EMPLOYMENT AND OUTPUT OBJECTIVES IN PROJECT SELECTION

BASUDEB SEN

A dissertation submitted to the Indian Statistical Institute
In partial fulfillment of the requirements for the award
Of the degree of
Doctor of Philosophy

1975

PREFACE

The origin of the piece of research work contained in the following pages is to be traced back to 1969 when the author was admitted to the Indian Statistical Institute as a Research Student under the Research Course leading to Ph. D. degree. I will ever remain grateful to our Institute for providing me an opportunity to complete the study. That I could fruitfully avail myself of this opportunity, however, is due t- the constant encouragement, valuable advice and extensive support of Dr. Deb Kumar Bose, Professor and Head, Economic Research Unit, under whose supervision the present study has been carried out. I express my deep sense of gratitude to Dr. Bose who patiently endured the frequent disturbances caused by me to his busy time schedule of work, has carefully gone through various drafts of the study and devoted long hours for discussions both at the Institute and at his residence. I wonder whether the present work would pass a social cost benefit test, considering the costs I inflicted on him. My sincere thanks are also due to Mrs. Bose who practically encouraged me to draw upon their holidays for the benefit of the study.

I gratefully acknowledge the stimulating discussions with and valuable suggestions from my teacher Dr. Sanjit Bose, Associate Professor. Indian Statistical Institute, who also accommodated in his busy work schedule, the time to go through a large portion of a chapter.

My association with the faculty members, ~~research scholars~~ and other staff of Economic ~~Research~~ Unit, Indian Statistical Institute, Calcutta as well as my colleagues at the Research Division, United Bank of India, Calcutta has been rewarding in many respects. My sincere thanks are due to all of them. In particular, I may mention the encouragement given to me by my teacher Dr. N. Bhattacharya, Professor, Indian Statistical Institute and Mr. D. N. Bhattacharya, Economist, United Bank of India. I also acknowledge the assistance and co-operation I received from my colleagues Mr. Dipankar Coondo and Mr. D. K. Bose, Librarian of United Bank of India and Professor Pradip Maiti and Mr. Sajal Lahiri of Indian Statistical Institute.

I would also like to recall the blessings and inspiration that flowed from my parents and elder brothers, and, in particular, their appreciation of my stand that Pramita and myself getting married in 1973 would in no way hinder the progress of the present work. And I am grateful to my wife for her assistance and patience during the last two and half years.

Finally, my sincere thanks are to Mr. K. C. Neogi for his neat and elegant typing of the thesis, Mr. L. M. Das for work relating to duplication of copies, and Mr. B. Bose for co-ordination work at various stages.

Calcutta
August 18, 1975.

Basudeb Sen

CONTENTS

Introduction

PRESENT STUDY — A SYNOPTIC OUTLINE

Alarmingly high and increasing rates of unemployment among the fast growing labour force has, in the recent years, become a serious threat to the social, political and economic environment in developing countries like India. Despite planned efforts at economic development, the percentage of unemployed in the labour force is estimated to have increased from 9.0 per cent in 1962 to 10.4 per cent in 1971 and 11.0 per cent in 1972 [Dutt and Sundharam (1975)]. Eradication of unemployment through creation of large-scale job opportunities has come to establish itself as a major objective of the country. In the first place, there is the constitutional obligation to provide all Indians with job opportunities. Secondly, growing unemployment creates political and social tensions that hinder the establishment of an environment conducive to the success of efforts at economic development. Thirdly, it has been realized from the experience of the successive Indian Five Year Plans that the modern technology in industries offer little scope for accommodating the increase in the country's labour force. 'Additional employment created by the organized industries over the successive Plans actually declined. It is now being appreciated that it will be a long time before the industrial sector in the country would be able to absorb the unemployed labour force. For sometime to come, therefore, means have to be found to contain substantial volume of the unemployment in the agricultural sector

and in industries and activities which can be labour intensive' [Bose (1975)]. In other words, it is currently being thought that the selection of investment projects should take account of the objective of providing employment to the growing labour force.

