.
- In general equilibrium structure, the Arrow-Debreu model can be applied in evaluating the overall effect on resource allocation of policy changes in areas such as taxation, tariff and price control.
- The modern portfolio theory and (MPT) and Capital Asset Pricing Model (CAPM) are considered two basic models for asset pricing and analysis. These models aregenerally accepted the way the pricing of risk and cash flows are consideredunder it.
- The Arrow-Debreu model is known as an explicit equilibrium model of asset prices.
- In general equilibrium theory, the 'allocation 'of a given quantity of each commodityimplies its final consumption with its corresponding utility score under uncertainty. The final consumption of a given allocation will depend on the state of nature in such a way that equal quantities of the same commodity could produce differentutility scores.

2.7 KEY TERMS

- **General equilibrium:** It is defined as a state in which all economic units maximize their respective objective function and all prices are simultaneously in equilibrium, and all markets are cleared.

- **Numeraire:** It is an item or commodity acting as a measure of value or as a standard for currency exchange.

2.8 ANSWERS TO 'CHECK YOUR PROGRESS'

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1. The working mechanism of economic system is unimaginably complex. It is not possible to trace the behaviour of each economic element and its interaction with the rest of the economy and trace equilibrium of each and every element of the economy. The economists, therefore, adopt two kinds of approaches to economic analysis: (i) partial equilibrium approach, and (ii) general equilibrium approach.
2. The task of general equilibrium theory is to find out whether there exists a general equilibrium in an economy.
3. The uniqueness of general equilibrium solution requires that at all partial equilibrium levels, demand and supply schedules intersect at only one point giving a positive price.
4. Walras was the first to recognize and formalize the mutual interdependence of various prices and quantities in an economic system. Although it is widely known that in economics or every-thing depends on everything else, the full implications of this generalisation were not grasped before Walras.
5. Factor market is described in Walrasian model by two sets of equations—one each on demand and supply sides.
6. The original equilibrium is regained only if supply of commodity increases (decreases) and supply curve shifts forward (backward) exactly to the extent of excess (shortfall) in demand.
7. (i) Financial economics

   (ii) Explicit equilibrium
8. The use of the concept of 'tatonnment' is a limitation of general equilibrium theory.
9. The Edgeworth's box is a way of representing various distributions of resources.

2.9 QUESTIONS AND EXERCISES

Short-Answer Questions

1. What are the limitations of partial equilibrium analysis?
2. Distinguish between general and partial equilibrium analysis.
3. Define general equilibrium.
4. Does general equilibrium analysis offer a unique solution of price and output determination?
5. What are the conditions for the stable general equilibrium solution?
6. Outline the general equilibrium approach to economic studies.
7. State the conditions for the existence, stability and uniqueness of a general equilibrium in an economy with two factors, two commodities and two consumers.
8. What are the conditions for the stability of the Walrasian general equilibrium? Do such conditions exist in reality?

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9. What is the process of automatic adjustment?
10. What are the key features of Arrow-Debreu economy?
11. Briefly state the Arrow-Debreu economy.
12. State some of the criticisms of general equilibrium theory.

Long-Answer Questions

1. Assess the principles of general equilibrium.
2. Discuss the existence, uniqueness and stability of a general equilibrium.
3. Critically analyse the Walrasian approach to general equilibrium.
4. Discuss Walrasian approach to general equilibrium assuming a two-commodity-two-consumer-two firms-two inputs model. Illustrate graphically how economic system reaches the general equilibrium position.
5. Evaluate the process of automatic adjustment.
6. Explain the Arrow-Debreu model.
7. Discuss the impacts of Arrow-Debreu model on economics and financial economics.
8. What does the theory of general equilibrium under uncertainty state?

2.10 FURTHER READING

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UNIT III: WELFARE ECONOMICS

Structure

3.0 Introduction

Welfare economics is a branch of economics that aims to assess economic policies in terms of their impact on community well-being. During the twentieth century, it established itself as a distinct branch of economic theory. Earlier writers thought of welfare as simply the sum of all individual satisfactions within a given economic system. Later theorists questioned whether it was possible to measure even one person's satisfaction and maintained that it was difficult to compare the states of the well-being of two or more people with precision. Simply put, the long-held notion that a poor man would get more additional satisfaction from a given rise in money than a rich man could no longer be maintained. This meant that policies shifting resources from rich to poor (such as progressive income taxes) could not be considered to raise the aggregate of individual satisfaction on a social policy level. Then a new, more limited criterion for judging economic policy was developed: one economic state was regarded superior to another only if at least one individual was made better off while no one else was made worse off. Alternatively, even if some consumers were harmed, one economic state could be regarded as superior to another if the gainers could compensate the losers and still be better off than before. However, there would be no means of deciding between multiple options that all met this requirement.

3.1 Objectives

After reading this unit, you will be able to know:

- Welfare economics and its meaning
- Pareto optimality, meaning and its marginal condition in consumption, production and production mix
- The critical evaluation of the Pareto optimality condition
- Meaning of compensation test by Kaldor, Hicks and Scitovsky.

- Little Criterion on welfare economics
- The social welfare function of Bergson

3.2 Pareto Optimality: Its conditions - Consumption, production and exchange, critical evaluation of Pareto Optimality

Pareto efficiency, or Pareto optimality, is an economic state where resources cannot be reallocated to make one individual better off without making at least one individual worse off. Pareto efficiency implies that resources are allocated in the most economically efficient manner, but does not imply equality or fairness. An economy is said to be in a Pareto optimum state when no economic changes can make one individual better off without making at least one other individual worse off.

Pareto efficiency, named after the Italian economist and political scientist Vilfredo Pareto (1848-1923), is a major pillar of welfare economics. Neoclassical economics, alongside the theoretical construct of perfect competition, is used as a benchmark to judge the efficiency of real markets—though neither perfectly efficient nor perfectly competitive markets occur outside of economic theory.

Hypothetically, if there were perfect competition and resources were used to maximum efficient capacity, then everyone would be at their highest standard of living or Pareto efficiency. Economists Kenneth Arrow and Gerard Debreu demonstrated, theoretically, that under the assumption of perfect competition and where all goods and services are tradeable in competitive markets with zero transaction costs, an economy will tend toward Pareto efficiency.

In any situation other than Pareto efficiency, some changes to the allocation of resources in an economy can be made, such that at least one individual gains and no individuals lose from the change. Only changes in the allocation of resources that meet this condition are considered moves toward Pareto efficiency. Such a change is called a Pareto improvement.

A Pareto improvement occurs when a change in allocation harms no one and helps at least one person, given an initial allocation of goods for a set of persons. The theory suggests that Pareto improvements will keep enhancing the value of an economy until it achieves a Pareto equilibrium, where no more Pareto improvements can be made. Conversely, when an economy is at Pareto efficiency, any change to the allocation of resources will make at least one individual worse off. The concept of Pareto optimum or economic efficiency stated above is based on a welfare criterion put forward by V. Pareto. Pareto criterion states that if any reorganization of economic resources does not harm anybody and makes someone better off, it indicates an increase in social welfare. If any reorganisation or change makes everybody in a society better off, it will, according to Pareto, undoubtedly mean an increase in social welfare.

Thus, in the words of Prof. Baumol, “any change which harms no one and which makes some people

better off must be considered to be an improvement." Pareto criterion can be explained with the help of the Edgeworth Box diagram which is based on the assumptions of ordinal utility and non-interpersonal comparison of utilities.

Suppose two persons A and B form the society and consume two goods X and Y. The various levels of their satisfaction by consuming various combinations of the two goods have been represented by their respective indifference curves.

In Figure 4.2.1 Oa and Ob are the origins for the utilities of two persons A and B respectively. Ia1, Ia2, Ia3, Ia4 and Ib1, Ib2, Ib3, and Ib4 are their successively higher indifference curve. Suppose the initial distribution of goods X and Y between the members of the society, A and B, is represented by point- K in the Edgeworth Box.

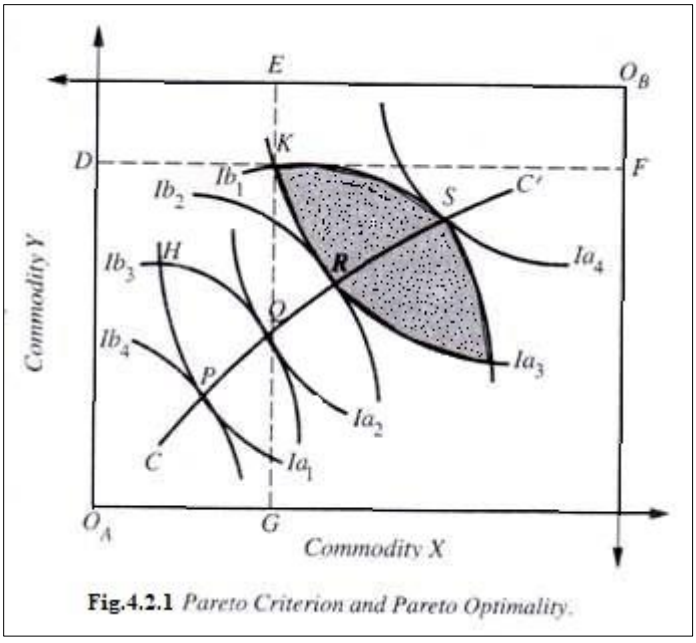

Fig.4.2.1 *Pareto Criterion and Pareto Optimality.*

Accordingly, individual A consumes OAG of X + GK of Y and is at the level of satisfaction represented by indifference curve Ia3. Similarly, individual B consumes KF of X+ KE of Y and gets the satisfaction represented by indifference curve Ib1.

Thus, the total given volume of goods X and Y is distributed between A and B. In this distribution, individual A consumes a relatively large quantity of good Y and individual B of good X. Now, it can be shown with the aid of Pareto's welfare criterion that a movement from the point K to a point such as S or R or any other point in the shaded region will increase social welfare. Any movement from K to S through redistribution of two goods between two individuals increases the level of satisfaction of A without any change in the satisfaction of B because as a result of this A moves to his higher indifference curve Ia4, and B remains on his same indifference curve Ib1 (K and 5 lies on B's same indifference curve Ib1).

In other words, as a result of the movement from K to S, individual A has become better off whereas individual B is no worse off. Thus, according to the Pareto criterion, social welfare has increased following the movement from K to S and therefore K is not the position of economic optimum.

Similarly, the movement from K to R is also desirable from the point of view of social welfare because in this individual B becomes better off without any change-in-the satisfaction of individual A. Therefore, both the positions S and R are better than K. The tangency points of the various indifference

curves of the two individuals of the society are the Pareto optimum points and the locus of these points is called the 'contract curve'.

Pareto criterion can also be explained with the help of Samuelson's utility possibility curve. The utility possibility curve is the locus of the various combinations of utilities obtained by two persons from the consumption of a particular bundle of goods.

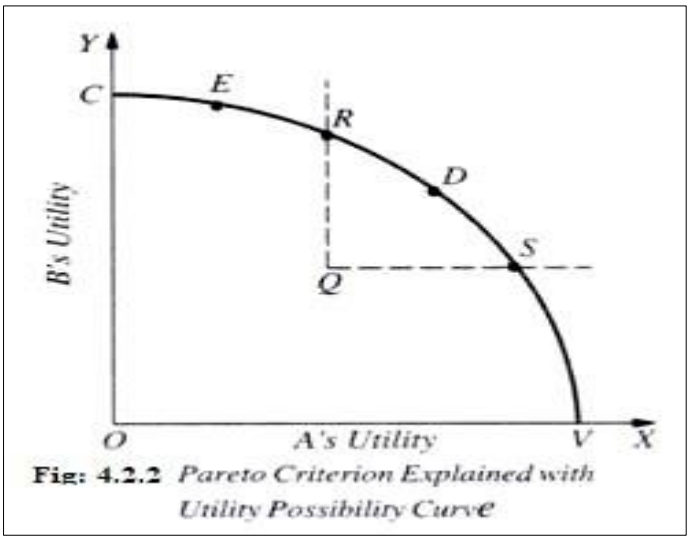

Fig: 4.2.2 *Pareto Criterion Explained with Utility Possibility Curve*

In Figure 4.2.2, CV is a utility possibility curve which shows the various levels of utilities obtained by two individuals A and B of the society resulting from the redistribution of a fixed bundle of goods and its consumption by them.

According to the Pareto criterion, a movement from Q to R, or Q to D, or Q to S represents an increase in social welfare because in such movements the utility of either A or B or both increases. A movement from Q to R implies that the utility or welfare of B increases, while that of A remains the same.

On the other hand, a movement from Q to S implies that while A has become better off, B is no worse off. And a movement from Q to D or any other point on the segment between R and S will mean an increase in welfare or utility of both the individuals. Thus points R, D and S are preferable to Q from the point of view of social welfare.

But unfortunately, the Pareto criterion does not help us in evaluating the changes in welfare if the movement as a result of redistribution is from the point Q to a point outside the segment RS; such as point E on the utility possibility curve CV. As a result of the movement from point Q to E, the utility of A decreases while that of B increases. In such circumstances, the Pareto criterion cannot tell us whether social welfare increases or decreases.

3.2.1 Marginal Conditions of Pareto Optimality:

Pareto concluded from his criterion that competition leads the society to an optimum position but he had not given any mathematical proof of it, nor did he derive the marginal conditions to be fulfilled for the achievement of the optimum position. Later on, Lerner and Hicks derived the marginal conditions which must be fulfilled for the attainment of the Pareto optimum.

These marginal conditions are based on the following important assumptions:

1. Each individual has his ordinal utility function and possesses a definite amount of each product and

factor.

2. Production function of every firm and the state of technology is given and remains constant.

3. Goods are perfectly divisible.

4. A producer tries to produce a given output with the least-cost combination of factors.

5. Every individual wants to maximise his satisfaction.

6. Every individual purchase some quantity of all goods.

7. All factors of production are perfectly mobile.

Given the above assumptions various marginal conditions (first-order conditions) required for the achievement of Pareto optimum or maximum social welfare are explained below:

1. The Optimum Distribution of Products among the Consumers: Efficiency in Exchange:

The first condition relates to the optimum distribution of the goods among the different consumers composing a society at a particular point of time. The condition says: "The marginal rate of substitution between any two goods must be the same for every individual who consumes them both."The marginal rate of substitution of one good for another so as is the amount of one good necessary to compensate for the loss of a marginal unit of another to maintain a constant level of satisfaction. So long as the marginal rate of substitution (MRS) between two goods is not equal for any two consumers, they will enter into an exchange which would increase the satisfaction of both or one without decreasing the satisfaction of the other.

This condition can be better explained with the help of the Edgeworth Box diagram. **In Figure- 4.2.3**, goods X and Y, which are consumed by two individuals A and B composing a society are represented on the X and Taxes respectively. OA and OB are origins for A and B respectively. Further, la1, Ia2, Ia3 and Ib1, Ib2, lb3 are the indifference curves showing successively higher and higher satisfaction of consumers A and B respectively. CC is the contract curve passing through various tangency points Q, R, and S of the indifference curves of A and B. The marginal rates of substitution (MRS) between the two goods for individuals A and B are equal on the various points of the contract curve CC'. Any point outside the contract curve does not represent the equality of MRS between the two goods for two individuals A and B of the society.

Let us consider point K where indifference curves Ia1 and Ib1 of individuals A and B respectively intersect each other instead of being tangential. Therefore, at point K marginal rate of substitution between two goods X and Y (MRS_{XY}) of individual A is not equal to that of B. With the initial distribution of goods as represented by point K, it is possible to increase the satisfaction of one individual without any decrease in that of the other or to increase the satisfaction of both by

redistribution of the two goods X and Y between them. A movement from K to S increases the satisfaction of A without any decrease in B's satisfaction.

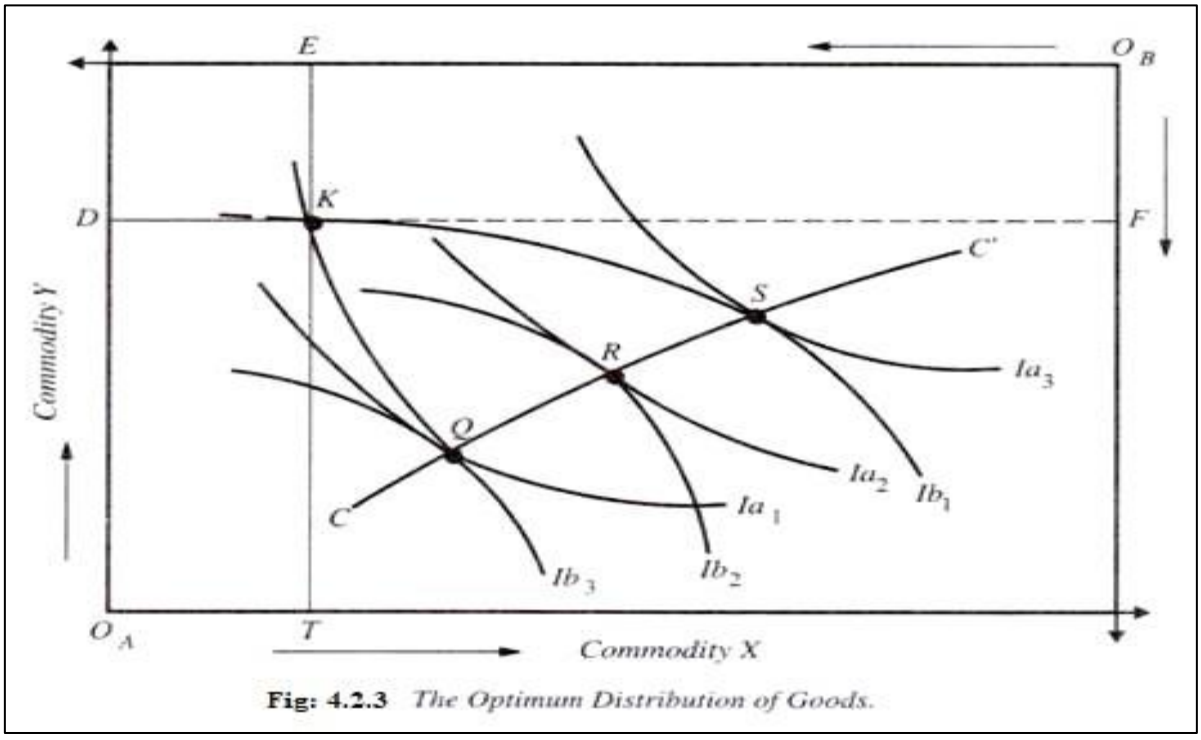

Fig: 4.2.3 *The Optimum Distribution of Goods.*

Similarly, a movement from K to Q increases B's satisfaction without any decrease in A's satisfaction. The movement from K to R increases the satisfaction of both because both move to their higher indifference curves. Thus, movements from K to Q or S or any other point on the segment SQ of the contract curve will, according to the Pareto criterion, increase the level of social welfare.

From the above, it follows that movement from any point away from the contract curve to a point on the relevant segment of the contract curve will mean an increase in social welfare. At any point away from the contract curve in the Edgeworth box, the indifference curves of the two individuals will intersect which will mean that the MRSxy of two individuals is not the same. And, as explained above, this indicates that through an exchange of some units of goods between them, they can move to some point on the contract curve where the social welfare (that is, the welfare of two individuals taken together) will be higher.

Since the slope of an indifference curve represents the marginal rate of substitution (MRS_{XY}) at any point of the contract curve, which represents tangency points of the indifference curves, the MRS_{XY} of the two individuals is equal. Therefore, points on the contact curve represent the maximum social welfare. However, a movement along the contract curve in either direction will make one individual better off and the other worse off since it will put one individual on his successively higher indifference curves and the other on his successively lower indifference curves. Thus, every point on the contract

curve denotes maximum social welfare in the Paretian sense but we cannot say anything about the best of them with the help of the Pareto criterion.

2. The Optimum Allocation of Factors: Pareto Efficiency in Production:

The second condition for Pareto optimum requires that the available factors of production should be utilised in the production of products in such a manner that it is impossible to increase the output of an open firm without a decrease in the output of another or to increase the output of both the goods by any reallocation of factors of production. This situation would be achieved if the marginal technical rate of substitution between any pair of factors must be the same for any two firms producing two different products and using both the factors to produce the products.

This condition too can be explained with the help of the Edgeworth Box diagram relating to production. This is depicted in Fig. 4.2.4. Let us assume two firms A and B produce the same product by using two factors labour and capital. The available quantities of labour and capital are represented on the vertical and horizontal axis respectively. OA and OB are the origins of firms A and B respectively.

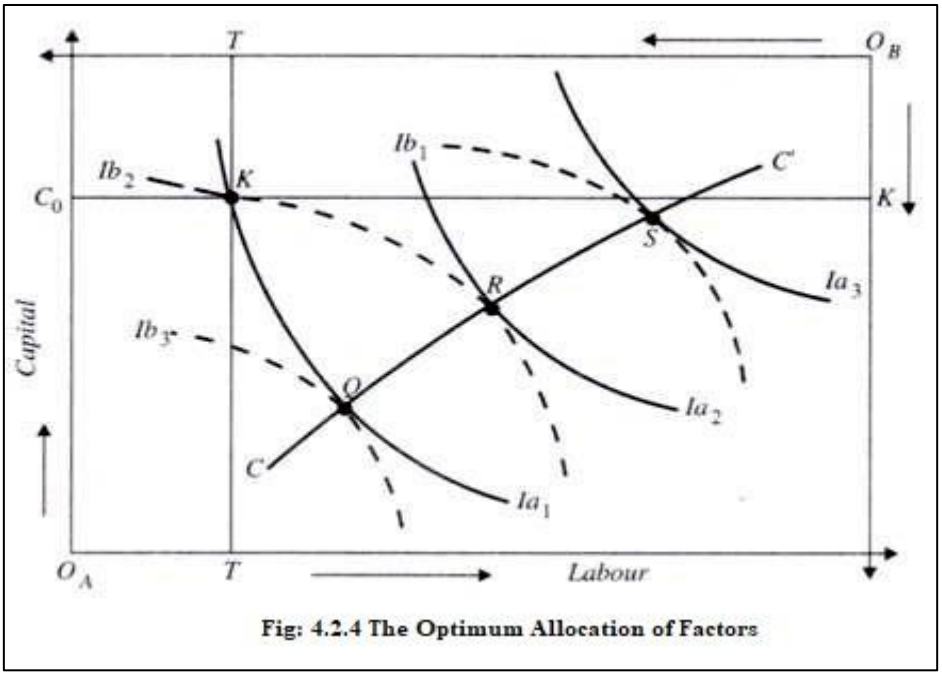

Fig: 4.2.4 The Optimum Allocation of Factors

Isoquants Ia1, Ia2, Ia3 and Ib1, Ib2, Ib3 of firms A and B respectively represent successively higher and higher quantities of output which they can produce by different combinations of labour and capital. The slope of the isoquants, which are convex to the origin, represents the marginal rate of technical substitution (MRTS) between two factors.

MRTS of one factor for another is the amount of one factor necessary to compensate for the loss of the marginal unit of another so that the level of output remains the same. So long as the MRTS between two factors for two firms is not equal, the total output of a product can be increased by the transfer of factors from one firm to another.

In terms of the above diagram, any movement from K to S or Q raises the output of one firm without

any decrease in the output of the other. The total output of the two firms increases when through the redistribution of factors between the two firms, a movement is made from the point K to the point Q or S on the contract curve. A glance at Figure 4.2.4 will reveal that movement from point K outside the contract curve to point R on the contract curve will raise the output of both the firms individually as well as collectively. Therefore, it follows that corresponding to a point outside the contract curve there will be some points on the contract curve production which will ensure greater total output of the two firms.

As the contract curve is the locus of the tangency points of the isoquants of two firms, the marginal rate of substitution of the two firms is the same at every point of the contract curve CC. It is, therefore, follows that on the contract curve at every point of which MRTS between the two factors of two firms is the sum, the allocation of factors between the two firms is optimum. When the allocation of factors between the two firms is such that they are producing at a point on the contract curve, then no reallocation of factors will increase the total output of the two firms taken together. But it is worth mentioning that there are several points on the contract curve and each of them represents the optimum allocation of labour and capital between the two firms. But which one of them is best cannot be said based on the Pareto criterion because movement along the contract curve in either direction represents such factor reallocation which increases the output of one and reduces the output of another firm.

3. Optimum Direction of Production: Efficiency in Product Mix:

This condition relates to the pattern of production. The fulfilment of this condition determines the optimum quantities of different commodities to be produced with the given factor endowments. This condition states that "the marginal rate of substitution between any pair of products for any person consuming both must be the same as the marginal rate of transformation (for the community) between them." According to this condition, to attain maximum social welfare, goods should be produced following consumers' preferences. Let us explain this with the help of Fig. 4.2.5. Commodities X and Y have been represented on the X and Y axes respectively. AB is a community's transformation curve between any pair of goods X and Y. This curve represents the maximum amount of X that can be produced for any quantity of Y, given the amounts of other goods that are produced and fixed supplies of available resources.

IC1 and IC2 are the indifference curves of a consumer the slope of which at a point represents the marginal rate of substitution between the two goods of the consumer. The MRT' of the community and MRS of the consumer are equal to each other at point R at which the community's transformation curve is tangent to the indifference curve IC2 of a representative consumer, Point R represents an optimum composition of production in which commodities X and Y are being produced and consumed in OM and ON quantities. This is because of all the points on the community's transformation curve, point R lies at the highest possible indifference curve IC2 of the consumer. For instance, if a combination of goods X and Y represented by S is being produced and consumed, the consumer would be at a lower level of welfare because S lies on his lower indifference curve IC1 which intersects the community's transformation curve instead of being tangential to it.

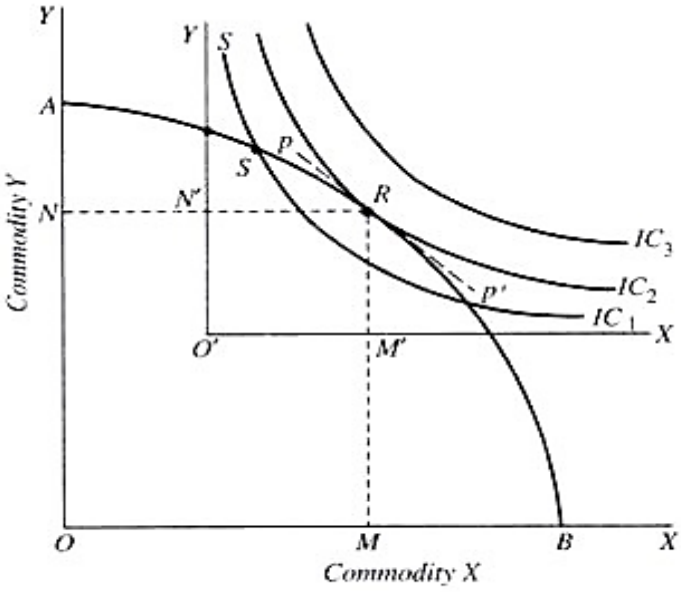

Fig:4.2.5 *Optimum Direction of Production :Optimum Product Mix.*

As a result, at point S, the MRSXY of the consumer is not equal to the MRTXY of the community. With the situation at S, there is a possibility of moving the consumers to a higher indifference curve by changing the direction (i.e. composition) of production i.e. by increasing the production of X and reducing the production of Y. Thus, the optimum direction of production is established at point R where community's transformation curve is tangent to the indifference curve of a consumer in the society.

The Second-Order and Total Conditions of Pareto Optimality:

The marginal or the first-order conditions explained above are 'necessary' but not sufficient for the attainment of maximum social welfare because the marginal conditions by themselves do not guarantee maximum welfare.

The marginal conditions can be fulfilled even at the level of minimum welfare. To attain the maximum social welfare position second-order conditions together with the marginal conditions must be satisfied. The second-order conditions require that all indifference curves must be convex to the origin and all transformation curves concave to it in the neighbourhood of any portion where marginal conditions are

satisfied. But even the satisfaction of both (first and second-order conditions) does not ensure the largest maximum welfare because even when marginal conditions (first and second-order) are fulfilled, it may still be possible to move to a position where social welfare is greater. To attain the maximum social welfare, another set of conditions which are called by J.R. Hicks the 'total conditions' must also be satisfied.

The total conditions state, "That if welfare is to be a maximum, it must be impossible to increase welfare by producing a product not otherwise produced or by using a factor not otherwise used." If it is possible to increase welfare by such activities the optimum position is not determined by marginal conditions alone. Therefore, welfare will be maximum if the marginal, as well as total conditions, are satisfied.

With a change in the distribution of income, Pareto optimality will be achieved with different output-mix of various products and different allocation of various factors among products. Thus, a new optimum will emerge due to the redistribution of income and there are no criteria to judge whether the new optimum is better or worse than the previous social optimum. This can be known only with the help of some value judgements regarding income distribution which has been ruled out by the Pareto criterion.

3.2.2 A Critical Evaluation of Pareto Criterion and Pareto Optimality:

Pareto criterion and the concept of Pareto optimality and maximum social welfare based on it occupy a significant place in welfare economics. To judge the efficiency of an economic system, the notion of Pareto optimality has been used.

It has also been used to bring out the gains of trading or exchange of goods between individuals. But even the Pareto criterion which rules out comparing those changes in policies which make some worse off has been a subject of controversy and has been criticised on several grounds.

First, it has been alleged that the Pareto criterion is not completely free from value judgements. The supporters of the Pareto criterion claim that it provides us with an 'objective' criterion of efficiency. However, this has been contested.

Against the Pareto criterion, it has been said that to say that a policy change which makes some better off without others being worse off increases social welfare is itself a value judgement. This is because we recommend such changes which pass the Pareto criterion.

The implication of this assertion will become obvious when the persons who gain as a result of policy change are the rich and those who remain where they were before are poor. Therefore, to say based on the Pareto criterion that whenever any policy change which, without harming anyone, benefits some people regardless of whoever they may be, increases social welfare is a value judgement which may not

be accepted by all.

Second, an important limitation of the Pareto criterion is that it cannot be applied to judge the social desirability of those policy proposals which benefit some and harm others. Such policy changes are quite rare and do no harm to at least some individuals in society.

Thus, the Pareto criterion is of limited applicability as it cannot be used to pronounce judgements on a majority of policy proposals which involve a conflict of preferences of two individuals. Thus, according to Prasanta K. Patnaik, "Pareto criterion fails seriously when it comes to comparing alternatives. Whenever there is a conflict of preferences of two individuals for two alternatives, the criterion fails to rank those two alternatives no matter what the preferences of the rest of individuals in the society might be".

To evaluate the social desirability of those policy changes which benefit some and harm others, we need to make an interpersonal comparison of utility which the Pareto criterion refuses to do. Thus, the "Pareto criterion works by sidestepping the crucial issue of inter-personal comparison and income distribution, that is, by dealing only with cases where no one is harmed so that the problem does not arise".

Another shortcoming of the Pareto criterion and notion of maximum social welfare based on it is that it leaves a considerable amount of indeterminacy in the welfare analysis since every point on the contract curve is Pareto-optimal. For instance, in Fig. 4.2.1, every point such as P, Q, R, and S on the contract curve is Pareto-superior to any point such as K and H which lies outside the contract curve. Movement from one point on the contract curve to another as a result of a change in economic policy, that is, through reallocation of resources that makes one individual better off and the other worse off, that is, one gain at the expense of the other.

This means that based on the Pareto criterion, social alternatives lying on the contract curve cannot be compared since with any movement on the contract curve one individual gain and the other loses, that is, it involves the redistribution of income or welfare. Therefore, to compare various alternatives lying on the contract curve and to choose between them, inter-personal comparison and value judgements regarding the proper distribution of income need to be made. However, Pareto refused to make value judgements and sought to put forward a value-free or objective criterion of welfare.

It, therefore, follows that based on the Pareto criterion where the change from an alternative lying outside the contract curve to an alternative on the contract curve is judged to increase social welfare but this cannot be said of the change from one position on the contract curve to another on it. But as there are infinite numbers of points on the contract curve all of which are Pareto optimal, no choice can be made out of them based on the Pareto criterion.

To remove this indeterminacy and to choose among the alternatives lying on the contract curve one needs to make some additional value judgements beyond what is implied in the Pareto criterion. Henderson and Quandt hold a similar view when they assert, "The analysis of welfare in terms of Pareto optimality leaves a considerable amount of indeterminacy in the solution there is an infinite number of points which are Pareto optimal." They further remark that the indeterminacy is the consequence of consider-ing an increase in welfare to be unambiguously defined only if an improvement in one individual's position is not accompanied by a deterioration of the position of another. The indeterminacy can only be removed by further value judgements."

Above all, a chief drawback of Pareto-optimality analysis is that it accepts the prevailing income distribution and no attempt is made to find an optimal distribution of income since it is thought that there does not exist any objective, value-free and scientific way of finding optimal distribution of income. Thus, Pareto optimality analysis remains either silent or biased in favour of the status quo on the issue of the income distribution. Further, Pareto optimality analysis may lead to recommending the prevailing income distribution where a majority of the population lives on the subsistence level or below the poverty line while a few live a life of affluence. Thus, "Ultimately, the Paretian approach can be considered the welfare economists' instrument par excellence for the circumvention of the issue of the income distribution."

It may also be mentioned that for any initial distribution of income (that is, for any given distribution of goods) between the individuals, there will be several Pareto optimal positions. Consider Figure 4.2.1. Corresponding to point, K, the points on the segment RS on the contract curve CC' will all represent Pareto optimal positions. Likewise, corresponding to a given distribution of income (i.e. distribution of goods) as represented by point H, the points on the segment PQ of the contract curve CC' will be Pareto-optimal. Thus corresponding to a different distribution of income, there will be different Pareto optima. In the Paretian analysis, there is no way of evaluating whether one pattern of income distribution is better than the other.

3.2.4 Compensation tests: Kaldor, Hicks and Scitovsky and Little's criterion

In welfare economics, compensation criteria or the compensation principle is known as a rule of decision for selecting between two alternative states. Two states will be compared; if one state provides an improvement for one part but causes deterioration in the state of the other, it will be chosen if the winner could compensate the loser's losses until the situation is at least as good as in the initial situation. However, this compensation may not necessarily occur. This neo-Paretian concept was developed to solve the dead-end in which the Pareto criterion was at the moment due to its limitations. Although, in essence, the compensation principle reduces to the Pareto criterion, it values positively a

wider set that allows a positive ordering without transgressing the Pareto optimal.

Pareto laid the foundation of modern welfare economics by formulating the concept of social optimum which is based on the concept of ordinal utility and is free from interpersonal com-parisons of utilities and value judgements. He aimed at formulating a value-free objective criterion designed to test whether a proposed policy change increases social welfare or not. Pareto's criterion states simply that an economic change which harms no one and makes someone better off indicates an increase in social welfare. Thus, this criterion does not apply to those economic changes which harm some and benefit others.

In terms of the Edgeworth box diagram, the Pareto criterion fails to say whether or not social welfare increases as movement is made in either direction along the contract curve because it rejects the notion of interpersonal comparison of utility.

There is thus no unique optimum position. This criterion does not tell us about changes in the level of social welfare if one moves on the contract curve from one tangency point to another because such movement harms one and benefits the other. Thus, the analysis of welfare in terms of Pareto optimality leaves a considerable amount of indeterminacy, for there are numerous Pareto optimum points on the contract curve.

3.4.1 Kaldor-Hicks Welfare Criterion: Compensation Principle:

Economists like Kaldor, Hicks and Scitovsky have made efforts to evaluate the changes in social welfare resulting from any economic reorganisation which harms somebody and benefits the others. These economists have sought to remove indeterminacy in the analysis of Pareto optimality. They have put forward a criterion known as the ‘compensation principle’ based on which they claim to evaluate those changes in economic policy or organisation which make some individuals better off and others worse off. The ‘compensation principle’ is based on the following assumptions.

Assumptions:

1. The satisfaction of an individual is independent of the others and he is the best judge of his welfare.
2. There exist no externalities of consumption and production.
3. The tastes of the individuals remain constant.
4. The problems of production and exchange can be separated from the problems of distribution. The compensation principle accepts the level of social welfare to be a function of the level of production. Thus, it ignores the effects of a change in distribution on social welfare.
5. Utility can be measured ordinally and interpersonal comparisons of utilities are not pos-sible.

Given the above assumptions, a criterion of compensation principle can be discussed. Kaldor, Hicks and Scitovsky have claimed to formulate a value-free objective criterion for measuring the changes in

social welfare with the help of the concept of 'compensating payments.

Nicholas Kaldor was the first economist to give a welfare criterion based on compensating payments. Kaldor's criterion helps us to measure the welfare implications of a movement in either direction on the contract curve in terms of the Edgeworth box diagram.

According to Kaldor's welfare criterion, if a certain change in economic organisation or policy makes some people better off and others worse off, then a change will increase social welfare if those who gain from the change could compensate the losers and still be better off than before. In the words of Prof. Baumol, "Kaldor's criterion states that a change is an improvement if those who gain evaluate their gains at a higher figure than the value which the losers set upon their losses."

Thus, if any policy change benefits any one section of the society (gainers) to such an extent that it is better off even after the payment of compensation to the other sections of the society (losers) out of the benefits received, then that change leads to increasing in social welfare. In Kaldor's own words, "In all cases…. where a certain policy leads to an increase in physical productivity and thus of aggregate real income… it is pos-sible to make everybody better off without making anybody worse off. It is quite sufficient…. to show that even if all those who suffer as a result are fully compensated for their loss, the rest of the community will still be better off than before."

Prof. J.R. Hicks supported Kaldor for employing the compensation principle to evaluate the change in social welfare resulting from any economic reorganisation that benefits some people and harms others. This criterion states, "If A is made so much better by the change that he could compensate B for his loss and still have something left over, and then the reorganisation is an unequivocal improvement." In other words, a change is an improvement if the losers in the changed situation cannot profitably bribe the gainers not to change from the original situation. Hicks has given his criterion from the losers' point of view, while Kaldor had formulated his criterion from the gainers' point of view. Thus, the two criteria are the same though they are clothed in different words. That is why they are generally called by a single name 'Kaldor-Hicks criterion.

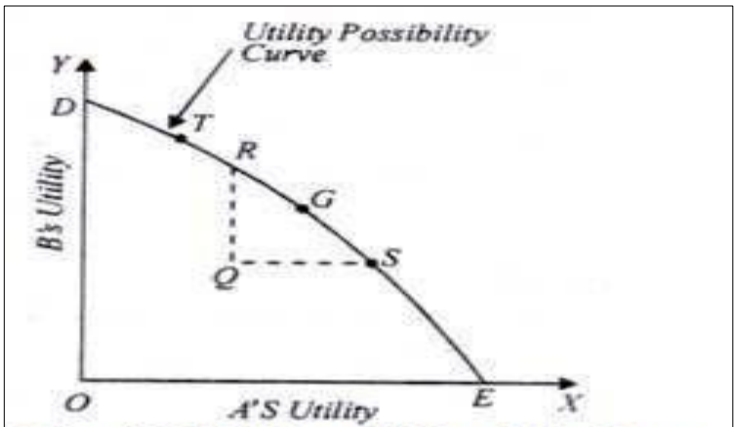

Fig: 4.3.1 Kaldor Hicks Criterion

Kaldor-Hicks criterion can be explained with the help of the utility possibility curve. In Fig. 4.3.1 ordinal utility of two individuals A and B is shown on X and Y axis respectively. DE is the utility possibility curve which represents the various

combinations of utilities obtained by individu-als A and B. As we move downward on the curve DE, the utility of A increases while that of B falls. On the other hand, if we move up on the utility curve ED, the utility of B increases while that of A falls. Suppose the utilities obtained by A and B from the distribution of income or output between them are represented by point Q inside the utility possibil-ity curve DE. Let us assume that as a result of some change in economic policy, the two individuals move from point Q to point T on the utility possibility curve DE.