One of the primary aims of the present study is to examine how far the currently available procedures of Social Cost Benefit Analysis as applied to the problem of choice of investment projects, take account of the society's objective of employment generation. In Chapter I, the essential characteristics of the social cost benefit approach to the problem of investment project choice in different economic systems are discussed and compared. In Chapter II, an attempt has been made to examine the interrelationships (i) among different macro-objectives, (ii) between macro-objectives and concepts of social costs and social benefits, (iii) among macro-objectives, resources constraints and valuation of costs and benefits, (iv) between macro-objectives and aggregation of costs and benefits distributed over time, and (v) between macro-objectives and the micro-level project choice criteria. The discussions in these first two Chapters reveal that employment generation has seldom, if ever, been treated as a disparate objective of the society. It is assumed that the objectives of aggregate consumption, output growth and income redistribution subsume the objective of employment and that there does not exist any conflict between the objectives of output growth and employment growth. Accordingly, most of the micro-level project choice criteria suggested in the literature are consistent with the macro-objectives of output growth, aggregate consumption and distribution. Some of these criteria

which are consistent with the objective of output growth (including those criteria found in the literature on social cost benefit analysis as applied in socialist countries) are compared under different project choice situations and their formal equivalence under certain conditions shown in Chapter III.

Chapters IV, V and VI serve the second basic aim of the present study, namely, to establish the need for treating employment as an independent macro-objective in Social Cost Benefit Analysis and derive a project choice criterion which is consistent with twin macro-objectives of output growth and employment growth. The possibility of conflict between output and employment objectives is shown in Chapter IV in terms of a project model and a macro-model. In the light of the large-scale and growing unemployment in developing countries such as India and in view of the possible conflict between output growth and employment growth demonstrated in Chapter IV, in Chapter V the importance of employment as an independent macro-objective is discussed, a project choice criterion of weighted sum of contributions towards the objectives of output growth and employment growth is suggested and a shadow wage rate formula is derived (on the basis of the suggested criterion) and compared with some of the standard shadow wage formula suggested in the literature on Social Cost Benefit Analysis and investment project choice. The application of the suggested criterion is illustrated with the help of data based on financing activities by Indian Commercial banks which have been expected to contribute towards faster employment generation in the country by formulating and financing appropriate

schemes of credit assistance to various productive activities. In what follows, a brief resume on each of the Chapters of the present study is presented.

Chapter I begins with illustrations of effects associated with investments projects, which are classified into social benefits and costs, statement of the problem of choice among investment projects and a discussion on a general choice criterion based on cost-benefit calculation as formulated by Tinbergen(1963) with an indication of the difficulties of applying such a choice criterion. The history and the need for undertaking Social Cost Benefit Analysis of projects in place of Private Cost Benefit Analysis in advanced market economies and developing economies are discussed next, followed up by an indication of the relation of Welfare Economics and Social Cost Benefit Analysis (SCBA). In the subsequent section the approach of SCBA of investment projects undertaken in socialist countries is examined and compared with SCBA as applied in western capitalist market economies (as discussed earlier). It has been shown that SCBA in both socialist and non-socialist setting are primarily guided by the macro-objective of output growth. The differences which exist despite some formal similarities between their approaches are also pointed out. In the concluding section of this Chapter, the role of SCBA under planning — whether in a socialist or non-socialist economy — is examined.

On the basis of a brief survey of the literature on various aspects of SCBA, the importance of the society's macro-level objectives in any social cost benefit analysis of projects is sought to be highlighted and the

relation between different macro-objectives (such as, aggregate consumption, redistribution, output growth and employment) and the various steps in SCBA are examined in Chapter II. It has been argued that the relevant concept of benefits and costs, the appropriate procedures of valuation (pricing) and intra-temporal and inter-temporal aggregation of benefits and costs as well as the appropriate criterion of project choice may well be different from the point of view of different macro-objectives. It has been shown that the development of the techniques of SCBA has been guided primarily by the objective of aggregate consumption or output growth. Sometimes, the objectives of redistribution and employment have also been considered. But, these objectives have been treated generally in an indirect manner, i.e., the techniques of social cost benefit calculation have been modified so as to work out an adjusted contribution of each project towards the primary objective of aggregate consumption or output growth in the light of the secondary objectives of redistribution and employment expansion. For example, the aggregate consumption benefits are adjusted to take account of the distribution of benefits among individuals/groups. Again, the shadow prices of investment and labour are determined in a manner such that the projects which are associated with relatively high surplus generation (re-investments) and relatively high employment tend to get priority over other projects. It has been argued that these procedures involve assigning of weights to the different objectives — primary and secondary — in an implicit manner. It has been argued that a better procedure would be the one that involves explicit weighting based on an examination of the nature