As a result of this movement, the utility of individual B has increased while the utility of A has declined, that is, B has become better off and A has become worse off than before. There-fore, this movement from point Q to point T cannot be evaluated through the Pareto criterion. Of course, points such as R, G, S or any other point on the segment RS of the utility-possibility curve DE are socially preferable to point Q based on the Pareto criterion.

However, the compensation principle propounded by Kaldor-Hicks enables us to say whether or not social wel-fare has increased as a result of movement from Q to T. According to the Kaldor-Hicks criterion, we have to see whether the individual A who gains with the movement from position Q to position T could compensate the individual A who is a loser and still be better off than before. Now, it will be seen from Figure 4.3.1 that the utility possibility curve DE passes through points R, G and S. This means that by mere redistribution of income between the two individuals, that is, if individual B gives some compensation to individual A for the loss suffered, they can move from position T to the position R.

It is evident from the figure that at position R individual A is as well off as at the position Q but individual B is still better off as compared to the position Q. It means due to a policy change and consequent movement from position Q to position T, the gainer (individual B) could compen-sate the loser (individual A) and is still better off than at Q. Therefore, according to Kaldor-Hicks criterion, social welfare increases with the movement from position Q to position T, because from T they could move to the position R through mere redistribution of income (i.e. compensation).

It is noteworthy that, according to Kaldor-Hicks criterion, compensation may not be actually paid to judge whether or not social welfare has increased. It is enough to know whether the gainer could compensate the loser for the loss of welfare and still be better off. Whether redistribution of income (that is, payment of compensation) should be made following the policy change is left for the Government to decide. If the gainer can compensate the loser and still be better off, the economists can say that social welfare has increased.

It may be noted that the gainer can compensate the losers and still be better off only when the change in economic policy leads to an increase in output or real income. That is why Kaldor and Hicks claim that

they have been able to distinguish between changes in output from a changes in distribution. When their criterion is satisfied by a change in the situation, it means that the economy has moved to a potentially more efficient position and as a result, social welfare can be said to have increased. Now, whether redistribution of income is made through payment of compensation by the gainers to the losers, according to them, is a different matter.

Now, the implications of the Kaldor-Hicks criterion become clearer if through redistribution the position of the two individuals changes from T to G (see Fig. 4.3.1). It is quite manifest that at position G both the individual's A and B are better off than at the position Q. Thus, the position T to which the two individuals moved as a result of a certain change in economic policy is superior to the initial position Q from the viewpoint of social welfare since from position T movement can be made merely through redistribution of income to position G where both are better off as compared to the position Q.

It may be noted that in the situation depicted in Figure 4.3.1, the change in economic policy brings about a movement from a position inside the utility possibility curve to a point on it. Now let us see what happens to social welfare if as a result of the adoption of a certain economic policy the utility possibility curve moves outward and the two individuals move from a point on a lower utility possibility curve to a point on a higher utility possibility curve.

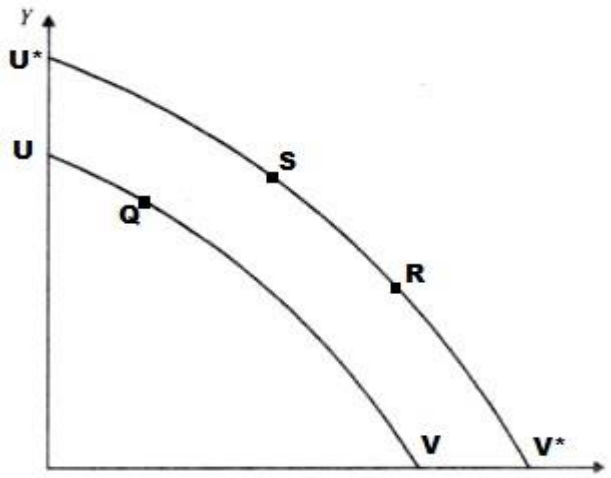

Fig: 4.3.2 Kaldor-Hicks Welfare Criterion

It can be shown that, according to the Kaldor-Hicks criterion, such a movement causes an improvement in social welfare. Consider Figure 4.3.2. UV is the original utility possibility curve and Q represents the position at which the two individuals are initially placed. Now, suppose the utility possibility curve shifts outward to the new position, U*V*, and the two individuals are placed at point R on it.

In the movement from Q on the utility possibility curve UV to point R on the utility possibility curve U*V* the utility of A has increased and that of B has declined. But position R denotes greater social welfare on the basis-of Kaldor's criterion when compared to the position Q on the original utility possibility curve UV because with UV as the utility possibility curve it is possible to move through mere redistribution of income from position R to position S where the individual B has been fully compensated for his loss of utility, the individual A is still better off as compared to position Q. To conclude, any change in the economy that moves the individuals from a position on a lower utility

possibility curve to a position on a higher utility possibility curve increases social welfare.

3.4.2 Scitovsky Paradox

Scitovsky pointed out an important limitation of the Kaldor-Hicks criterion that it might lead to contradictory results. He showed that, if in some situations, position B is shown to be an improvement over position A on the Kaldor-Hicks criterion, it may be possible that position A is also shown to be an improvement over B based on the same criterion.

For getting consistent results when position B has been revealed to be preferred to position A based on a welfare criterion, then position A must not be preferred to position B on the same criterion. According to Scitovsky, Kaldor- Hicks criterion involves contradictory and inconsistent results. Since Scitovsky was the first to point out this paradoxical result in the Kaldor-Hicks criterion, it is known as the 'Scitovsky Paradox'.

How the Kaldor-Hicks criterion may lead to contradictory results in some situations is depicted in Figure 4.3.3. In this figure, JK and GH are the two utility possibility curves which intersect each other. Now suppose that the initial position is at point C on JK.

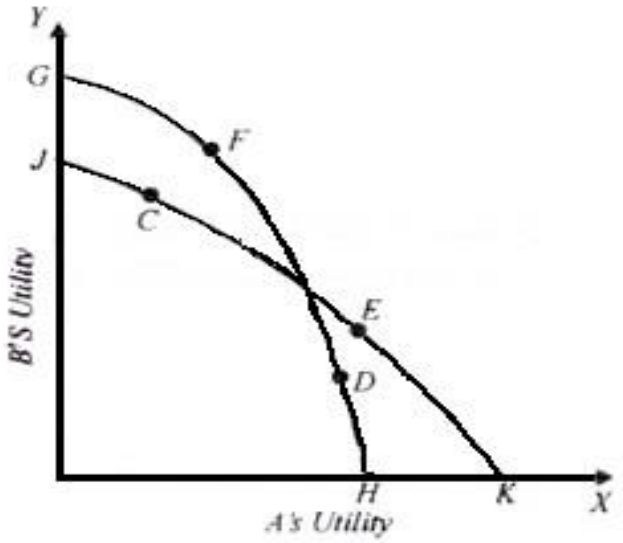

Fig: 4.3.3 Scitovsky Paradox

Further suppose that due to a certain policy change, the utility possibility curve changes and takes the position GH and the two individuals find themselves at position D. Position D is superior to position C based on Kaldor-Hicks criterion because from position D movement can be made through mere redistribution to position F at which individual B has been fully compensated but individual A is still better off as compared to the original position C. Thus movement from position C to position D satisfies Kaldor-Hicks crite-rion.

But, as has been pointed out by Scitovsky, reverse movement from position D on the new utility possibil-ity curve GH to the position C on the old utility possibility curve JK also represents an improvement on Kaldor- Hicks criterion, that is, C is socially better than D based on Kaldor- Hicks criterion.

This is because from position C movement can be made by mere redistribution of income to posi-tion E on the utility possibility curve JK on which position C lies and which also passes through the position E. And, as will be observed from Fig. 4.3.3, that at position E while A is as well off as at position D, the individual B is still better off than at D.

We thus see that the movement from position C to position D due to a policy change is passed by the Kaldor-Hicks criterion and also the movement back from position D to position C is also passed by the Kaldor-Hicks criterion. This implies that D is socially better than C on this criterion and C is also socially better than D on the same criterion. So Kaldor-Hicks criterion leads us to contradictory and inconsistent results.

It is mentioned that these contradictory results are obtained by Kaldor-Hicks criterion when follow-ing a policy change new utility possibility curve intersects the former utility possibility curve. After bringing out the possibility of contradictory results in Kaldor-Hicks criterion Scitovsky formulated his own criterion which is generally known as Scitovsky's Double Criterion.

3.4.3 Scitovsky's Double Criterion of Welfare:

To rule out the possibility of contradictory results in Kaldor-Hicks criterion Scitovsky formulated a double criterion which requires the fulfilment of Kaldor-Hicks criterion and also the fulfilment of the reversal test. It means that a change is an improvement if the gainers in the changed situation can persuade the losers to accept the change and simultaneously losers are not able to persuade the gainers to remain in the original situation.

Scitovsky's double criterion can also be explained with the help of the utility possibility curve. In Figure 4.3.4, CD and EF are the two utility possibility curves which do not intersect each other at any point. Suppose there is a change from position Q on the utility possibility curve CD to position G on the utility possibility curve EF as a result of the adoption of a new economic policy.

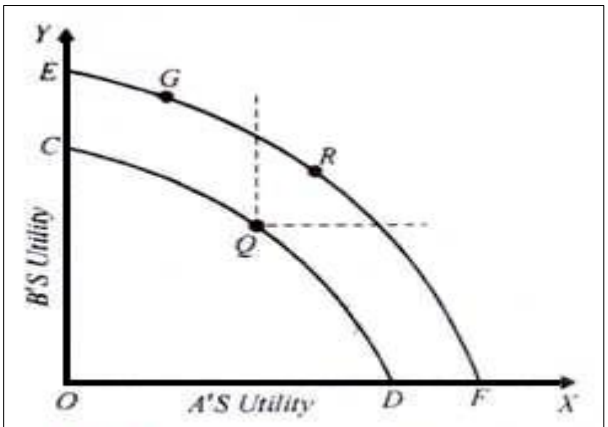

Fig:4.3.4 *Scitovsky's Double Criterion*

Such a movement is an improvement on the Kaldor-Hicks criterion because G lies on the utility possibility curve EF passing through point R. From position G, movement can be made to position R simply by redistributing income between the two individuals. R is better than Q because the utility of both the individuals is greater at R as compared to the position Q. Thus, the Kaldor-Hicks criterion is sat-isfied and therefore change from Q to G will increase social welfare.

Now, let us see, what happens to the reversal test. It must also be satisfied if the Scitovsky double test is to be fulfilled. That is, a movement from the position G back to the original position Q must not be passed by Kaldor-Hicks criterion if Scitovsky's reversal test is to be satisfied. It is evident from Figure

4.3.4 that from position R we cannot move to any position on the utility possibility curve CD merely through redistribution of income which is socially better than G (that is, which raises utility of either A or B, the utility of the other remaining constant or which raises the utility of both).

We, thus, see that while moving from position Q to G is passed by Kaldor-Hicks criterion, reverse movement from position G to position Q is not passed by Kaldor-Hicks criterion. Hence, in Figure 4.3.4 the movement from the position Q to G satisfies Scitovsky's criterion. Thus, when the two utility possibility curves are non-intersecting and change involves movement from a position on a lower utility possibility curve to a position on a higher utility possibility curve, the change raises social welfare based on Kaldor-Hicks-Scitovsky criterion. This happens only when a change brings about an increase in aggregate output or real income.

3.4.4 Little's Criterion

Dr. Little has developed a reaction against the compensation criteria proposed by Kaldor, Hicks and Scitovsky. In form, it is also a compensation criterion, but in spirit, it differs markedly from the earlier Kaldor-type criteria. Dr. Little asserts that neither the Kaldor-Hicks test nor the Scitovsky double test, either alone or together, can be taken as a criterion of welfare.

Since little believe that value judgements are essential in welfare economics, he bases his criterion on two value premises.

1. The well-being of an individual is supposed to be greater in a chosen position than it is in any other position.

2. Any social alternation that makes everybody better off is a good thing.

Based on these value judgements, the criterion can be stated in this way: An economic change constitutes social improvement (a) if the resulting redistribution is no worse than the old and (b) if it is impossible to make the community as well-off in the initial position as it would be after the change.

3.5 Bergson's Social welfare function

The concept of 'Social Welfare Function' was propounded by A. Bergson in his article 'A Re-formulation of Certain Aspects of Welfare Economics' in 1938. Prior to its various concepts of social welfare had been given by different welfare theorists but they failed to provide a satisfactory solution to the problem of maximisation of social welfare and measurement. Bentham talked of welfare in terms of 'the greatest happiness of the greatest number.'

Neo-Classical welfare theorists discussed the problem of social welfare based on cardinal measurability of utility and interper-sonal comparison of utility. Analysis of Pareto optimality maximises social welfare by satisfying various marginal conditions of production, distribution and allocation of resources among products. But unfortunately, they are not fulfilled due to the existence of various externalities

and imperfections in the market. Moreover, Pareto optimality analysis fails to measure the changes in welfare resulting from any change which benefits one section of society and harms the other. The compensation principle as given by Kaldor-Hicks-Scitovsky attempts to measure the changes in social welfare resulting from such economic changes which harm some and benefit others through hypothetical compensating payments**.**

Compensation theorists claimed to give a value-free objective criterion based on the ordinal concept of utility but, this is based upon implicit value judgements and does not evaluate changes in social welfare satisfactorily. By providing the concept of social welfare function Bergson and Samuelson have attempted to provide a new approach to welfare economics and have succeeded in rehabilitating welfare economics. They have put forward the concept of social welfare function that considers only the ordinal preferences of individuals. They agree with Robbins' view that interpersonal comparison of utility involves value judgements but they assert that without making some value judgements, economists cannot evaluate the impact of changes in economic policy on social welfare. Thus, according to them, welfare economics cannot be separated from value judgements. According to them, welfare economics is essentially a normative study. But the approach to studying it must be scientific even though the use of value judgements in it is unavoidable.

The following features of the Bergson-Samuelson Social Welfare function are worth noting:

1. The Bergson-Samuelson social welfare function is based on explicit value judgements and involves interpersonal comparisons of utility in ordinal terms.

2. Bergson-Samuelson social welfare function, the maximum social welfare position is completely determined as a result of the introduction of value judgements regarding the distribution of welfare among individuals.

3. The social welfare function is not based on any unique value judgements. Instead, any set of value judgements can be used by a welfare economist to construct a social welfare function. Thus, it is not any unique function but changes with the change in value judge-ments.

4. Once the social welfare function has been decided upon by value judgements, the maximisation technique is used to obtain the maximum social welfare position at which allocation of resources is Pareto optimum and also the distribution of goods and services is equitable. Thus, both efficiency and equity are achieved so that social welfare may be maximised.

5. Used along with the Pareto optimality analysis the concept of social welfare function enables us to find a unique optimum solution which combines economic efficiency with distributive justice.

The social welfare function is an ordinal index of society's welfare and is a function of the utility levies of all individuals constituting the society. Bergson-Samuelson social welfare function can be written in

the following manner:

W= W(U1, U2,U3……. , Un)

Where W If represents the social welfare U1, U2, U3, ..., Un represent the ordinal utility indices of different individuals of the society. The ordinal utility index of an individual depends upon the goods and services he consumes and the magnitude and kind of work he does. The important thing to note about the social welfare function is that in its construction explicit value judgements are introduced. Value judgements determine a form of the social welfare function; with a different set of value judgements, the form of social welfare function would be different. Value judgements are essentially ethical notions which are introduced from outside economics. The value judgements required to construct a social welfare function may be obtained through a democratic process with voting by individuals or it may have to be imposed on the society in a dictation manner.

Whatever the case may be, the form of social welfare function depends upon the value judgements of those who decide about them since it expresses their views regarding the effect that the utility level of each individual has on the social welfare. In the world of Prof. Scitovsky. “The social welfare function can be thought of as a function of each individual’s welfare which in turn depends both on his personal well-being and on his appraisal of the distribution of welfare among all members of the community”. Since the value judgements required for the formation of social welfare function are not of the economist himself and instead they are introduced from outside economics they are not obtained through any scientific method.

It has been claimed that the social welfare function has solved the basic problem of welfare economics since it thinks unnecessary for the economists themselves to make value judgements concerning what is a desirable distribution of welfare between individuals constituting the society. In other words, an economist need not himself decide about what is the most desirable distribution of welfare. He can make value judgements regarding distribution as given from outside economics. Bergson’s social welfare function is supposed to be dependent on changes in economic events that have a direct effect on individual welfare. The ordinal utility level of an individual is a function of his consumption of goods and services and not of others.

Moreover, the utility level of an individual depends on his value judgments regarding the composition of different goods and services consumed which depends upon his tastes. An individual may derive more utility from the consumption of liquor whereas another individual may derive very nominal utility or no utility at all from it. We can explain the social welfare function with the help of social indifference curves or welfare frontiers. Let us assume a society of two persons. In such a case social welfare function can be represented with the help of social indifference curves.

In Fig. 4.4.1 the utilities of individuals A and B have been represented on the horizontal and vertical axes respectively. W1, W2 and W3 are the social indifference curves representing successively higher levels of social welfare. A social indifference curve is a locus of various combinations of utilities of A and B which result in an equal level of social welfare. The properties of social indifference curves are just like that of individual consumer indifference curves. Given a family of social indifference curves, the effect of a proposed change in policy on social welfare can be evaluated. In terms of **Fig. 4.4.1** any policy change that moves the economy from Q to T is an improvement.

Similarly, a movement from Q to S or from R to S also represents an improvement in social welfare, and a movement from T to Q or T to S represents a decrease in social welfare. A movement along the same social indifference curve represents no change in the level of social welfare.

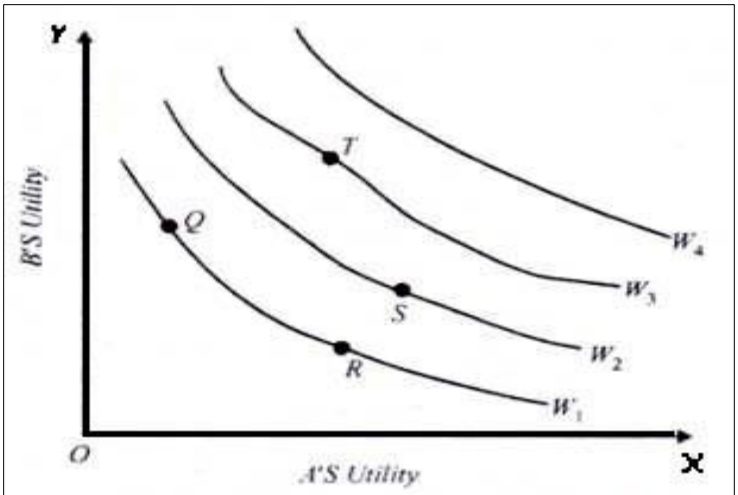

Fig:4.4.1 Social Indifference Curve depicting Social Welfare function

Analysis of Pareto optimality failed to provide a 'unique optimum solution' which represents maximum social welfare. There are a large number of solutions which are optimum based on the Pareto criterion. In terms of Edgeworth-box diagram every point on the contract curve represents the optimum position. In terms of the Grand Utility Possibility Frontier, all points on it are Pareto optimal or economically efficient. But Pareto criterion does not tell us the best of them. Thus, Paretian analysis leaves us with a lot of indeterminacy in the choice of maximum social welfare point. Now, the significance of the social welfare function is that it enables us to obtain a unique optimum position regarding social welfare. This unique optimum position is the best of all the Pareto optima and therefore ensures the maximum social welfare. By including the concept of grand utility possibility frontier along with Bergson-Samuleson social welfare function we can obtain a unique optimum position or maximum

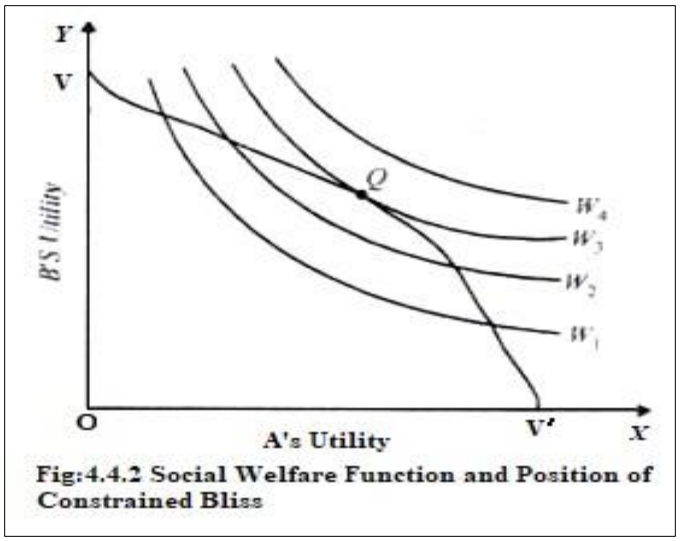

Fig:4.4.2 Social Welfare Function and Position of Constrained Bliss

social welfare position which is explained below.