of interrelationship among the objectives, i.e., whether they are conflicting in nature or not, and on the basis of the relative importance of the objectives to the society. The method of explicit weighting of objectives and working out weighted sum of contributions of projects towards different macro-objectives helps the society know the trade-off implication of alternative investment project choice decisions. The knowledge of trade-off implications is necessary for more informed and rational decision-making when there exists theoretical and empirical bases for questioning the assumption made by some economists that objectives like output growth and employment growth are not conflicting (i.e., an increase in output/employment growth implies that employment/output growth will also increase). Once multiple objectives are introduced, the problems of undertaking SCBA of investment projects increase. In the first place, the valuation and aggregation procedures applicable under the objective of aggregate consumption are unlikely to be appropriate under other objectives such as employment. For example, it is difficult to find a unit of measurement for employment benefits and costs and aggregating benefits from the increase in employment of different categories. Again, the considerations which suggest that future benefits are less valuable than present benefits under the gggregate consumption objective may not be relevant under the employment objective; the rate of discount for employment benefits will be influenced by other considerations also. Secondly, the weights to be assigned by a society to different macro-objectives may be difficult to determine. Finally, there is the problem of designing an appropriate investment project choice criterion to

be applied at the micro-level which would be consistent with the relative weights assigned to different objectives of the society at the macro-level. Talking of investment criteria, a number of criteria suggested in the literature in the light of different macro-objectives have been examined. The conflict among different criteria consistent with aggregate consumption (or output-growth objective) and a proposed procedure of resolving the conflict have been discussed. An attempt has also been made to examine the nature of problems which arise because of externalities and linkages and uncertainties and risks.

In Chapter III various criteria such as Payback Period Criterion (PPC), Present Value Criterion (PVC), Internal Rate of Return Criterion (IRORC), True Rate of Return Criterion (TRORC) and Limiting Recoupment Period Criterion (LRPC), which are consistent with the output growth objective are compared under varying situations concerning project choice. The limitation of the concept of payback period has been demonstrated by the restricted applicability of generalized versions of PPC in situations where projects can be classified as quick-yielding and late-yielding and when investment outlays in projects are required to be made in phases. The superiority of PVC over PPC in this respect is also noted. A comparison of PVC and IRORC shows that under conditions of budgetary constraints they yield the same results (provided that internal rate of return is unique). The TRORC can be easily shown to be a generalized version of IRORC. The possibility of conflict among TRORC and PVC has also been made. This Chapter also makes an attempt at demonstrating the formal similarity among the above five criteria under choice involving incompatible projects.

In Chapter IV, the relation between output growth and employment growth in the short-run as well as in the long-run has been examined in terms of a project model and a macro-model. The project model shows that when the choice in all periods is restricted to a given set of projects, output growth is faster, the higher is the internal rate of surplus generation. Moreover, in the long-run, the rates of growth of output and employment are equal to the internal rate of surplus generation for all the projects taken together. However, there could be a conflict between long-run output growth and short-run employment growth (choice of labour-intensive technique creates larger employment but often implies smaller surplus generation rate and thereby depresses the long-run output growth rate). The macro-model which assumes that the labour-capital ratio for the economy as a whole declines at a constant rate over time shows that it is quite possible that in the short-run as well as in the long-run, (i) growth rate of output may be higher than the growth rate of employment, (ii) growth rate of output may be positive while the growth rate employment may be negative and (iii) a faster rate of decline in labour-capital ratio (i.e., a faster rate of increase in capital-intensity) in the economy may raise the growth rate of output but lower the growth rate of employment. The conditions under which the inverse nature of relation between output growth and employment growth as expressed in (ii) and (iii) above holds good have been established. It has been shown that whether there will be a conflict between output growth and employment growth or not depends on the inter-relation among the rates of change in the labour-capital ratio, output-

capital ratio and the surplus-capital ratio. The sources (factors) explaining the existence of conflict between output growth and employment growth have also been discussed.