As shall be explained below, a grand utility possibility frontier is a locus of the various physically attainable utility combinations of two persons when the factor endowments, state of technology and preference orders of the individuals are given. In other words, every point on the grand utility possibility curve represents the optimum position about the allocation of the products among the consumers, allocation of factors among different products and the direction of production. Thus every point on the grand utility possibility curve represents a Pareto optimum and as we move from one point to another on it the utility of one individual increases while that of the other falls.

Now, let us superimpose the grant utility possibility curve on the social indifference curves representing the social welfare function to find a unique optimum position of social welfare. In Fig. **4.4.2** social indifference curves W1, W2, W3 and W4 representing the social welfare function have been drawn along with the grand utility possibility curve VV'.

Social indifference curve W3 is tangent to the grand utility possibility curve VV' at point Q. Thus, point Q represents the maximum possible social welfare given the factor endowments, state of technology and preference scales of the individuals. Point Q is known as the point of constrained bliss since, given the constraints regarding factor endowments and the state of technology. Q is the highest possible state of social welfare the society can attain. Social welfare represented by the social indifference curve W4 is higher than social indifference curve W3 passing through Q but it is not pos-sible to attain it, given the technology and factor endowment. Thus, from among a large number of Pareto optimum points on the grand utility possibility curve, we have a unique optimum point Q at which the social welfare is the maximum. The point of constrained bliss represents the unique pattern of production of goods, the unique distribution of goods between the individuals and the unique combination of factors employed to produce the goods**.**

3.5.1 A Critical Evaluation of Bergson-Samuelson Social Welfare Function

The main aim of welfare economics has been to find an acceptable social welfare function which could measure the changes in social welfare resulting from a change in economic and non-economic variables. Bergson and Samuelson solved this problem by formulating a social welfare function which is based on explicit value judgements.

This function can incorporate the various economic and non-economic determinants of the welfare of individuals. In this function utility or welfare is conceived and measured in ordinal terms. Preferences or utilities of different individuals of the society and decisions about them are taken through a democratic method or by an authorised institution based on its value judgements. Even according to its bitter critic little, the concept of social welfare function is a brilliant theoretical construct which

completes the formal mathematical system of welfare economics.

Pareto optimality analysis does not help us in providing a unique solution to the problem of maximising social welfare. As seen above, with the help of the social welfare function we can measure the changes in social welfare even when one individual becomes better off and another worse off by making some distributional value judgements in the form of the social welfare function.

Bergson- Samuelson's social welfare function incorporating explicit value judgements is an improvement over earlier attempts such as the compensation principle advanced by Kaldor, Hicks and Scitovsky. However, economists have pointed out some important drawbacks to the concept of social welfare function.

3.6 Let's Sum Up

The unit begins with an explanation of the meaning and definition of welfare economics. Then, it discussed the definition and explanation of welfare economics by Vilfredo Pareto and also discuss the marginal condition of Pareto on consumption, production and production mix. Critical evaluation of welfare criteria by the Pareto is also discussed in detail. In welfare economics, the compensation principle plays an important role. In the process of economic reorganisation for the welfare purpose, it is obvious that some sections of the society may harm or deprived of the welfare measure. But at the same point of time, other sections may get benefitted from it. Therefore, that section of the society that got benefits may compensate those who were deprived of the change. The unit also discusses the various compensation principle of Kaldor, Hicks and Scitovsky. It further explains the compensation test that was adopted by Kaldor, Hicks and Scitovsky to measure welfare. It also discusses the welfare criteria of IMD Little. At last, the unit discusses the Bergson social welfare function.

3.7 Suggested Questions

Short Questions:

1. Define welfare economics.
2. Define the Paretian criterion of welfare.
3. What is compensation principle of welfare?
4. What is the marginal condition of pareto criterion?
5. What is Scitosvsky paradox?

Long Questions:

1. Discuss the marginal condition of Paetro criterion of welfare.
2. Explain the Kaldor-Hicks compensation principle.
3. Discuss the Scitosvsky double criterion.

4. Critically discuss the Paretian criteria of welfare.
5. Discuss the Bergson social welfare function.

3.8 Further/Suggested Readings.

1. Koutsoyiannis, A., *Modern Microeconomics*, Macmillan Press, London, 1979.
2. Madella and Miller Microeconomics Tata Mc Graw Hills, 2015
3. Tandon Pankaj, A textbook of Microeconomic theory, Sage Publucation, 2015
4. Per-Olov Johansson, An Introduction to Modern Welfare Economics 1991

UNIT 4 CHOICE UNDER UNCERTAINTY AND RISK

NOTES

Structure

4.0 INTRODUCTION

Most market conditions are known to the investor or can be predicted in investment decisions under the condition of certainty. In reality, however, a large area of investment decisions fall in the realm of *risk and uncertainty*. It is important to note that risk and uncertainty go hand in hand. Wherever there is uncertainty, there is risk. The probability of some kinds of risk is calculable whereas that of some other kinds of risk is not. The calculable risk like accident, fire and theft are insurable. Therefore, decision-making in case of insurable risks is a relatively easier task. But, incalculable risks are not insurable. Therefore, investment decisions are greatly complicated where the probability of an outcome is not estimable. However, some useful techniques have been devised and developed by economists, statisticians and management experts to facilitate investment decision-making under the conditions of risk and uncertainty. Also, there are several techniques and methods that are applied under different business conditions and for evaluating investment projects. In this unit, however, we concentrate on the popular methods of investment decision-making.

Let us begin with the concepts of and distinction between risk and uncertainty as applied to business decision-making.

4.1 UNIT OBJECTIVES

After going through this unit, you will be able to:

- Differentiate between uncertainty and risk
- Discuss the cardinal and ordinal measures of utility
- Evaluate the axioms and characteristics of Neumann-Morgenstern (N-M) utility
- Assess the relationship between shape of utility function and behaviour towards risk

- Explain the concept of elasticity of marginal utility and risk aversion
- Analyse absolute and relative risk aversion

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4.2 DIFFERENCE BETWEEN UNCERTAINTY AND RISK

The concept of risk and uncertainty can be better explained and understood in contrast to the concept of certainty. Therefore, let us first have a closer look at the concept of certainty and then proceed to explain the concepts of risk and uncertainty. *Certainty* is the state of perfect knowledge about the market conditions. In the state of certainty, there is only one rate of return on the investment and that rate is known to the investors. That is, in the state of certainty, the investors are fully aware of the outcome of their investment decisions. For example, if you deposit your savings in 'fixed deposit' bearing 10 per cent interest, you know for certain that the return on your investment in time deposit is 10 per cent, and *FDR* can be converted into cash any day. Or, if you buy government bonds or treasury bills, etc. bearing an interest of 11 per cent, you know for sure that the return on your investment is 11 per cent per annum, your principal remaining safe. In either case, you are sure that there is little or no possibility of the bank or the government defaulting on interest payment or on refunding the money. This is called the *state of certainty*.

However, there is a vast area of investment avenues in which the outcome of investment decisions is not precisely known. The investors do not know precisely or cannot predict accurately the possible return on their investment. Some examples will make the point clear. Suppose a firm invests in R&D to innovate a new product and spends money on its production and sale. The success of the product in a competitive market and the return on investment in R&D and in production and sale of the product can hardly be predicted accurately. There is, therefore, an element of uncertainty. Consider another example. Suppose a company doubles its expenditure on advertisement of its product with a view to increasing its sales. Whether sales will definitely increase proportionately can hardly be forecast with a high degree of certainty, for it depends on a number of unpredictable conditions. Consider yet another example. Maruti Udyog Limited (*MUL*) decided in July 2014 to invest money in financing the sale of its own cars with a view to preventing the downslide in its sales which it had experienced over the past two years. However, the managers of *MUL* could hardly claim the knowledge of or predict the outcome of this decision accurately. Hence, this decision involves risk and uncertainty. In real life situations, in fact, a large number of business decisions are taken under the conditions of risk and uncertainty, i.e., the lack of precise knowledge about the outcome of the business decisions. Let us now look into the precise meaning of the terms risk and uncertainty in business decisions.

Meaning of Risk

In common parlance, risk means a low probability of an expected outcome. From business decision-making point of view, risk refers to a situation in which a business decision is expected to yield more than one outcome and the probability of each outcome is known to the decision makers or it can be reliably estimated. For example, if a company doubles its advertisement expenditure, there are four probable outcomes: (*i*) its sales may more-than-double, (*ii*) they may just double, (*iii*) increase in sales may be less than double and (ii) sales do not increase at all. The company has the knowledge of these probabilities

or has estimated the probabilities of the four outcomes on the basis of its past experience as: (*i*) more-than double: — 20 per cent (or 0.2), (*ii*) almost double — 40 per cent (or 0.4), (*iii*) less-than double — 50 per cent (or 0.5) and (*iv*) no increase — 10 per cent (or 0.1). It means that there is 80 per cent risk in expecting more-than-doubling of sales, and 60 per cent risk in expecting doubling of sale, and so on.

There are two approaches to estimating probabilities of outcomes of a business decision, viz., (*i*) *a priori approach*, i.e., the approach based on deductive logic or intuition and (*ii*) *posteriori approach*, i.e., estimating the probability statistically on the basis of the past data. In case of *a priori probability*, we know that when a coin is tossed, the probabilities of 'head' or 'tail' are 50:50, and when a dice is thrown, each side has 1/6 chance to be on the top. The *posteriori* assumes that the probability of an event in the past will hold in future also. The probability of outcomes of a decision can be estimated statistically by way of 'standard deviation' and 'coefficient of variation'.

Meaning of Uncertainty

Uncertainty refers to a situation in which there are more than one outcome of a business decision and the probability of no outcome is not known nor can it be meaningfully estimated. The unpredictability of outcome may be due to the lack of reliable market information, inadequate past experience, and high volatility of the market conditions. For example, if an Indian firm, highly concerned with population burden on the country, invents an irreversible sterility drug, the outcome regarding its success is completely unpredictable. Consider the case of insurance companies. It is possible for them to predict fairly accurately the probability of death rate of insured people, accident rate of cars and other automobiles, rate of buildings catching fire, and so on, but it is not possible to predict the death of a particular insured individual, a particular car meeting an accident or a particular house catching fire, etc.

The long-term investment decisions involve a great deal of uncertainty with unpredictable outcomes. But, in reality, investment decisions involving uncertainty have to be taken on the basis of whatever information can be collected, generated and 'guesstimated'. For the purpose of decision-making, uncertainty is classified as:

- Complete ignorance
- Partial ignorance

In case of *complete ignorance*, investment decisions are taken by the investor using their own judgement or using any of the rational criteria. What criterion he chooses depends on his attitude towards risk. The investor's attitude towards risk may be that of:

- A risk averter
- A risk neutral
- A risk seeker or risk lover

In simple words, a risk averter avoids investment in high-risk business. A risk-neutral investor takes the best possible decision on the basis of his judgement, understanding of the situation and his past experience. He does his best and leaves the rest to the market. A risk lover is one who goes by the dictum that 'the higher the risk, the higher the gain'. Unlike other categories of investors, he prefers investment in risky business with high expected gains.

In case of *partial ignorance*, on the other hand, there is some knowledge about the future market conditions; some information can be obtained from the experts in the

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field, and some probability estimates can be made. The available information may be incomplete and unreliable. Under this condition, the decision-makers use their subjective judgement to assign an *a priori probability* to the outcome or the pay-off of each possible action such that *the sum of such probability distribution is always equal to one*. This is called *subjective probability distribution*. The investment decisions are taken in this case on the basis of the *subjective probability distribution*.

4.3 CLASSES OF MEASURES: ORDINAL AND CARDINAL MEASURES

We have learnt about the concept of utility in unit 1. Here, we deal with the measurability of utility. Utility is a psychological phenomenon. It is a feeling of satisfaction, pleasure or happiness. Is utility measurable quantitatively? Measurability of utility has, however, been a contentious issue. The classical economists, viz., Jeremy Bentham, Leon Walrus, Carl Menger, etc. and the neo-classical economist, notably Alfred Marshall, believed that utility is cardinally or quantitatively measurable like height, weight, length, temperature and air pressure. This belief resulted in the *Cardinal Utility* concept. The modern economists, most notably J. R. Hicks and R. G. D. Allen, however, hold the view that utility is not quantitatively measurable—it is not measurable in absolute terms. Utility can be expressed only ordinally comparatively or in terms of 'less than' or 'more than'. It is, therefore, possible to list the goods and services in order of their preferability or desirability. This is known as the *ordinal* concept of utility. Let us now look into the origin of the two concepts of utility and their use in the analysis of demand.

(i) **Cardinal measurement of utility:** Some early psychological experiments on an individual's responses to various stimuli led classical and neo-classical economists to believe that utility is measurable and cardinally quantifiable. This belief gave rise to the concept of cardinal utility. It implies that utility can be assigned a cardinal number like 1, 2 and 3. The neo-classical economists, especially Marshall, devised a method of measuring utility.According to Marshall, utility of a commodity for a person equals the amount of money he/she is willing to pay for a unit of the commodity. In other words, price one is prepared to pay for a unit of a commodity equals the utility he expects to derive from the commodity. They formulated the theory of consumption on the assumption that utility is cardinally measurable. They coined and used a term 'util' meaning 'units of utility'. In their economic analysis, they assumed: (*i*) that one 'util' equals one unit of money, and (*ii*) that utility of money remains constant.

It has, however, been realized over time that *absolute* or cardinal measurement of utility is not possible. Difficulties in measuring utility have proved to be insurmountable. Neither economists nor scientists have succeeded in devising a technique or an instrument for measuring the feeling of satisfaction, i.e., the utility. Numerous factors affect the state of consumer's mood, which are impossible to determine and quantify. *Utility is, therefore, immeasurable in cardinal terms*.

(ii) **Ordinal measurement of utility:** The modern economists have discarded the concept of *cardinal utility* and have instead employed the concept of *ordinal utility* for analysing consumer behaviour. The concept of *ordinal utility* is based on the fact that it may not be possible for consumers to express the utility of a commodity in numerical terms, but it is always possible for them to tell

Check Your Progress

1. How can the concept of risk and uncertainty be understood?
2. Define risk.
3. How can the probability of outcomes of a decision be estimated statistically?

introspectively whether a commodity is more or less or equally useful as compared to another. For example, a consumer may not be able to tell that a bottle of Pepsi gives 5 utils and a glass of fruit juice gives 10 utils. But he or she can always tell whether a glass of fruit juice gives more or less utility than a bottle of Pepsi. This assumption forms the basis of the ordinal theory of consumer behaviour.

To sum up, the neo-classical economists maintained that cardinal measurement ofutility is practically possible and is meaningful in consumer analysis. The modern economists, on the other hand, maintain that utility being a psychological phenomenon is inherently immeasurable quantitatively. They also maintain that the concept of ordinal utility is a feasible concept and it meets the conceptual requirement of analysing the consumer behaviour. However, both the conceptsof utility are used in analysing consumer behaviour.

Two Approaches to Consumer Demand Analysis

Based on cardinal and ordinal concepts of utility, there are two approaches to the analysis of consumer behaviour.

(i) **Cardinal utility approach,** attributed to Alfred Marshall and his followers, is also called the neo-classical approach or Marshallian approach.

(ii) **Ordinal utility approach**, pioneered by J. R. Hicks, a Nobel laureate and R. G. D. Allen, is also called Hicks-Allen approach or the indifference curve analysis.

The two approaches are not in conflict with one another. In fact, they represent two levels of sophistication in the analysis of consumer behaviour. Both the approaches are important for managerial decisions depending on the level of sophistication required.

It is **important** to note in this regard that in spite of tremendous developments in consumption theory based on ordinal utility, the neo-classical demand theory based on cardinal utility has retained its appeal and applicability to the analysis of market behaviour. Besides, the study of neo-classical demand theory serves as a foundation for understanding the advanced theories of consumer behaviour. The study of neo-classical theory of demand is of particular importance and contributes a great deal in managerial decisions.

9.3.1 Axioms of Neumann-Morgenstern (N-M) Utility

A major contribution to the utility theory was made by a famous mathematician, John von Neumann, and a well-known economist Oskar Morgenstern in their famous book *Theory of Games and Economic Behaviour*. Their theory is also known as Modern Utility Theory and Neumann-Morgenstern Hypothesis (N-M hypothesis). It is important to note that N-M hypothesis is concerned with the measurement of utility concept, particularly of money, rather than explaining the utility maximizing behaviour of the consumer. In other words, the prime objective of N-M hypothesis is to provide a measure (or an index) of utility and to show that marginal utility of money decreases.

To appreciate the contribution of *modern utility theory*, we need to look at its point of deviation from the *cardinal* and *ordinal utility* theories of consumer behaviour. Recall that the cardinal utility assumes measurability of utility in terms of constant utility of money. The ordinal utility theory considers cardinal measurement of utility neither possible nor necessary in consumer analysis, and relies on ordinal concept of utility. An important aspect of these theories is that they presume all consumer choices to be made under *certain* and *riskless* conditions. That is, these theories ignore the possibility of

uncertainty and risk involved in consumer's alternative choices. Neumann and Morgenstern have gone, without disputing the ordinal utility approach, one step forward to suggest a measure of utility where risk is involved in choice-making.

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In this section, we will briefly describe the basic idea of N-M hypothesis, its approach towards construction of utility index, and also look into its drawbacks.

Characteristics of N-M Utility Index

The N-M hypothesis suggests that if an individual behaves consistently, it is possible to construct his 'utility index' and express his preferences numerically. For example, consider an individual who makes a choice between: (i) witnessing a test cricket-match (*M*) being played in the city, and (ii) going around for sight-seeing (*S*). Suppose his preference is given as $M > S$. Let us now introduce the element of uncertainty in his choice for, under N-M hypothesis, the consumer is required to make choice under the conditions of uncertainty. In order to introduce uncertainty (or a risk element), let us suppose that the cricket-match (*M*) is likely to be interrupted by rainfall. Therefore, if the individual goes to witness the match he may either enjoy a good cricket (M_g) or a bad cricket (M_b) due to interruptions by rainfall. Assuming certain probability rates of rainfall, individual's preferences for the alternative probability rates may be hypothetically ranked as follows.

(i) If probability of clear weather is rated at 80 per cent (or 0.8) the individual expects to enjoy a good cricket (M_g) and he prefers M_g to *S*.

(ii) If probability of clear weather is 60 per cent (or 0.6) and of rainfall 40 per cent (or 0.4), the individual becomes indifferent between the alternatives, *M* and *S*.

Given the first set of probability rates and ranking of individual's preferences, his preferences may be arranged, assuming consistency in his behaviour, as follows.

$$M_g > S > M_b$$

This ordering of his preferences follows the utility expected from these alternatives. Consider now (the second) situation in which probabilities of their clear weather and rainfall are rated as 60:40 (or 0.6:0.4). Under these probability rates, the individual is indifferent between *M* and *S*. It means that the composite *expected utility* (U_e) of M_g and M_b is the same as that of *S*.