Chapter V begins with a discussion of the nature of considerations that call for treating employment growth as an important and desparate macro-objective of the society. Briefly stated, the possibility of inverse nature of relation between output growth and employment growth, the failure of a large number of developing economies to avoid sharp rise in unemployment to serious proportions leading to social tensions and environmental chaos, the relative abundance of manpower and the relative scarcity of non-renewable resources, the distributional implications of faster expansion of unskilled employment, etc., explain the basis for incorporating employment expansion as a major and independent macro-objective in the Social Welfare Function. With both output growth and employment growth as the macro-objectives, a criterion of weight sum of contributions of projects towards these two objectives has been suggested. The application of the criterion also involves that the choice of projects is restricted to those projects which make non-negative contribution towards output growth objective. For, even in an economy with large-scale unemployment, society is unlikely to prefer a situation of declining output just for the sake of employment. The possibility of incorporating in this criterion, a set of weights consistent with the macro-levels weights (signifying the relative importance of the above two objectives of the society) has also been demonstrated. The suggested criterion, it has been shown, is equivalent to

to maximizing the rate of surplus generation, where the rate of surplus generation is worked out on the basis of a shadow wage rate given by a specific formula. This shadow wage rate formula has been compared with the usual shadow wage rate formula consistent with the aggregate consumption objective, which have been suggested in the SCBA literature. It has been shown that the usual formula implicitly assigns weights on the objectives of output growth and employment. In the final section of this Chapter, the nature of extension of the suggested cirterion, which is necessary to take account of the linkages and externalities is indicated.

In the concluding Chapter, an attempt has been made to illustrat the application of the criterion suggested in Chapter V. In India commercial banks have been called upon to contribute effectively towards the generation of employment through financing appropriate credit schemes. It has been shown that the usual (pre-sanction) credit appraisal procedures are consistent with the output growth objective only. It is felt that the adoption of the suggested criterion for project choice and allocation of finance among alternative credit schemes would impart the desired employment-orientation to the banks' lending activities. Two illustrations, on the basis of data available in extant literature, are presented — one on financing of job printing projects and another on financing of alternative farm mechanization schemes.

Chapter I

SOCIAL COST BENEFIT APPROACH TO INVESTMENT PROJECT CHOICE PROBLEM

1.1 Investment Project : Associated Effects

1.1.1 The structural differences among the economies notwithstanding (planned or free market, socialist or capitalist one or a variant of any or a mixture of the two), a basic problem of choice at the micro-level that a decision-maker invariably encounters with relates to the selection, among a given set of investment projects or project variants, of the sub-set of projects/variants that achieves the maximum results under a specified set of objectives and constraints. Any project, if implemented, is associated with one or more effects on the national economy, the individuals comprising the society and the society as a whole. From the point of view of the society, these effects may be classified, at least with accuracy enough for practical purposes, into two broad categories, viz., (i) social benefits[1/] — those effects which imply some positive gains to any subset of individuals constituting the society, and (ii) social costs[2/] — those effects which involve some loss or

---

1/ & 2/ For illustrative purpose, some of the social benefits and social costs associated with different types of investment projects are indicated below :

project	some social benefits	some social costs
A Water Reservior	(i) elimination of possible damage by floods and increased production of crops;	(i) capital cost of construction;
	(ii) employment to a set of individuals.	(ii) operating costs on fuel & labour etc.;
		(iii) maintenance cost (for desilting operations).

contd/....

sacrifice on the part of any subset of individuals comprising the society 3/

A rational procedure of selecting among a given set of alternative projects/

Footnotes 1/ & 2/ contd.

projects	some social benefits	some social costs
An Airport	(i) easier flow of air-borne passenger traffic; (ii) employment to individuals	(i) capital cost of construction; (ii) maintenance costs; (iii) air-pollution and noice-disturbance.
An Underground Railway	(i) time-savings for passengers resulting from lessening of congestion of vehicles on existing surface railway and other routes during peak hours; (ii) possible cost-savings because of the use of direct routes; (iii) employment to individuals.	(i) capital cost for earth removal, construction of tunnel and acquisition of rolling stock; (ii) cost of maintenance of tunnel and equipments; (iii) cost of operating railway services; (iv) inconvenience caused to people and vehicular traffic during earth removing and construction work.
An Agro-cum-Custom-Service Centre	(i) increased production by farmers availing of agro-cum-custom services; (ii) employment to individuals;	(i) capital cost for acquiring machinery and implements etc.; (ii) operating costs on labour, fuel and other inputs; (iii) maintenance costs.
Introduction of a fleet of Mini-buses on selected routes of a city	(i) increased comfort to passengers; (ii) employment to individuals.	(i) capital cost for acquiring mini-buses; (ii) operating and maintenance costs.
A Paper and Pulp Mill	(i) increased availability of paper and paper boards; (ii) employment to individuals; (iii) saving in foreign exchange through reduction in imports of paper; (iv) surplus available for further investment (potential contribution to future output growth)	(i) capital cost for acquiring machinery; (ii) costs of procuring raw materials from forests; (iii) other operating and maintenance costs; (iv) environmental costs such as health hazards caused due to discharge of effluents into water from paper factory and ill-effects of deforestation.

3/ Costs, however, may be interpreted as negative benefits. For practical purposes, since generally there is an upper limit on the costs that may be borne or incurred at a certain point of time or during a specified period of time, the distinction between benefits and costs proves usef

project variants (proposed for undertaking), would be to select the subset of projects associated with positive net social benefits where net social benefits are defined as social benefits less social costs[4]. In other words, the first requirement under Social Cost Benefit Analysis (SCBA), which a project must satisfy would be that it should show an excess of social benefits over social costs or a social benefit-cost ratio greater than unity[5]. Otherwise, the project would not be regarded as viable.

1.2 The Choice Problem

1.2.1 It may not, however, be feasible to choose all viable projects for implementation. The decision-problem with regard to choice of projects among alternatives assumes economic significance because of the fact that the objective conditions prevailing in a real economy impose an upper limit on the total costs that the society is able to bear at any particular point/period of time. For example, the investment fund in the economy may be limited and the total investment requirement of all the viable projects cannot be greater than the availability of investment fund. In other words, a real economy is characterized by a limited endowment of resources from which the projects chosen will draw upon and hence any number of projects with social benefit-cost ratios greater than unity cannot be undertaken for implementation. It is, therefore, necessary to rank the viable projects in terms of an appropriate index of social desirability and choose from

4/ One of the basic problems in project evaluation is concerned with the measurement of various costs and benefits, in quantitative terms, and their aggregation.

5/ Viability may be defined also as non-negative net benefits or benefits-cost ratio not less than unity, which is less restrictive.

these projects in accordance with the relative desirability till the resources are fully allocated among the selected set of projects. This ensuresthat the selected projects are associated with net social benefits of the maximum possible measure.

1.3 A General Criterion of Choice

1.3.1 The decisions with regard to the choice among projects or project variants in a real economy are taken generally by a large number of micro-level planners quite independently of each other. It appears necessary that such micro-level decisions are made on the basis of an appropriate decision rule or criterion or priority index or measure of desirability which will ensure : (i) the attainment of maximum measure of net social benefits (evaluated in the light of the society's macro-level objectives), and (ii) that the total demand of projects chosen for each resource is not larger than its supply.

1.3.2 If B_i be the set of social benefit variables and P_i be the equilibrium prices for different types of social benefits (i) per unit, the gross social benefits associated with any project may be expressed as $\sum_i P_i \cdot \Delta B_i$ (where Δ denotes the increase/decrease in the amount of social benefit or cost in the economy, which results from the project). Similarly, the social cost involved in the project may be measured by $\sum_i P_j \cdot \Delta R_j$ where P_j is the 'equilibrium' price for the j-th resource and R_j is the j-th social resource (cost) variable.

The ranking of the projects may be made according to the Priority Index I given by

$$I = \frac{\text{Social Net Benefits}}{\text{Social Costs}} = \frac{\sum_i P_i \cdot \Delta B_i - \sum_j P_j \cdot \Delta R_j}{\sum_j P_j \cdot \Delta R_j} \quad \ldots (1.1)$$

In other words, 'I' measures the value of social net benefits per unit of social costs involved in a project.

1.3.3 The values for P_j will be so determined that the demand (from k projects actually chosen) for the j-th resource factor is less than or equal to its availability ($\bar{R}_j$),

$$\sum_k \Delta R_j \leq \bar{R}_j \qquad \text{for all } j \qquad \ldots (1.2)$$

The values for P_i may be obtained exogenously and should normally be expected to reflect the relative weight to be attached to the benetit variable i.