The *expected utility*, under the conditions of uncertainty, is obtained by multiplying the riskless utility (*U*) of an event by its probability rate (*P*). Thus, individual's equation of *indifference* may be expressed as:

$$U(S) = P \cdot U(M_g) + (1 - P) \cdot U(M_b)$$

As we have assumed above, the probability (*P*) of M_g is 0.6 and probability of M_b is $1 - P = 1 - 0.6 = 0.4$. Now if the individual is somehow in a position to obtain the information regarding the utilities which he can assign to M_g and M_b, he is able to assign a numerical value to $U(S)$. Let us assume that the values M_g at 50 utils and M_b at 25 utils, i.e., $U(M_g) = 50$ and $U(M_b) = 25$. By substituting these values in the above equation, we get:

$$U(S) = 0.6(50) + 0.4(25)$$

$$U(S) = 30 + 10 = 40$$

Thus, the individual assigns 40 utils to *S*. This illustrates the N-M measure of utility index. Having computed the utility index of S, individual's preferences may be ranked as $M_g > S > M_b$ and may be numerically expressed as:

$$50 > 40 > 25.$$

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Assumptions

The construction of N-M utility index is based on three basic assumptions.

1. **Transitivity:** The N-M hypothesis, like indifference curve and revealed preference theories, assumes transitivity in consumer's preferences. That is, if he prefers *A* to *B* and *B* to *C*, then he prefers *A* to *C*.
2. **Consistency:** Consistency in consumer's behaviour implies that if a consumer preferss *A* to *B*, *A* having a probability *P* and *B* having a probability 1 – *P*, then he will not prefer *B* to *A* under the same probabilities.
3. **Continuity of preferences:** The consumer has a 'system of preferences that is all-embracing and complete.' His preferences have continuity in the sense that if he prefers event *A* to *B* when probability of *A* equals 1 (i.e., $P(A) = 1$) and if he prefers *B* to *A* when $P(A) = 0$, there lies a probability between 1 and 0, at which he is indifferent between events *A* and *B*.

Appraisal of N-M Utility Index

The N-M utility index is only a theoretical or conceptual measure of utility. It provides a basis for indexing the expected utility levels under uncertain conditions. It does not measure the *intensity of introspective satisfaction or pleasure* nor is it the purpose of N-M measure of 'cardinal' utility.

It is also worth noting that N-M cardinal utility is not identical with neo-classical cardinal utility. While cardinal utility, in the neo-classical sense, means actual, absolute measurement of strength of feeling, the word 'cardinal' has been used in N-M measure of utility entirely in the 'operational' sense.

The N-M measure of utility serves a useful purpose by providing a basis for rational thinking and prediction, particularly where uncertainty and risk are involved, in spite of the fact that there is an arbitrariness in the method of computing utility index.

4.4 RELATIONSHIP BETWEEN SHAPE OF UTILITYFUNCTION AND BEHAVIOUR TOWARDS RISK

Based on the behaviour that people project towards risk, it is possible to place them under one of the three distinct categories. The category under which they will be placed will depend on the respective Bernoulli utility functions that they display with their behaviours.

Let us use the example of tossing a coin to explain this. Assume that on heads the amount won is ` 10 and on tails the amount won is ` 20. Hence, the gamble's expected value will be:

$$(0.5 \times 10) + (0.5 \times 20) = \$15.$$

A person who is risk-averse

When an individual's utility of the gamble's expected value is higher than the expected utility from the gamble itself, the individual is considered to be risk-averse. This is a more precise definition of Bernoulli's idea.

Check Your Progress

4. Name the classical economists who believed that utility is cardinally measurable.
5. What are the two approaches to the analysis of consumer behaviour?
6. What does the N-M hypothesis suggest?

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Aperson's risk-averse behaviour can be captured in the concave Bernoulli utility function, like a logarithmic function. In the case of the gamble of coin toss as given above, a person who is risk averse and whose Bernoulli utility function was:

$$u(w) = \log(w) \text{ ; (w representing the outcome)}$$

might have an expected utility over the gamble of:

$$0.5 \times \log(10) + 0.5 \times \log(20) = 1.15,$$

And the utility expected of the value will be:

$$\log (15) = 1.176$$

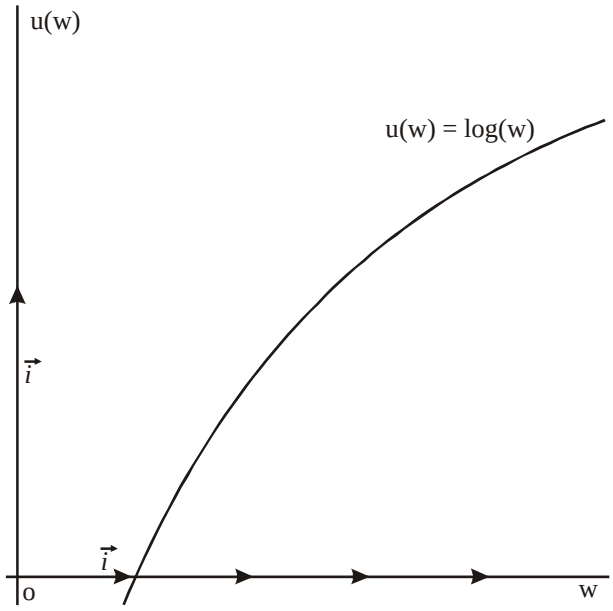

Fig. 9.1 *Bernoulli Utility Function*

A person who is risk loving

When an individual's utility of the gamble's expected value is lower than the expected utility from the gamble itself, they are categorised as being risk-loving. Nevertheless, it is important to note that, this is not how normally gambling behaviour works, for example in a casino. If this definition is to be accepted, then a truly risk-loving person should be ready to put all his assets at stake for just one roll of dice.

Risk-loving behaviour is captured in the convex Bernoulli utility function. For example, an exponential function. In case of the gamble given above, a risk-loving person with the Bernoulli utility function as:

$$u(w) = w^2$$

would display an expected utility for the gamble as being:

$$0.5 \times 10^2 + 0.5 \times 20^2 = 250,$$

When the utility of the gamble's expected value is:

$$15^2 = 225$$

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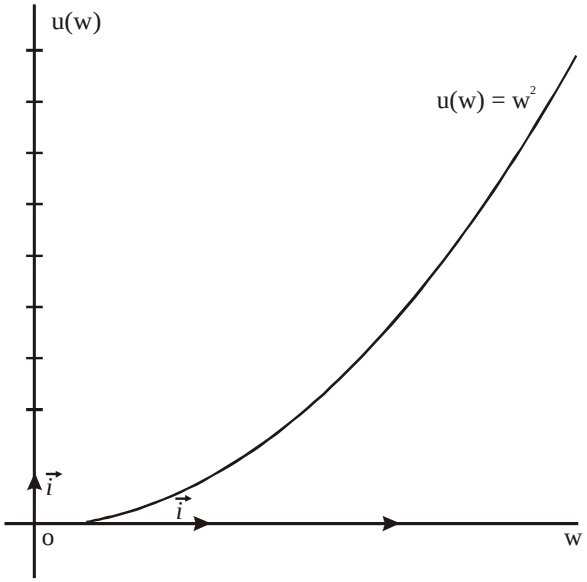

Fig. 9.2 *Convex Bernoulli Utility Function*

A person who is risk neutral

When an individual's utility of the gamble's expected value is exactly equal to the expected utility from the gamble itself, they are categorised as being risk-neutral. In practice, the best example of risk-neutrality are the majority of the financial institutions that adopt this method in making investments.

A linear Bernoulli function is used to capture risk-neutral behaviour. In the case of the gamble that has been discussed above, a risk-neutral person with Bernoulli utility function as:

$$u(w) = 2w$$

would have an expected utility over the gamble of:

$$(0.5 \times 2 \times 10) + (0.5 \times 2 \times 20) = 30,$$

While the utility of the expected value of the gamble is:

$$2 \times 15 = 30$$

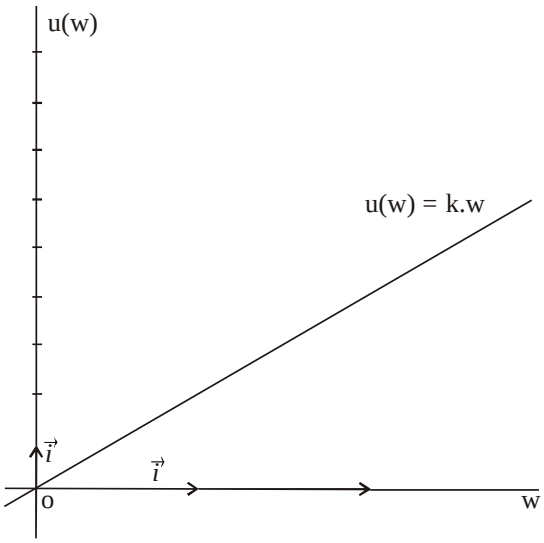

Fig. 9.3 *Linear Bernoulli Function*

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If we take the example of insurance, while the buyers of insurance display behaviour that is risk-averse, the insurance company itself shows a behaviour of being risk-neutral. The insurance company is earning its profit with the received premiums' value being greater than the value of the loss that the company expects.

Any gambling 'g' will have the *certainty equivalent* which is an amount of money, say 'Q', which will certainly accrue and will provide the consumer the exact same utility as would be provided by the gamble itself.

A gamble's *risk premium* is the difference of the gamble's expected value and the gamble's certainty equivalent.

From the above, it can be said that a person who is risk averse will have certainty equivalent lower than the gamble's expected value, and the person's risk premium will be positive. This means that a person who is risk averse will require some added incentive to actually participate in the gambling risk.

There is a zero risk premium for a person who is risk neutral and the person's certainty equivalent is exactly the same as the gamble's expected value. On the other hand, a person who is risk loving has a risk premium in the negative. This is due to the need to accept the expected value for extra incentives, not due to the risky gamble, and the person will have a higher certainty equivalent than the gamble's expected value.

4.4.1 Elasticity of Marginal Utility and Risk Aversion

The money income of an individual is representative of the market basket of goods that can be purchased by him. The assumption that will be made is that the individual is aware of the existing probabilities of gaining or making money income in various situations and the pay-offs/outcomes will be measured not in rupees but as provided utility.

As has been seen above, individuals have their own attitudes towards risk. Mostly, individuals opt for situations that are less risky, and that which will have less variability as far as rewards/outcomes are concerned. We could say that mostly individuals aim at keeping their risks at a minimum and these persons are referred to as risk averse or risk averters. People who like to take risks are referred to as risk lovers or risk seekers. There are persons who are referred to as risk neutral also as they are the ones who have an attitude of indifference towards risk.

People have different attitude towards risk based on whether the marginal utility of money increases, diminishes or remains constant.

A person who is risk averse will have diminishing marginal utility with increase in money. In the case of a risk seeker, there is increase in marginal utility of money with increase in money. For a risk neutral person, marginal utility of money remains constant with increase in the amount of money.

Risk Averter

Let us look at money income as a single composite commodity to consider risk attitude in the light of marginal utility. The money income of an individual is representative of the basket of goods that he can purchase from the market. We are going with the assumption that the individual is well aware of the probabilities of gaining/making money income in various situations and that the pay-offs or outcomes will be measured in the utility provided rather than in terms of rupees.

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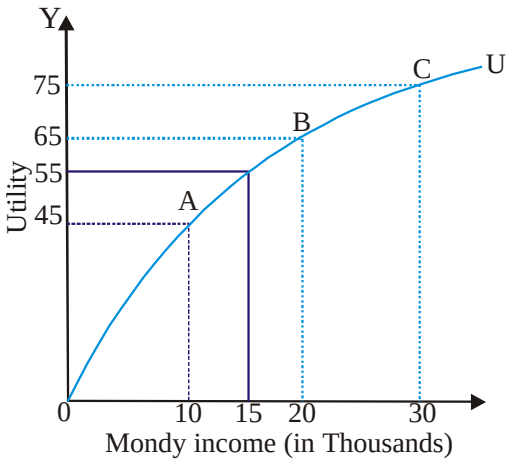

Fig. 9.4 *Money Income and Utility*

In the figure given above, the X axis represents the money income and the Y axis represents utility while the curve OU has been drawn to represent the utility function of money income of a risk-averse individual. Here, OL is the slope of total utility function and with the increase in the individual's money income, this slope is seen to decrease.

As there is an increase in the individual's money income from ` 10,000 to ` 20,000, there is an increase in his total utility by twenty units as it escalates from 45 units to 65. When there is a rise in money income from ` 20,000 to ` 30,000, the individual's total utility increases from 65 units to 75 units which is an increase of just 10 units.

In the above graph, the concave utility function shows the marginal utility of money of the individual decreasing with a decrease in his money income, showing that the individual is risk averse.

Consider that at this point the individual is in a job that provides him with ` 15,000 fixed monthly salary. Since this has no uncertainty as far as income from the job is concerned, there is no risk present. If the individual decides to move to a job of a salesperson whose income is dependent on commission, it will involve risk since the income will not be certain. In case he is successful in his sales job, he might make an income much higher than he is currently making and if he is not that good he might earn just about the same as he is earning in his current job. Let us consider that in the new job that he is considering to take lies a 50-50 probability of getting either ` 30,000 or ` 10,000 (implying that the probability for each is 0.5). Therefore, in case of uncertainty, there is no way for the individual to know what the actual utility is of performing a specific action. Since there are probabilities of alternative outcomes, it is possible to calculate the expected utility. Whether or not the new risky job will be taken up by the individual can be known through comparison of the utility that is expected from the new risky job against the utility from the job the individual is currently holding. In the above graph, the OU, the utility function curve, shows that the money income of ` 15,000 in certainty is 55. In the new risky job, in case the individual is successful and has an income of ` 30,000, the utility gained from ` 30,000 is 75. In case he fails at the new risky job and just gains ` 10,000 as income his utility will be 45.

While the utility function of money income shows the individual to be risk-averse, but as the risky job's expected utility appears greater than the present job's utility with a certain income, the individual will opt for the risky job.

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Now, consider that in the new risky job, the individual succeeds and earns an income of ` 30,000, which is twice as the assured income from the present job. If failure at the new job on the part of the individual will decrease the income to zero, then the expected utility of the risky job is given by:

$$E(U) = 0.5\,U(0) + 0.5\,U(30{,}000)$$
$$= 0 + 0.5 \times 75$$
$$= 37.5$$

Hence, the new jobs expected utility is lower than the utility of 55 which the individual gains from the current job which is providing him ` 15,000 as a fixed assured income.

Even in the risky job the income that can be expected is ` 15,000:

$$[E(x) = 0.5 \times 0 + 0.5 \times 30{,}000 = 15000]$$

In the graph given above, the choice of a risk-averse individual is being represented and for him there is a fall in marginal utility of money with increase in money. We are now in a position to provide a precise definition of a risk-averse individual.

A risk lover or risk-preferred person is an individual who likes to opt for an outcome that is risky but comes with the same expected income as a certain income. For an individual who is risk-loving, there is an increase in the marginal utility of income with increase in his money income. This is represented by the convex total utility function curve OU in the graph given below.

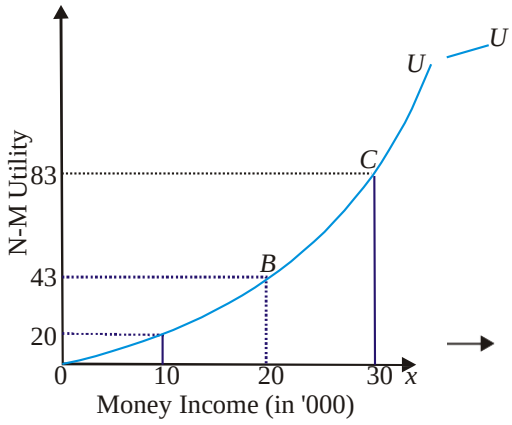

Fig. 9.5 *Convex Total Utility Function*

Consider that this individual who is risk-loving is holding a job that earns him ` 20,000 as a certain income. The above graph depicts that 43 units is the utility of ` 20,000 for the individual. In case the individual is offered a risky job with ` 30,000 as income if he proves to be extremely efficient and just ` 10,000 if he is extremely inefficient with equal probability of 0.5 in both the jobs, then the new jobs expected utility will be:

$$E(U) = 0.5\,U(10{,}000) + 0.5\,U(30{,}000)$$

As depicted in the graph above, ` 20 is the utility of ` 10,000 for this individual and for ` 30,000 it is 83. Hence,

$$E(U) = 0.5(20) + 0.5(83)$$
$$= 10 + 41.5$$
$$= 51.5$$

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With 51.5 being the new risky job's expected utility which is more than the present job's utility of 43, the new job will be preferred by the risk-loving individual despite the fact that the expected income in the new risky job is also ` 20,000 as:

$$(0.5 \times 10{,}000) + 0.5\,(30{,}000) = ` 20{,}000).$$

Risk-loving individuals are the ones who gamble, purchase lotteries, take part in criminal activities, and commit big frauds, even at the risk of punishment if caught.

A person will be considered to be risk neutral, if he is indifferent either towards a certain given income or an uncertain income with the same expected value. A person is risk neutral if his money income's marginal utility remains constant with increase in his money income. The graph given below represents a risk neutral individual's total utility function.

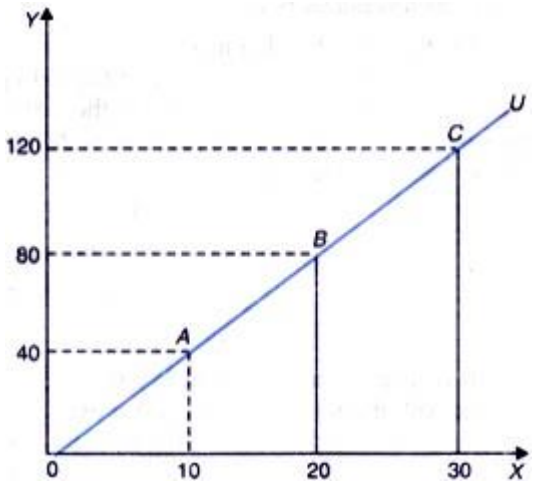

Fig. 9.6 *Risk Neutral Individual's Total Utility Function*

The graph in the figure above shows that the utility of a certain income of ` 20,000 is 80. With the new risky job and rise in income on being a successful salesman to ` 30,000, the utility goes up to 120 units.

Then again in case the individual is unsuccessful at the new risky job as a salesman, the income falls to ` 10,000 and its utility slips to 40 units. The assumption is that increase in income or decrease in income is equally possible at the new risky job.

The expected utility of the new risky job is:

$$E(U) = 0.5\,U(10{,}000) + 0.5\,U(30{,}000)$$
$$= 0.5(40) + 0.5(120)$$
$$= 20 + 60$$
$$= 80$$

NOTES

Risk Aversion and Fair Bets

According to Bernoulli's hypothesis, an individual whose marginal utility of money declines will not be willing to accept a fair gamble. A fair gamble or game is that where the gamble's expected value of income is equal to the same amount of income with certainty. An individual refusing a fair bet will be considered to be risk-averse. This individual will give preference to a 'given income with certainty to a risky gamble with the same expected value of income'.

The commonest attitude found towards risk is of risk aversion. It is because of this attitude that many people take insurance for all kinds of risks like accident, theft, illness, to name a few. The risk-averse individuals are the ones who would rather be in occupations or jobs that get them stable income rather than those that have uncertain income.

The Neumann-Morgenstern method of measuring expected utility can be used to explain the risk-averse attitude. For an individual who is risk averse, as his income increases, his marginal utility of income diminishes.

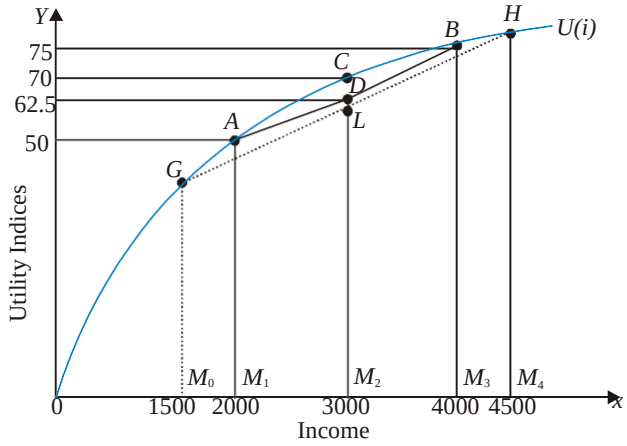

Fig. 9.7 *Neumann-Morgenstern Utility Function Curve*

The graph in the figure given above shows the Neumann-Morgenstern utility function curve *U (I).* The utility curve begins at the origin and continues on a positive slope showing that the individual has preference for more income in comparison to less income.