1.3.4 Precise application of this criterion is confronted with difficulties in the absence of adequate data required for the estimation of the future stream of costs and benefits associated with the projects and the estimation of prices which would reflect the relative scarcity of different resources and the relative importance of different types of social benefits (i.e., prices which appropriately take account of resource constraints and social objectives). A simplified procedure usually applied involves the use of market prices for factors/resources and output/benefits, (this resembles the usual profitability criterion which governs investment decisions in commercial firms in a market economy). A refined

procedure involves estimation of equilibrium prices (often termed as 'accounting' or 'shadow' prices) through a process of trial and error. The problem in estimation of prices may be stated as follows :

$$\text{maximize } W\left\{B_i\,(I, P_j, P_i)\right\} \qquad \ldots (1.3)$$

subject to

$$\text{resource constraints : } R_j\,(I, P_j, P_i) = \bar{R}_j \qquad \ldots (1.4)$$

and

$$\text{input-output relations : } \phi_i\,(R_j) = B_i \qquad \ldots (1.5)$$

Adopting the Lagrange Method the problem is to maximize

$$W\left\{B_i\,(I, P_j, P_i)\right\} + \sum_i \lambda_i \left\{\phi_i\,(R_j) - B_i\right\} + \sum_j \lambda_j \left\{R_j\,(I, P_j, P_i) - \bar{R}_j\right\} \qquad \ldots (1.6)$$

The optimality conditions are

$$\frac{\delta W}{\delta B_i} = \lambda_i, \qquad i = 1, 2, \ldots, m$$

$$\sum_i \lambda_i \frac{\delta \phi_i}{\delta R_j} = \lambda_j, \qquad j = 1, 2, \ldots, n \qquad \ldots (1.7)$$

The equilibrium prices of B_i and R_j are respectively the values of λ_i and λ_j which satisfy the optimality conditions above. The values of λ_i and λ_j are arrived at through a trial and error procedure.6/

6/ A detailed description of the trial and error procedure as well as a cogent presentation of the problem have been made by Tinbergen (1963).

1.3.5 In practice, however, it is difficult to take account of all types of benefits relevant from the point of view of the individuals and the society. Besides, it is practically an impossible task to identify all meaningful resource constraints and associated costs and take all of them into account in social cost-benefit calculations with reasonable degree of accuracy and ease. For illustration, mention may be made of the social objectives such as clean air, non-polluted water, quality of life, love, peace of mind, self-actualization, companionship and time for rest, leisure and contemplation. By the very nature of these objectives, the benefits or costs relevant from the point of view of these objectives are not easily amenable to quantification or measurement. Attempts have been made by some cost benefit analysts to measure benefits (or costs) relevant ~~from~~ environmental objectives such as clean air and water [Henderson Hazel(1973)] 1/ Generally, however, social cost benefit analysis (SCBA) has been applied under situations where benefits and costs are easily identifiable and measurable. It has been pointed out by some, that by ignoring the benefits and costs relevant from point of view of environmental objectives and such other objectives as reflect the psychic needs

---

1/ For example, in cost benefit analysis of pollution control, attempts have been made, using marginal analysis and economic compensation principles of welfare economics, to evaluate environmental goals in terms of willingness to pay for some standard environmental quality or the willingness to accept compensation for damage. (These are further discussed in Chapter II, Sec. 2.6 .) However, the interpretation of the objectives of clean air, non-polluted water, rest and health in terms of desires or preferences for money income has been considered untenable in certain quarters, particularly by ecologists [Kapp (1971)].

of the individuals comprising the society, the application of SCBA helps ensure partial optimality only[8].

1.3.6 In SCBA literature, generally the maximization of aggregate consumption is taken as the sole macro-economic objective of the society. With this objective, the consumption of goods and services (valued in terms of willingness to pay by the consumers) generated by a project is counted as benefit and the sacrifice involved in terms of consumption foregone is counted as costs. In other words, the increments to the possibility of consumption of goods and services associated with a project is the net social benefit accruing from the project[9]. In a competitive economy, the allocation of resources into projects which will yield the maximum possible net consumption benefit to the society is also the set of projects which generates maximum possible surplus, in value terms, of outputs over inputs including labour (since, theoretically, this results in an efficient allocation of resources in a competitive market economy, this concept of net benefits is also termed efficiency benefits). Under certain conditions, maximization of surplus (or profit) also ensures maximization of the rate of growth of output (as measured in terms of the rate of growth of the Gross National Product or Per Caput Gross National Product). In some developing countries, the basic constraint to economic

8/ And this partial optimality may not help ensure desirable ecological balance. It has been shown that in complex non-linear systems, the optimization of any sub-system will generally be conflicting with the well-being of a larger system of which it is a part [Forrester (1971)].