Additionally, a conclave utility curve implies that an individual's marginal utility of income diminishes with increase in his income. The utility curve in the above graph depicts the risk-averse attitude.

Neumann-Morgenstern Concave Utility Curve of a Risk-Averter

Assume that the current income of an individual is ` 3,000. The individual is offered a fair gamble where there is a 50-50 chance of losing/winning ` 1,000 which places the probability of winning at 0.5 or 1/2. In case he wins the game, his income will go up to ` 4,000 and on losing it will go down to ` 2,000.

In such an uncertain situation, the individual's expected money value of income is:

$$E(V) = 1/2 \times 4000 + 1/2 \times 2000 = ` 3000$$

If the gamble is not accepted by the individual, his income will remain ` 3,000 with certainty. Even 'though the expected value of his uncertain income prospect is

equal to his income with certainty, a risk averter will not accept the gamble'. The reason being that he will act according to the expected utility of his income in the uncertain situation.

According to the above graph, the utility obtained from ` 4,000 is 75 and just 50 from ` 2,000.

The uncertain prospects expected utility is:

$$E(U) = 1/2\,(75) + 1/2\,(50)$$

$$= 37.5 + 25 = 62.5$$

The individual's rejection of the gamble is based on his diminishing marginal utility of money income. He perceives the utility gained from ` 1,000 to be lower than the loss he would incur on ` 1000 on losing the gamble.

Therefore, if money income's marginal utility diminishes, an individual will stay away from fair gambles. An individual of this type is known as a risk averter as he would rather go for an income with certainty than for a gamble that provides the same expected value.

Here is an example to explain the above situation.

Consider that the individual has a certain income of ` 3,000 and is offered 2 fair gambles.

- A 50:50 chance to lose or win ` 1000
- A 50:50 chance to lose or win ` 1,500

In the second case, the even chance to lose or win the expected value of income will be:

$$1/2(1500) + 1/2\,(4500) = \text{`}.\,3000$$

In the above figure on the utility curve *U (I),* a straight line segment *GH* is drawn to join *G* (corresponding to income of ` 1500) and *H* (corresponding to income of ` 4500).

GH, the straight-line segment shows the expected utility from the expected money value of ` 3,000 from the second gamble which is:

M₂L

Which is less than M₂D of the first gamble.

Hence, the first gamble is preferred by the individual as it has lower variability of outcome compared to the second gamble.

In the case where there is certainty of income, there is no risk, as there exists no variability of outcome.

4.4.2 Absolute and Relative Risk Aversion

It can be possible that a person is risk averse in some segments while he is risk loving in others and can also change his attitude towards risk in any segment. It is argued by Friedman and Savage that an individual can be at the same time risk averse and risk loving for different choices and for different segments of wealth. Therefore, effectively, we cannot consider it to be irrational when an individual purchases insurance to cover some varieties of risk on a day and them is seen gambling on the same day. They proposed that all individuals are capable of irrational behaviour when they are faced with choices that are risky under some situations.

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It is also possible to make a distinction between an individual's reaction to absolute changes in wealth and to proportional changes in wealth, where the former measures an absolute risk aversion and the latter measures a relative risk aversion.

The implication of a decreasing absolute risk aversion depends on the amount of wealth an individual is ready to risk which will increase with increase in wealth. Similarly, the implication of a decreasing relative risk aversion depends on the proportion an individual will be ready to risk which will rise with rise in wealth. In case of constant absolute risk aversion, the amount of wealth which the individual will put to risk will stay constant with increase in wealth, while the proportion of wealth will remain the same with constant relative risk aversion. Individuals will be ready to put increasing smaller amounts of wealth at risk as they grow wealthier, with increasing absolute risk aversion, and decreasing proportions of wealth with increasing relative risk aversion.

Using the Arrow-Pratt measure, we can write the relative risk aversion measure in the following manner:

Arrow-Pratt relative risk aversion = $-W\,U''(W)/U'(W)$

where,

W = Level of wealth

$U'(W)$ = First derivative of utility to wealth, measuring how utility changes as wealth changes

$U''(W)$ = Second derivative of utility to wealth, measuring how the change in utility itself changes as wealth changes

We can use the log utility function to illustrate the concept:

$U = \log(W)$

$U' = 1/W$

$U'' = 1/W^2$

Absolute risk aversion coefficient = $U''/U' = W$

Relative risk aversion coefficient = 1

Therefore, the log utility function shows a decreasing absolute risk aversion in which an individual will be willing to invest more money in risky assets as their wealth increases. It also shows a constant relative risk aversion in which an individual will be willing to invest the same percentage of wealth in risky assets even when their wealth increases.

Majority of the risk and return models, are in practice based around certain specific assumptions regarding relative and absolute risk aversion, and also if they decrease, increase or remain constant with increase in wealth.

Check Your Progress

7. When is an individual considered to be risk averse?
8. When is an individual categorised as being risk-neutral?
9. On what basis do people have different attitude towards risk?
10. What did Friedman and Savage argue regarding being risk-averse and risk loving?

4.5 SUMMARY

In this unit, you have learnt that,

4.5.1 The concept of risk and uncertainty can be better explained and understood in contrast to the concept of certainty.

4.5.2 Certainty is the state of perfect knowledge about the market conditions. In the state of certainty, there is only one rate of return on the investment and that rate is known to the investors.

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- In common parlance, risk means a low probability of an expected outcome. From business decision-making point of view, risk refers to a situation in which a business decision is expected to yield more than one outcome and the probability of each outcome is known to the decision makers or it can be reliably estimated.
- There are two approaches to estimating probabilities of outcomes of a business decision, viz., (i) a priori approach, i.e., the approach based on deductive logic or intuition and (ii) posteriori approach, i.e., estimating the probability statistically on the basis of the past data.
- The probability of outcomes of a decision can be estimated statistically by way of 'standard deviation' and 'coefficient of variation'.
- Uncertainty refers to a situation in which there is more than one outcome of a business decision and the probability of no outcome is known nor can it be meaningfully estimated.
- For the purpose of decision-making, uncertainty is classified as:
  - Complete ignorance
  - Partial ignorance
- Utility is a psychological phenomenon. It is a feeling of satisfaction, pleasure or happiness.
- Measurability of utility has, however, been a contentious issue. The classical economists, viz., Jeremy Bentham, Leon Walrus, Carl Menger, etc. and the neo-classical economist, notably Alfred Marshall, believed that utility is cardinally or quantitatively measurable like height, weight, length, temperature and air pressure. This belief resulted in the Cardinal Utility concept.
- The modern economists, most notably J. R. Hicks and R. G. D. Allen, however, hold the view that utility is not quantitatively measurable—it is not measurable in absolute terms. Utility can be expressed only ordinally comparatively or in terms of 'less than' or 'more than'. It is, therefore, possible to list the goods and services in order of their preferability or desirability. This is known as the ordinal concept of utility.
- According to Marshall, utility of a commodity for a person equals the amount of money he/she is willing to pay for a unit of the commodity. In other words, price one is prepared to pay for a unit of a commodity equals the utility he expects to derive from the commodity. They formulated the theory of consumption on the assumption that utility is cardinally measurable. They coined and used a term 'util' meaning 'units of utility'.
- The modern economists have discarded the concept of cardinal utility and have instead employed the concept of ordinal utility for analysing consumer behaviour. The concept of ordinal utility is based on the fact that it may not be possible for consumers to express the utility of a commodity in numerical terms, but it is always possible for them to tell introspectively whether a commodity is more or less or equally useful as compared to another.
- A major contribution to the utility theory was made by a famous mathematician, John von Neumann, and a well-known economist Oskar Morgenstern in their famous book *Theory of Games and Economic Behaviour*.
- The N-M hypothesis suggests that if an individual behaves consistently, it is possible to construct his 'utility index' and express his preferences numerically.
- The N-M utility index is only a theoretical or conceptual measure of utility. It provides a basis for indexing the expected utility levels under uncertain conditions.

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It does not measure the intensity of introspective satisfaction or pleasure nor is it the purpose of N-M measure of 'cardinal' utility.

- It is worth noting that N-M cardinal utility is not identical with neo-classical cardinal utility. While cardinal utility, in the neo-classical sense, means actual, absolute measurement of strength of feeling, the word 'cardinal' has been used in N-M measure of utility entirely in the 'operational' sense.
- Based on the behaviour that people project towards risk, it is possible to place them under one of the three distinct categories. The category under which they will be placed will depend on the respective Bernoulli utility functions that they display with their behaviours.
- When an individual's utility of the gamble's expected value is higher than the expected utility from the gamble itself, the individual is considered to be risk-averse.
- A person's risk-averse behaviour can be captured in the concave Bernoulli utilityfunction, like a logarithmic function.
- When an individual's utility of the gamble's expected value is lower than the expected utility from the gamble itself, they are categorized as being risk-loving.
- Risk-loving behaviour is captured in the convex Bernoulli utility function. For example, an exponential function.
- When an individual's utility of the gamble's expected value is exactly equal to the expected utility from the gamble itself, they are categorized as being risk-neutral. Alinear Bernoulli function is used to capture risk-neutral behaviour.
- A gamble's risk premium is the difference of the gamble's expected value and thegamble's certainty equivalent.
- The money income of an individual is representative of the market basket of goods that can be purchased by him. The assumption that will be made is that the individual is aware of the existing probabilities of gaining or making money income in various situations and the pay-offs/outcomes will be measured not in rupees but as provided utility.
- People have different attitude towards risk based on whether the marginal utility of money increases, diminishes or remains constant.
- A risk lover or risk-preferred person is an individual who likes to opt for an outcome that is risky but comes with the same expected income as a certain income.
- Risk-loving individuals are the ones who gamble, purchase lotteries, take part in criminal activities, and commit big frauds, even at the risk of punishment if caught.
- According to Bernoulli's hypothesis, an individual whose marginal utility of money declines will not be willing to accept a fair gamble. A fair gamble or game is that where the gamble's expected value of income is equal to the same amount of income with certainty.
- The Neumann-Morgenstern method of measuring expected utility can be used to explain the risk-averse attitude. For an individual who is risk-averse, as his income increases, his marginal utility of income diminishes.
- It can be possible that a person is risk-averse in some segments while he is risk-loving in others and can also change his attitude towards risk in any segment. It is argued by Friedman and Savage that an individual can be at the same time risk-averse and risk-loving for different choices and for different segments of wealth.

- It is also possible to make a distinction between an individual's reaction to absolute changes in wealth and to proportional changes in wealth, where the former measures an absolute risk aversion and the latter measures a relative risk aversion.

NOTES

4.6 KEY TERMS

- **Certainty:** It is the state of perfect knowledge about the market conditions.
- **Risk:** It refers to a situation in which a business decision is expected to yield more than one outcome and the probability of each outcome is known to the decision makers or it can be reliably estimated.
- **Uncertainty:** It refers to a situation in which there are more than one outcome of a business decision and the probability of no outcome is not known nor can it be meaningfully estimated.
- **Gamble risk premium:** A gamble's risk premium is the difference of the gamble's expected value and the gamble's certainty equivalent.

4.7 ANSWERS TO 'CHECK YOUR PROGRESS'

1. The concept of risk and uncertainty can be better explained and understood in contrast to the concept of certainty.
2. Risk refers to a situation in which a business decision is expected to yield more than one outcome and the probability of each outcome is known to the decision makers or it can be reliably estimated.
3. The probability of outcomes of a decision can be estimated statistically by way of 'standard deviation' and 'coefficient of variation'.
4. Classical economists, like, Jeremy Bentham, Leon Walrus and Carl Menger and the neo-classical economist, notably Alfred Marshall, believed that utility is cardinallyor quantitatively measurable.
5. Based on cardinal and ordinal concepts of utility, there are two approaches to the analysis of consumer behaviour:
   (i) Cardinal utility approach, attributed to Alfred Marshall and his followers, is also called the neo-classical approach or Marshallian approach.
   (ii) Ordinal utility approach, pioneered by J. R. Hicks, a Nobel laureate and R. G. D. Allen, is also called Hicks-Allen approach or the indifference curve analysis.
6. The N-M hypothesis suggests that if an individual behaves consistently, it is possible to construct his 'utility index' and express his preferences numerically.
7. When an individual's utility of the gamble's expected value is higher than the expected utility from the gamble itself, the individual is considered to be risk averse.
8. When an individual's utility of the gamble's expected value is exactly equal to the expected utility from the gamble itself, they are categorised as being risk neutral.
9. People have different attitude towards risk based on whether the marginal utility of money increases, diminishes or remains constant.
10. It is argued by Friedman and Savage that an individual can be at the same time risk averse and risk loving for different choices and for different segments of wealth.

NOTES

4.8 QUESTIONS AND EXERCISES

Short-Answer Questions

1. What is certainty? What are the two approaches to estimate probabilities of outcomes of a business decision?
2. What is uncertainty? How can it be classified?
3. What is subjective probability distribution?
4. What led to the idea of cardinal utility and ordinal utility? Why have the modern economists discarded the concept of cardinal utility?
5. How is N-M cardinal utility different from neo-classical cardinal utility?
6. Who is a risk-averse person? How can his behaviour be captured?
7. Illustrate graphically the attitude of a risk averter towards risk.
8. What does Bernoulli's hypothesis of fair gamble state?

Long-Answer Questions

1. Differentiate between uncertainty and risk in decision making.
2. Discuss the ordinal and cardinal measures of utility.
3. Assess the principle of Neumann-Morgenstern utility and the assumptions of N-M utility index.
4. 'Based on the behaviour that people project towards risk, it is possible to place them under one of the three distinct categories.' What are these categories?
5. Evaluate the elasticity of marginal utility and risk aversion.
6. Describe absolute and relative risk aversion.

4.9 FURTHER READING

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UNIT V ECONOMICS OF IMPERFECT INFORMATION

NOTES

Structure

5.0 INTRODUCTION

Imperfect information can be due to ignorance or uncertainty. If the market participant is aware that better information is available, information becomes another need or want. Information may be acquired through an economic transaction and becomes a commodity that is a cost to the buyer or seller. Useful information is available as a market product in forms of books, media broadcasts, and consulting services. Decision making is an important aspect of imperfect information.

Most decision theories are normative or prescriptive, i.e., it is concerned with identifying the best decision making assuming an ideal decision maker who is fully informed, able to compute with perfect accuracy, and fully rational. The practical application of this prescriptive approach (how people *ought to* make decision) is called decision analysis, and it is aimed at finding tools, methodologies and software to help people make better decisions. The most systematic and comprehensive software tools developed in this way are called decision support systems. In this unit, you will be acquainted with the economics of imperfect information and decision-making under certainty and uncertainty.

5.1 UNIT OBJECTIVES

After going through this unit, you will be able to:

- Discuss the concept of risk, certainty and uncertainty
- Describe investment decisions under the condition of certainty
- Evaluate investment decisions under the condition of uncertainty
- Assess the concept of asymmetric information
- Analyse the term adverse selection and signalling
- Explain moral hazard as a problem
- Discuss the applications of moral hazards on insurance

NOTES

5.2 INFORMATION AND DECISION MAKINGUNDER CERTAINTY AND UNCERTAINTY

In recent decades, there has been increasing interest in what is sometimes called 'behavioural decision theory' and this has contributed to a re-evaluation of what rational decision-making requires.

Uncertainty: Uncertainty is a case when there is more than one possible outcome to a decision and where the probability of each specific outcome occurring is not known. This may be due to the insufficiency in past information or instability in the structure of the variables. In extreme forms of uncertainty, not even the outcomes themselves are known. Many of the choices that people make, involve considerable uncertainty. Most people, for example, borrow to finance large purchases, such as a house or college education, and plan to pay for them out of future income. But for most of us, future incomes are uncertain. Our earnings can go up or down; we can be promoted or demoted, or even lose our jobs. And if we delay buying a house or investing in college education, we risk increasing price rates that could make such purchases less affordable.

Certainty: Certainty refers to a situation where there is only one possible outcome to a decision and this outcome is known precisely. For example, investing in treasuring bills leads to only one outcome and this is known with certainty. The reason is that there is virtually no chance that the central government will fail to redeem these treasuring bills.

Risk: Risk refers to a situation where there is more than one possible outcome to a decision and the probability of each specific outcome is known or can be estimated. Thus, risk requires that the decision maker knows all the possible outcomes of the decision and have some idea of the probability of each outcome's occurrence. For example, in tossing a coin, we can get either a head or a tail, and each has an equal chance of occurring. In general, the greater the number of possible outcomes, the greater is the risk associated with the decision.

Choice under Uncertainty

So far in consumption theory, we have assumed that prices, incomes and other variables are known with certainty. If a consumer purchases a house, he knows the benefits of ownership of the house. But when uncertainty exists, a decision does not lead to a single outcome but to several possible outcomes with different probabilities. If you decide to purchase a house in New Delhi, you are not certain of enjoying all its benefits. You are taking a gamble. One remote but distinct outcome is that your dream home will be damaged extensively by an earthquake. Or, if you have invested in a college education and look forward to a prosperous career, you may not receive the benefits of the education you have worked for so diligently. There is a probability that you will be killed in an automobile accident. Each of these dismal events has only a small probability of occurring, but if it does, it is devastating. In each example an individual makes a decision where multiple outcomes are possible.

Since more than single outcomes are associated with decision, it makes little sense to say that the individual maximizes utility, because multiple possible outcomes have multiple possible utilities. To analyse decision making under uncertainty, we must replace utility maximization with some other goal.

5.2.1 Investment Decisions under Certainty

The condition of certainty refers to a state of perfect knowledge. It implies that investors have complete knowledge about the market conditions, especially the investment opportunities, cost of capital and the expected returns on the investment. Of the several criteria proposed for evaluating the profitability of the various kinds of projects, the three most commonly used criteria under certainty are:

- Pay-back (or pay-out) period
- Net discounted present value
- Internal rate of return or marginal efficiency of capital

These criteria are equally applicable to a variety of investment decisions regarding new investments and those pertaining to replacement, scrapping, and widening or deepening of capital. Incidentally, from analysis point of view, there is no structural difference between decisions on new investment and those on replacement.

Let us now briefly describe the three criteria mentioned above and look into their applicability. We will discuss these criteria under the condition of *certainty*.

Pay-Back Period Method

The pay-back period is also known as 'pay-out' and 'pay-off' period. The *pay-back period* method is the simplest and one of the most widely used methods of project evaluation. *The pay-back period is defined as the time required to recover the total investment outlay from the gross earnings,* i.e., gross of capital wastage or depreciation. If a project is expected to generate a constant flow of income over its life-time, the pay-back period may be calculated as given below.

$$\text{Pay-back Period} = \frac{\text{Total Investment outlays}}{\text{Gross Return per period}}$$

For example, if a project costs ` 40,000 million and is expected to yield an annual income of ` 8,000 million, then its pay-off period is computed as follows:

$$\text{Pay-off Period} = \frac{\text{` 40,000 million}}{\text{` 8,000 million}} = 5 \text{ years}$$

In case of projects which yield cash in varying amounts, the pay-back period may be obtained through the cumulative total of annual returns until the total equals the investment outlay. The sum of cash inflows gives the pay-back period. For example, suppose that the cost of a project is ` 10,000 million which yields cash flows over 5 years as given in Col. 3 of Table 10.1. The table provides necessary information for the calculation of pay-back period.

NOTES

Table 10.1 *Calculation of Pay-back Period*

Year	Total fixed outlay (` in million)	Annual Cash-flows (` in million)	Cumulative Total of Col. (3) (` in million)
(1)	(2)	(3)	(4)
1st	10,000	4,000	4,000
2nd	—	3,500	7,500
3rd	—	2,500	10,000
4th	—	1,500	11,500
5th	—	1,000	12,500

As the table shows, the cumulative total of annual cash flows breaks-even with the total outlay of the project (` 10,000 million) at the end of the 3rd year. Thus, the pay-back period of the project is 3 years

In case of projects with different investments yielding different annual returns, the project evaluation procedure can be described as follows. After pay-back period of each project is calculated, projects are ranked in increasing order of their pay-back period. Let us suppose, for example, that a firm has to select one out of four riskless projects, viz., *A*, *B*, *C* and *D*. The total cost of each project and their respective annual yields are given in columns (2) and (3), respectively, in Table 10.2. The calculation of their respective pay-back period given in column (4) of the table. Project *B* ranks 1st and projects *C*, *D* and *A* rank 2nd, 3rd, and 4th, respectively. The firm will invest in these project in the same order, if it adopts the pay-back period criterion for project evaluation.

In case projects *A*, *B*, *C* and *D* yield cash flows at different rates in the subsequent years, the cumulative total method can be adopted to calculate their pay-back periods as shown in Table 10.1 and projects ranked accordingly. After projects are ranked, they are selected in order of their ranking depending on the availability of funds.

All other things being the same, a project with a shorter pay-off period is preferred to those with longer pay-off period. This method of ranking projects or project selection is considered to be simple, realistic and safe. Its simplicity is obvious in the calculation of the pay-off period. It is realistic in the sense that businessmen want their money back as quickly as possible and this method serves their purpose. It is safe since it avoids incalculable risk in the long run.

Table 10.2 *Ranking of Projects*

Project	Total outlay (` in million)	Annual return (` in million)	Pay-back period (Years)	Rank
(1)	(2)	(3)	(4)	(5)
A	36,000	6,000	36,000 ÷ 6,000 = 6	4
B	24,000	8,000	24,000 ÷ 8,000 = 3	1
C	20,000	5,000	20,000 ÷5,000 = 4	2
D	15,000	3,000	15,000 ÷3,000 = 5	3

This method is 'a crude rule of thumb' and can hardly be defended except on the ground of avoiding risk associated with long pay-back projects. Besides, this method assumes that cash inflows are known with a high degree of certainty.

The second and the major drawback of this criterion is that it considers only a short period in which cost of project is recovered. It ignores the period and the subsequent returns, after the pay-off period. This criterion, if applied, may deprive the investor of additional earning in future. For example, suppose that an investor has to make a choice between two Projects *A* and *B*, their costs and returns are given as follows:

(i) **Project *A*:** Total cost = ` 24,000

Annual returns ` 8,000 over three years

Pay-back period = 3 years

(ii) **Project *B*:** Total cost = ` 20,000

Annual returns ` 5,000 over six years

Pay-back period = 20,000/5,000 = 4 years

Obviously, according to pay-off period criterion, Project *A* will be preferred to project *B*. But this will lead to foregoing an additional expected income of ` 6,000, calculated as follows.

Total yield from Project B = ` 5000 × 6 (years) = ` 30,000

Total yield from Project A = ` 8000 × 3 (years) = ` 24,000

Loss of expected additional income = Total earning from Projects *B less* total earning from Project *A*.

= ` 30,000 – ` 24,000 = ` 6000.

The application of pay-back criterion can be justified only if project *B* involves a high degree of uncertainty and risk. Nevertheless, this criterion can be profitably adopted if terminal year of all projects under consideration is the same.

Net Present Value Method

***Concept of present value: Time value of money*—**The concept of the present value of money is very well reflected in the proverb 'a bird in the hand is worth two in the bush'. In general, money received today is valued more than money receivable tomorrow. Cash in hand is valued more because it gives: (*i*) liquidity and (*ii*) an opportunity to invest it and earn return (interest) on it. This is called the time value of money. The concept of the time value of money is very often applied to investment decisions. Generally, there is a time-lag between investment and its returns. When an investment is made today, it begins to yield returns at some future date. The time gap between the investment and the first return from the investment is called 'time lag'. During this time lag, the investor loses interest on the expected incomes. This implies that a rupee received today is worth more than a rupee receivable at some future date. Or conversely, a rupee expected to be received one year hence is worth less than a rupee today. In the context of the time value of money, the present value of a future income is lower than the value of the same amount received today.

The concept of present value of money can be better understood through an example. Suppose that a sum of ` 100 held in cash today is deposited in a bank at 10 per cent rate of interest. After one year, ` 100 today will increase to ` 110. The amount (principal + interest) is worked out as follows.

NOTES

$$\text{Amount} = 100 + 100\,(10/100)$$
$$= 100 + 100\,(0.1)$$
$$= 100 + 10 = 110$$

It follows that ` 110 expected one year hence is worth only ` 100 today. This means that ` 100 is the *present value* of ` 110 to be earned after a period of one year. The present value (*PV*) of ` 110 can be obtained as follows.

$$PV \text{ of } `110 = \frac{110}{(1+0.1)} = 100$$

The present value of a future income may thus be defined as its value discounted at the current rate of interest. Alternatively, the present value of an amount expected at a future date, say after one year, is the sum of money which must be invested today to get that amount after one year.

The Formula for Computing Present Value: Suppose that an amount X_0 is invested for a period of one year at a compounding interest rate. At the end of the year, the total receipt, say X_1 can be expressed as:

$$X_1 = (X_0 + r\,X_0) = X_0\,(1 + r) \qquad \ldots(10.1)$$

Equation (10.1) shows that X_0 increases at the rate of $(1 + r)$ to take the value X_1 after one year. It implies that if X_1 is discounted at the same rate of interest, it gives its present value (*PV*). The formula for computing the present value is given below.

$$PV \text{ of } X_{1-} = \frac{X_1}{(1+r)} = X_1 \left(\frac{1}{1+r}\right) \qquad \ldots(10.2)$$

In Eq. (10.2), $1/(1 + r)$ is the *discount rate* for one year. Given the rate of interest (i.e., the numerical value for *r*), any income receivable after one year can be discounted to its present value. For example, the present value of an income of ` 500 expected after one year at 10 per cent interest per annum (where $r = 0.10$), can be calculated as:

$$PV = 500\left(\frac{1}{1+0.10}\right) = 454.55$$

It means that, at 10 per cent interest rate, the present value of ` 500 expected after one year is ` 454.55. The discount rate (d_2) for an income receivable after 2 years will be $1/(1 + r)^2$, and for an income receivable after 3 years, $d_3 = 1/(1 + r)^3$ and so on. The formula for discount rate for the *n*th year is given as:

$$d_n = \frac{1}{(1+r)^n} \qquad \ldots(10.3)$$

The formula for calculating present value (*PV*) of an amount receivable in the nth year is given as:

$$PV = X_n\left[\frac{1}{(1+r)^n}\right] \qquad \ldots(10.4)$$

or

$$PV = \frac{X_n}{(1+r)^n}$$

NOTES

Present Value of an Income Stream: The formula for calculating the total present value (*TPV*) of a stream of annual return (*R*) over *n* years is given as:

$$TPV = \frac{R_1}{(1+r)} + \frac{R_2}{(1+r)^2} + \frac{R_3}{(1+r)^3} + \ldots + \frac{R_n}{(1+r)^n} \qquad \ldots(10.5a)$$

$$= \sum_{j=1}^{n} R_n \frac{1}{(1+r)^n}$$

or

$$= \sum_{j=1}^{n} \frac{R_n}{(1+r)^n} \qquad \ldots(10.5b)$$

***Net present value and investment decision*—**Having noted the concept of present value (*PV*) and the method of calculating *PV* of a future income, let us now see how investment decisions are taken on the basis of present value. In fact, present value (*PV*) adjusted for the cost of investment provides the basis of investment decisions. The *PV* adjusted for its cost is called 'net present value'. The investment decision—accepting or rejecting a project—is taken on the basis of *net present value.* The *net present value* (*NPV*) may be defined as the difference between the present value (*PV*) of an income stream and the cost of investment (*C*), i.e.,

$$NPV = PV - C$$

or

$$= \sum_{j=1}^{n} R_n \left[\frac{1}{(1+r)^n} \right] - C \qquad \ldots(10.6)$$

where *C* is the total cost of investment without any recurring expenditure.

The investment decision rules can be specified as follows:

(i) if $NPV > 0$, the project is acceptable

(ii) if $NPV = 0$, the project is accepted or rejected on non-economic considerations

(iii) if $NPV < 0$, the project is rejected

If investment is a recurring expenditure, the total present cost (*TPC*) for *n* years can be calculated in the same manner as present value of an income stream is calculated, i.e.,

$$TPC = \sum_{j=1}^{n} \frac{C_n}{(1+r)^n} \qquad \ldots(10.7)$$

And then,

$$NPV = \sum_{j=1}^{n} \frac{R_n}{(1+r)^n} - \sum_{j=1}^{n} \frac{C_n}{(1+r)^n}$$

$$= \sum_{j=1}^{n} \frac{R_n - C_n}{(1+r)^n} \qquad \ldots(10.8)$$

The investment decision rule in this case is the same as given above. If the *NPV* is positive (i.e., $NPV > 0$), the project is profitable and acceptable. The firm can borrow any amount at the existing interest rate (*r*) and invest in it. When a choice between two projects has to be made, the one with higher *NPV* would be chosen.

NOTES

The Internal Rate of Return (*IRR*) is also called Marginal Efficiency of Investment (*MEI*), Internal Rate of Project (*IRP*) and Break-even Rate (*BER*). For example, if a one-year project costing ` 100 million yields ` 120 million at the end the year, then its internal rate of return (*r*) can be obtained as follows.

$$\frac{120 \text{ million}}{(1+r)} = ` 100 \text{ million}$$

$$= (1+r)\,100 = 120$$

and $$r = 0.20$$

The *IRR* of this project is 0.20 or 20 per cent. No other value of *r* can equate the *NPV* of the project with its cost.

The *IRR* or *MEI* is defined as '*the rate of interest or return which renders the discounted present value of its expected future marginal yields exactly equal to the investment cost of project*'. In other words, '*IRR* is the rate of return (*r*) at which the discounted present value of receipts and expenditures are equal'. The *IRR* of a project yielding a stream of returns over *n* years and involving different investment costs can be obtained by using the formula given in Eq. (10.9).

$$\sum_{j=1}^{n} \frac{R_n}{(1+r)^n} = \sum_{j=1}^{n} \frac{C_n}{(1+r)^n} \qquad ...(10.9)$$

or $$\sum_{j=1}^{n} \frac{R_n}{(1+r)^n} - \sum_{j=1}^{n} \frac{C_n}{(1+r)^n} = 0 \qquad ...(10.10)$$

The *IRR* criterion is basically the same as Keynes's Marginal Efficiency of Investment (*MEI*). This criterion is theoretically superior to other criteria, though it has its own shortcomings. The *IRR* criterion says that so long as internal rate of return is greater than the market rate of interest, it is always profitable to borrow and invest. However, in a perfectly competitive market, a firm's internal rate of return always equals the market rate of interest.

From Eq. (10.10) it may be inferred that *IRR* and *NPV* criteria lead to the same conclusion or yield the same decision. There are situations, however, where the two criteria give conflicting results. For example, suppose that a firm has to make a choice between projects *A* and project *B*, each having a productive life of two years. The stream of net income at the end of the year from the two projects and their respective costs are presented in Table 10.3.

Table 10.3 *Flow of Net Incomes*

	Cost of project	*Ist year*	*2nd year*
Project *A*	100	0	140
Project *B*	100	130	0

Let us now calculate the *NPV* for both the projects, assuming a 10 per cent expected rate of return, and compare the result with *IRR*. Remember that *NPV* = *PV* – *C*.

Project *A*: $PV = \frac{0}{(1+0.10)} + \frac{140}{(1+0.10)^2} = 115.70$

and $NPV = 115.70 - 100 = 15.70$

Since *NPV* is positive (` 15.70) at the expected rate of return of 10 per cent, Project *A* is acceptable. But if we raise the expected rate of return to 20 per cent, Project A will not be acceptable because at this rate of return, *NPV* is negative (– 2.78), as calculated below:

$$NPV = \frac{0}{(1+0.20)} + \frac{140}{(1+0.20)^2} - 100 = 97.22 - 100 = -2.78$$

Project *B*: $PV = \frac{130}{(1+0.10)} + \frac{0}{(1+0.10)^2} = 118.18$

and $NPV = 118.18 - 100 = 18.18.$

Project *B* is acceptable at the rate of 10 per cent return since *NPV* which equals 18.18 per cent is positive. It will be acceptable even at the expected return or interest rate of 20 per cent since, in that case, *NPV* will be ` 8.33 calculated as follows.

$$NPV = \frac{130}{(1+0.20)} + \frac{0}{(1+0.20)^2} - 100 = 108.33 - 100 = 8.23$$

Having calculated the *NPVs* for Projects *A* and *B*, let us now calculate the *IRR* for both projects, for comparing the decisions.

By definition, the *IRR* is the rate of return (*r*) which renders the net present value (*NPV*) equal to zero. Using the definition (10.10), *r* for Project *A* may be calculated as follows.

$$NPV = 0 + \frac{140}{(1+r)^2} - 100 = 0$$

By solving this equation, we can obtain the value of *r* as shown below.

$$NPV = 0 + \frac{140}{(1+r)^2} - 100 = 0$$

$$(1+r)^2 = \frac{140}{100} = 1.40$$

$$(1+r) = \sqrt{1.40} = 1.183$$

$$r = 0.183 \quad \text{or} \quad 18.3 \text{ per cent}$$

Likewise, in case of Project *B*, the value of *r* can be obtained as follows.

$$NPV = \frac{130}{(1+r)} + 0 = 100$$

$$(1+r) = \frac{130}{100} = 1.30$$

$$r = 0.30 \text{ or } 30 \text{ per cent}$$

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We find that *IRR* of Project *A* is 18.3 per cent and for Project *B* it is 30 per cent. The *NPV* at different interest rates and the *IRRS* of Project *A* and *B* can be tabulated as given in Table 10.4.

Table 10.4 *NPV and IRR of Projects A and B*

Project A			*Project B*		
r		*NPV*	*r*		*NPV*
0.0		40.00	0.00		30.00
10.0		16.70	10.00		18.18
18.3	= *IRR*	0.00	20.00		8.33
20.0		–2.78	30.00	= *IRR*	0.00

The conflict between the two criteria may be shown by plotting the information given in Table 10.4 as shown in Fig. 10.2. The lines marked by Project *A* and Project *B* show relation between the various rates of return (*r*) and the corresponding *NPV* for Projects *A* and *B*. The two lines internally intersect at point *P*. The value of *r* at point *P* is 7.7 per cent. It shows that only at 7.7 per cent rate of return, both projects are equally acceptable. Below a rate of 7.7 per cent return, Project *A* is preferable because its *NPV* is higher than that of Project *B*. But above 7.7 per cent return, Project *B* is preferable because its *NPV* is higher than that of Project *A*. It follows that if a firm opts for Project *A* with higher *NPV*, it will earn a return less than 7.7 per cent and will have a longer pay-back period. Thus, the choice between the two projects will be based on the pay-off-period.

Furthermore, if firms evaluate the two projects on the basis of their *IRR*, Project *B* should be preferable since its *IRR* = *r* = 30 per cent is greater than that of Project *A* (with its *IRR* = 18.3 per cent). Obviously, the two criteria (*NPV* and *IRR*) produce conflicting conclusions in regard to the choice of projects. In actual practice, however, the firms are guided by their objective relative to returns.

5.2.2 Investment Decisions under Uncertainty

In this sec-tion, we will discuss the techniques of investment decisions under *uncertainty*. As defined above, *uncertainty* refers to a situation in which a decision is expected to yield more than one outcome and the probability of none of the possible outcomes is known. Therefore, decisions taken under uncertainty are neces-sarily *subjective*. However, analysts have devised some decision rules to impart some objectivity to the subjective decisions, provided *decision-makers are able to identify the possible 'states of nature' and can estimate the outcome of each strategy*. Some such important decision rules are discussed below.

Hurwicz Decision Criterion

Hurwicz has suggested a criterion for investment decisions under uncertainty. In his opinion, full realization of optimistic pay-off or full realization of most pessimistic pay-off is a rare phenomenon. The actual pay-off of a strategy lies somewhere between the two extreme situations. According to Hur-wicz criterion, therefore, the decision-makers need to construct a *decision index* of most optimistic and most pessimistic pay-offs of each alternative strategy. The *decision index* is, in fact, a weighted average of maximum possible and minimum possible pay-offs, weight being their subjective probability such

that sum of probabilities of maximum (Max) and minimum (Min) pay-offs equals one. Hurwicz formula for *decision index* (D_i) is given below.

$$D_i = a \text{ Max}_i + (1 - a) \text{ Min}_i$$

where D_i = decision index of the ith strategy; and a = probability of maximum pay-off.

The construction of Hurwicz *decision index* is illustrated in Table 10.5. Column (2) presents the maximum possible pay-offs of investment strategies, S_1, S_2, S_3 and S_4 listed in column (1). Column (3) shows the probability of maximum pay-offs. Column (4) gives the weighted pay-offs of the maximum pay-offs of the four strategies. *Weighted pay-off* equals the maximum pay-off multiplied by *a* (where *a* is subjective probability of pay-off). Note that the same probability applies to all the strategies. Columns (5), (6) and (7) give similar values of minimum pay-offs of the four strat-egies. The last column (8) gives the *decision index*.

Table 10.5 *Hurwicz Decision Index*

Strategy	Max	α	α Max	Min	$(1 - \alpha)$	$(1 - \alpha)$ min	D
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
S_1	10	0.8	8	6	0.2	1.2	9.2
S_2	20	0.8	16	10	0.2	2.0	18.0
S_3	15	0.8	12	5	0.2	1.0	13.0
S_4	12	0.8	9	– 10	0.2	– 1.0	8.0

As regards the *investment decision*, as the table (Col. 8) shows, strategy S_2 has the highest decision index (18.0). Therefore, strategy S_2 is preferable to all other strategies.

Laplace Decision Criterion

The Laplace criterion uses the Bayesian rule to calculate the *expected value* of each strategy. Bayesian rule says that where meaningful estimate of probabilities is not available, the outcome of each strategy under each state of nature must be assigned the same probability and that the sum of probabilities of outcome of each strategy must add up to one. For this reason, the Laplace criterion is also called the 'Bayesian criterion'. By assuming equal probability for all events, the environment of 'uncertainty' is converted into an environment of 'risk'.

Once this decision rule is accepted, then decision-makers can apply the decision criteria that are applied under the condition of risk. The most common method used for the purpose is to calculate the 'expected value'. Once expected value of each strategy is worked out, then the strategy with the highest expected value is selected.

This decision rule avoids the problem that arises due to subjectivity in assuming a probability of pay-offs. This criterion is, there-fore, regarded as the criterion of rationality because it is free from a decision-maker's attitude towards risk.

To sum up, uncertainty is an important factor in investment decisions but there is no unique method of dealing with uncer-tainty. There are several ways of making investment decisions under the condition of uncertainty. None of the methods, as described above, lead to a flawless decision. However, they do add some degree of certainty to decision-making. The choice of method depends on the availability of necessary data and reliability of a method under different conditions.

Check Your Progress

1. What is uncertainty?
2. What does the condition of certainty mean?
3. State one limitation of the pay-back period method.
4. What is a decision index?

5.3 ASYMMETRIC INFORMATION

NOTES

Asymmetric information is a situation where some people have more information about a thing than others. Asymmetric information is characteristic of many business situations. Usually, a seller of a product knows more about its quality than the buyer does. Workers usually know their own skills and abilities better than employers. And business managers know more about their firm's costs, competitive position, and investment opportunities than do the firm's owners.

Asymmetric information explains many institutional arrangements in our society. It is one reason why automobile companies offer warranties on parts and service for new cars; why firms and employees sign contracts that include incentives and rewards, and why the shareholders of corporations must monitor the behaviour of managers.

Suppose you buy a new car for ` 20,000, drove it 100 miles, and then decided you really did not want it. There was nothing wrong with the car—it performed beautifully and met all your expectations. You simply felt that you could do just as well without it and would be better off saving the money for other things. So you decide to sell the car. How much should you expect to get for it? Probably not more than ` 16,000—even though the car is brand new, has been driven only 100 miles, and has a warranty that is transferable to a new owner. And if you were a prospective buyer, you probably would not pay much more than ` 16,000 yourself.

Used cars sell for much less than new cars because *there is asymmetric information about their quality*: The seller of a used car knows much more about the car than the prospective buyer does. The buyer can hire a mechanic to check the car, but the seller has had experience with it and will know more about it. Furthermore, the very fact that the car is for sale indicates that it may be a 'lemon'—why sell a reliable car? As a result, the prospective buyer of a used car will always be suspicious of its quality.

Asymmetric information is also present in many other markets. Here are just a few examples.

- **Retail store:** Will the store repair or allow you to return a defective product? The store knows more about its policy than you do.
- **Dealers of rare stamps, coins, books, and paintings:** Are the items real or counterfeit? The dealer knows much more about their authenticity than you do.
- **Roofers, plumbers, and electricians:** When a roofer repairs or renovates the roof of your house, do you climb up to check the quality of the work?
- **Restaurants:** How often do you go into the kitchen to check if the chef is using fresh ingredients and obeying the heath laws?

In all these cases, the seller knows much more about the quality of the product than the buyer does. Unless sellers can provide information about quality to buyers, low-quality goods and services will drive out high-quality ones.

Implications of Asymmetric Information

In an ideal world of fully functioning markets, consumers would be able to choose between low-quality and high-quality cars. While some will choose low-quality cars because they cost less, others will prefer to pay more for high-quality cars. Unfortunately, consumers

cannot in fact easily determine the quality of a used car until after they purchase it. As a result, the price of used cars fall, and high-quality cars are driven out of the market.

Market failure arises because there are owners of high-quality cars who value their cars less than potential buyers of high-quality cars. As a result, both parties can enjoy gains from trade. Unfortunately, the buyers' lack of information prevents this mutually beneficial trade from occurring.

The implications of asymmetric information about product quality were first analysed by George Akerlof. Akerlof's analysis goes far beyond the market for used cars. The markets for insurance, financial, credit and even employment are also characterized by asymmetric quality information. To understand the implications of asymmetric information, we take the market for used cars and then see how the same principles apply to other markets.

Market for Used Cars

Suppose two kinds of used cars are available—high-quality cars and low-quality cars. Also, *suppose that sellers and buyers can tell which kind of car is which.* There will then be two markets, as illustrated in Figure 10.1. In part (a) S_H is the supply curve for high-quality cars, and D_H is the demand curve. Similarly S_L and D_L in part (b) are the supply and demand curves for low-quality cars. For any given price, S_H lies to the left of *St* because owners of high-quality cars are more reluctant to part with them and must receive a higher price to do so. Similarly, D_H is higher than D_L because buyers are willing to pay more to get a high-quality car. As the figure shows, the market price for high-quality cars is ` 10,000, for low-quality cars ` 5000, and 50,000 cars of each type are sold.

In reality, the seller of a used car knows much more about its quality than a buyer does. Buyers discover the quality only after they buy a car and drive it for a while. Consider, what happens, then, if sellers know the quality of cars, but buyers do not. Initially, buyers might think that the odds are 50-50 that a car they have will be high-quality. Why? Because when both sellers *and* buyers knew the quality, 50,000 cars of each type were sold. When making a purchase, buyers would therefore view all cars as 'medium' quality. Of course, after buying the car, they will learn its true quality. The demand for cars perceived to be medium-quality, denoted by D_M in Figure 10.1, is below D_H but above D_L. As the figure shows, *fewer high-quality cars (25,000) and more low-quality cars (75,000) will now be sold.*

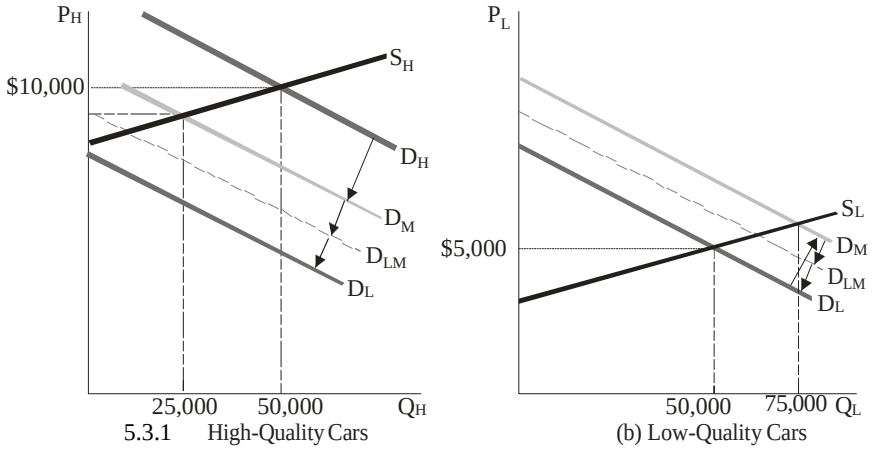

Fig 10.1 *The Market for Used Cars*

NOTES

As consumers begin to realize that most cars sold (about three-fourths of the total) are low quality, their perceived demand shifts. As Figure 10.1 shows, the new perceived demand curve might be D_{LM}, which means that, on average, cars are thought to be of low to medium quality. However, the mix of cars then shifts even more heavily to low quality. As a result, the perceived demand curve shifts further to the left, pushing the mix of cars even further toward low quality. *This shifting continues until only low-quality cars are sold*. At that point, the market price would be too low to bring forth any high-quality cars for sale, so consumers correctly assume that any car they buy will be of low quality, and the only relevant demand curve will be D_L.

The situation in Figure 10.1 is extreme. The market may come into equilibrium at a price that brings forth at least some high-quality cars. *But the fraction of high-quality cars will be smaller than it would be if consumers could identify quality before making the purchase.* That is why a person should expect to sell his brand new car, which he knows is in perfect condition, for much less than he has paid for it. Because of asymmetric information, low-quality goods drive high-quality goods out of the market. This phenomenon is sometimes referred to as the ***lemons problem***.

The English meaning of **lemon** is **'no attraction in anything'**. Alemon problem may arise when low quality goods drive out high quality goods from market.

Asymmetric information exists when one side of a potential transaction has more information than the other side. When asymmetric information exists, the owners of high quality products suffer losses. When they offer high quality products, and sell them in a poor market that includes low quality products, they receive a lower price with adverse selection. The products that appear in the market are different from the products that firms sell when both sides have complete information. When asymmetric information exists, market institutions such as warranties and testing arise, and there is greater reliance on the seller's reputation.

10.3.1 Adverse Selection and Signalling

Adverse selection is a process used in economics in which such results occur which are undesired when the buyers and sellers have access to different or imperfect information. This imperfect knowledge causes a shift in the price and quantity of goods and services. This results into a selection of 'bad' products or services. For instance, if a bank sets a fixed or stable price for all its checking account customers, then it runs into the risk of being unfavourably affected by its low-balance and high activity customers. The bank would not profit much due to the individual price.

George Akerlof's 'The Market for Lemons' from 1970 is an archetypal paper on adverse selection. This paper brought numerous informational concerns to the forefront of economic theory. This paper also discusses the two principal solutions to this problem, screening and signalling.

Signalling

The idea of signalling was originally propounded by Michael Spence. He was of the idea that when a situation of information asymmetry comes into being, people can or may signal their type, simultaneously transporting information to the other party and resolving the asymmetry.

This technique was usually applied in the context of searching a job wherein an employer wants to hire a new employee who is 'skilled in learning'. This is true that all the employees coming in for an interview will claim to be 'skilled in learning', but only

the employee's themselves know if they really are 'skilled in learning' or not. This is an information asymmetry. Skills are dependent on various factors such as diet, money and exercise.

Further, Spence proposes that if a person goes to a school or college, this signals as an ability to learn. It is a known fact that a person who is skilled in learning will easily finish his studies than a person who is unskilled. This skilled person by finishing his education signals to the prospective employers his capacity for learning. It does not matter how varied or how less the student has grasped in college, their finishing the college functions as a signal of their capacity of learning. Moreover, getting done with the college or education may act as a signal of the willingness of the individual to adhere to orthodox views, or the ability to pay for the education or it may signal a willingness to comply with authority.

10.3.2 Moral Hazard and its Application to Insurance

A moral hazard problem exists when an agent takes less than the socially optimal care in response to a principal's action. Moral hazard occurs when an insured party whose actions are unobserved can affect the probability or magnitude of a payment associated with an event.

When one party is fully insured and cannot be accurately monitored by an insurance company with limited information, the insured party may take an action that increases the likelihood that an accident or an injury will occur. For example, if a person's house is fully insured against theft, the person may be less diligent about locking the doors when he leaves, then he may choose not to install an alarm system. The possibility that an individual's behaviour may change because the individual has an insurance is an example of a problem known as moral hazard.

The concept of moral hazard applies not only to problems of insurance but also to problems of workers who perform below their capabilities when employers cannot monitor their behaviour ('job shirking'). In general, *moral hazard occurs when a party whose actions are unobserved affects the probability or magnitude of a payment*. For example, if one has a complete medical insurance coverage, he may visit the doctor more often than he would if his coverage were limited. If the insurance provider can monitor its insurees' behaviour, it can also charge higher fees for those who make more claims. But if the company cannot monitor behaviour, it may find its payments to be larger than expected. Under conditions of moral hazard, insurance companies may be forced to increase premiums for everyone, or even to refuse to sell insurance at all.

Consider, for example, the decisions faced by the owners of a warehouse valued at ` 100,000 by their insurance company. Suppose that if the owners run a 50 fire-prevention programme for their employees, the probability of a fire is .005. Without this programme, the probability increases to .01. Knowing this, the insurance company faces a dilemma if it cannot monitor the company's decision to conduct a fire-prevention programme. The policy that the insurance company offers cannot include a clause stating that payments will be made only if there is a fire-prevention programme. If the programme were in place, the company could insure the warehouse for a premium equal to the expected loss from a fire—an expected loss equal to .005 × 100,000 = 500. Once the insurance policy is purchased, however, the owners no longer have an incentive to run the programme. If there is a fire, they will be fully compensated for their financial loss. Thus, if the insurance company sells a policy for 500, it will incur losses because the expected loss from the fire will be 1000(.01 × 100,000).

NOTES

Moral hazard is not only a problem for insurance companies. It also alters the ability of markets to allocate resources efficiently. In Figure 10.2, for example, *D* gives the demand for automobile driving in miles per week. The demand curve, which measures the marginal benefits of driving, is downward sloping because some people switch to alternative transportation as the cost of driving increases. Suppose, initially the cost of driving includes the insurance cost and that insurance companies can accurately measure miles driven. In this case, there is no moral hazard and the marginal cost of driving is given by MC. Drivers know that more driving will increase their insurance premium and so increases their total cost of driving (the cost per mile is assumed to be constant). For example, if the cost of driving is 1.50 per mile (50 paisa of which is insurance cost), the driver will go 100 miles per week.

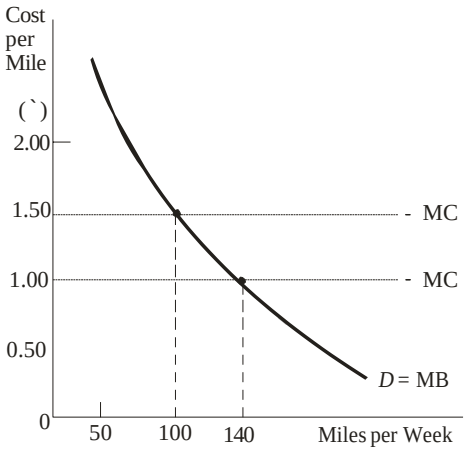

Fig. 10.2 *The Effects of Moral Hazard*

A moral hazard problem arises when insurance companies cannot monitor individual driving habits, so that the insurance premium does not depend on miles driven. In that case, drivers assume that any additional accident costs that they incur will be spread over a large group, with only a negligible portion accruing to each of them individually. Because their insurance premium does not vary with the number of miles that they drive, an additional mile of transportation will cost ` 1.00, as shown by the marginal cost curve MC′, rather than ` 1.50. The number of miles driven will increase from 100 to the socially inefficient level of 140.

Moral hazard not only alters behaviour, it also creates economic inefficiency. The inefficiency arises because the insured individual perceives either the cost or the benefit of the activity differently from the true social cost or benefit. In the driving example of Figure 10.2, the efficient level of driving is given by the intersection of the marginal benefit (MB) and marginal cost (MC) curves. With moral hazard, however, the individual's perceived marginal cost (MC′) is less than actual cost, and the number of miles driven per week (140) is higher than the efficient level at which marginal benefit is equal to marginal cost (100).

Check Your Progress

5. What is asymmetric information?
6. Why do market failures arise?
7. Who analysed the first implications of asymmetric information about product quality?
8. When does a moral hazard occur?

5.4 SUMMARY

In this unit, you have learnt that:

- Most decision theories are normative or prescriptive, i.e., it is concerned with identifying the best decision making assuming an ideal decision maker who is fully informed, able to compute with perfect accuracy, and fully rational.

NOTES

- Uncertainty is a case when there is more than one possible outcome to a decision and where the probability of each specific outcome occurring is not known.
- Certainty refers to a situation where there is only one possible outcome to a decision and this outcome is known precisely.
- Risk refers to a situation where there is more than one possible outcome to a decision and the probability of each specific outcome is known or can be estimated.
- The condition of certainty refers to a state of perfect knowledge. It implies that investors have complete knowledge about the market conditions, especially the investment opportunities, cost of capital and the expected returns on the investment.
- The pay-back period is also known as 'pay-out' and 'pay-off' period. The pay-back period method is the simplest and one of the most widely used methods of project evaluation.
- All other things being the same, a project with a shorter pay-off period is preferred to those with longer pay-off period. This method of ranking projects or project selection is considered to be simple, realistic and safe.
- The concept of the present value of money is very well reflected in the proverb 'a bird in the hand is worth two in the bush'. In general, money received today is valued more than money receivable tomorrow.
- The Internal Rate of Return (IRR) is also called Marginal Efficiency of Investment (MEI), Internal Rate of Project (IRP) and Break-even Rate (BER).
- The IRR or MEI is defined as 'the rate of interest or return which renders the discounted present value of its expected future marginal yields exactly equal to the investment cost of project'.
- Hurwicz has suggested a criterion for investment decisions under uncertainty. In his opinion, full realization of optimistic pay-off or full realization of most pessimistic pay-off is a rare phenomenon.
- The Laplace criterion uses the Bayesian rule to calculate the expected value of each strategy. Bayesian rule says that where meaningful estimate of probabilities is not available, the outcome of each strategy under each state of nature must be assigned the same probability and that the sum of probabilities of outcome of each strategy must add up to one.
- Asymmetric information is a situation where some people have more information about a thing than others. Asymmetric information is characteristic of many business situations.
- Asymmetric information explains many institutional arrangements in our society. It is one reason why automobile companies offer warranties on parts and service for new cars; why firms and employees sign contracts that include incentives and rewards, and why the shareholders of corporations must monitor the behaviour of managers.
- In an ideal world of fully functioning markets, consumers would be able to choose between low-quality and high-quality cars. While some will choose low-quality cars because they cost less, others will prefer to pay more for high-quality cars.
- The implications of asymmetric information about product quality were first analysed by George Akerlof.

NOTES

- Adverse selection is a process used in economics in which such results occur which are undesired when the buyers and sellers have access to different or imperfect information.
- George Akerlof's 'The Market for Lemons' from 1970 is an archetypal paper on adverse selection. This paper brought numerous informational concerns to the forefront of economic theory. This paper also discusses the two principal solutions to this problem, screening and signalling.
- The idea of signalling was originally propounded by Michael Spence. He was of the idea that when a situation of information asymmetry comes into being, people can or may signal their type, simultaneously transporting information to the other party and resolving the asymmetry.
- A moral hazard problem exists when an agent takes less than the socially optimal care in response to a principal's action.
- The concept of moral hazard applies not only to problems of insurance but also to problems of workers who perform below their capabilities when employers cannot monitor their behaviour ('job shirking').
- A moral hazard problem arises when insurance companies cannot monitor individual driving habits, so that the insurance premium does not depend on miles driven.
- Moral hazard not only alters behaviour, it also creates economic inefficiency. The inefficiency arises because the insured individual perceives either the cost or the benefit of the activity differently from the true social cost or benefit.

5.5 KEY TERMS

- **Uncertainty:** It is a case when there is more than one possible outcome to a decision and where the probability of each specific outcome occurring is notknown.
- **Certainty:** It refers to a situation where there is only one possible outcome to a decision and this outcome is known precisely.
- **Risk:** It refers to a situation where there is more than one possible outcome to a decision and the probability of each specific outcome is known or can be estimated.
- **Condition of certainty:** It refers to a state of perfect knowledge.
- **Pay-back period:** It is defined as the time required to recover the total investment outlay from the gross earnings, i.e., gross of capital wastage or depreciation.
- **Time lag:** The time gap between the investment and the first return from the investment is called 'time lag'.
- **Internal Rate of Return (IRR):** The rate of interest or return which renders the discounted present value of its expected future marginal yields exactly equalto the investment cost of project.
- **Asymmetric information:** It is a situation where some people have more information about a thing than others.
- **Adverse selection:** It is a process used in economics in which such results occur which are undesired when the buyers and sellers have access to differentor imperfect information.

5.6 ANSWERS TO 'CHECK YOUR PROGRESS'

NOTES

1. Uncertainty is a case when there is more than one possible outcome to a decision and where the probability of each specific outcome occurring is not known.
2. The condition of certainty refers to a state of perfect knowledge. It implies that investors have complete knowledge about the market conditions, especially the investment opportunities, cost of capital and the expected returns on the investment.
3. This method is 'a crude rule of thumb' and can hardly be defended except on the ground of avoiding risk associated with long pay-back projects. Besides, this method assumes that cash inflows are known with a high degree of certainty.
4. The decision index is, in fact, a weighted average of maximum possible and minimum possible pay-offs, weight being their subjective probability such that sum of probabilities of maximum (Max) and minimum (Min) pay-offs equals one.
5. Asymmetric information is a situation where some people have more information about a thing than others. Asymmetric information is characteristic of many business situations.
6. Market failure arises because there are owners of high-quality cars who value their cars less than potential buyers of high-quality cars. As a result, both parties can enjoy gains from trade.
7. The implications of asymmetric information about product quality were first analysed by George Akerlof.
8. Moral hazard occurs when an insured party whose actions are unobserved can affect the probability or magnitude of a payment associated with an event.

5.7 QUESTIONS AND EXERCISES

Short-Answer Questions

1. What is decision analysis?
2. Distinguish between certainty and uncertainty.
3. Write a note on the concept of present value.
4. Define internal rate of return (IRR).
5. 'Hurwicz has suggested a criterion for investment decisions under uncertainty.' What is this criterion?
6. Why do automobile companies offer warranties on parts and service for new cars?
7. How does the market for used cars describe the idea of asymmetric information?
8. What is the lemon's problem?
9. Write a note on adverse selection and signalling.
10. What is a moral hazard?

Long-Answer Questions

1. Discuss the concept of risk, certainty and uncertainty. Also, discuss choices taken under uncertainty.

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2. Describe investment decisions under the condition of certainty.
3. Evaluate investment decisions under the condition of uncertainty.
4. Assess the concept of asymmetric information. Also, discuss the implications of asymmetric information using the example of market for used cars.
5. Critically evaluate the term 'adverse selection' and 'signalling'.
6. What is moral hazard? Discuss.
7. Discuss the applications of moral hazards on insurance.

5.8 FURTHER READING

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Institute of Distance Education

Rajiv Gandhi University

A Central University

Rono Hills, Arunachal Pradesh

Contact us:

+91-98638 68890 | Ide Rgu | Ide Rgu | helpdesk.ide@rgu.ac.in

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A Central University

Rono Hills, Arunachal Pradesh

Contact us:

+91-98638 68890 | Ide Rgu | Ide Rgu | helpdesk.ide@rgu.ac.in