9/ Marglin (1967) UNIDO (1972), OECD (1969); the relations between this objective and other objectives and other aspects of SCBA are further discussed in Chapter II.

growth is the paucity of investible funds required for undertaking development projects. And, in the light of this constraint and the objective of maximizing rate of growth of income, the usual criterion adopted is maximization of the rate of return (or profit) on investment outlay[10]. In the simplest formulation of the model duducing this criterion, the argument runs as follows : a higher rate of return implies a higher rate of surplus and a higher rate of capital accumulation for the Society, which in turn implies a faster rate of growth of national output or income.

1.4 SCBA in Market Economies

1.4.1 Although the origins of the SCBA which has become highly fashionable in recent decades may be traced back to the theoretical welfare economics of the nineteenth century[11], the formal recognition of SCBA in economic policy-making was in the legislation on water resources made in the United States in the 1930's. The Flood Control Act of 1936 was based on the principle of comparing benefits with costs. In the Green Book of 1950 produced by the Federal Inter-Agency River Basin Committee and the Budget Circular A.47 of 1952 released by the Bureau of Budget attempts were made at formalization of criteria involving social cost benefit calculation. At about the same time contributions in

---

10/ Golden Rule of Accumulation : Tinbergen (1960), von-Neuman (1945-6), and Robinson (1956).

11/ The welfare basis of SCBA is discussed in Section 1.5.

academic journals on these criteria appeared. With the publication of the works of Eckstein (1957 , 1958), Mckean (1958), and Krutilla and Eckstein (1958), the applications of SCBA made a real beginning. A monumental volume on the application of social cost benefit principles to water resources development was published by the Harvard Water Resources Program in 1962 (Maass et. all). In the United Kingdom a Government White Paper in 1967 formally recognized the principle of social cost benefit analysis, although its application was limited to the nationalized industries. The exercises in SCBA in U.K. were mostly confined to transport projects and to some extent to expenditure on education, nuclear power plants and research and development.

1.4.2 The limited application of SCBA in Western Capitalist countries is due to the belief that under the conditions prevailing in these economies, private benefits and private costs are, in general, satisfactory measures of social benefits and social costs. It is assumed that the competitive general equilibrium is reasonably approximated by their economic systems. Since under such an economic framework all individuals are satisfied with the monetary transactions they make and the objective of the society is to maximize aggregate consumption, the efficient allocation of investment fund among alternative projects is ensured by the application of the criterion of maximizing private rate of return (profits) on investment expenditure. It is, however, well recognized that there exist situations, even in such advanced capitalist economies,

under which significant divergence between private benefits (and costs) and social benefits (and costs) may arise. Under such circumstances, project appraisal and selection should not be made on the basis of Private Cost Benefit Analysis (which is nothing but profit-loss accounting practised by private enterprises in a market economy). Social Cost Benefit Analysis should be undertaken to evaluate the projects in terms of their probable effects on not only the project owners but also the employees engaged, consumers served and other groups in the society. In place of the private benefit (revenue receipts) a less precise but meaningful concept of social benefit and in place of private costs (expenditure and purchases) a concept of social value foregone (or social opportunity costs) have to be introduced. Once this is done project ranking and selection may be done on the basis of a priority index like 'I' in para 1.3.2.

1.4.3 The need for resorting to SCBA instead of Private Cost Benefit Analysis (PCBA) can not be underscored, particularly, in situations where either (i) the price mechanism can offer very little guide to the evaluation of benefits (e.g., education, health, defence, roads, etc., — the services in which are seldom thought of as being saleable to individuals or where exclusion principle does not apply[12]), or (ii) the price

12/ Exclusion principle is said to apply when a person could be excluded from the enjoyment of a particular commodity or service unless he is willing to pay a stipulated price for such enjoyment /Musgrave (1959)/. This principle fails to apply in the case of flood-control project which saves an entire region, sanitary campaigns which raise the general level of health, and expenditures on defence and judiciary system. Sometimes, the failure of the exclusion principle can even lead to disatrous situations. Large communal fields for grazing animals in U.K. were destroyed because each individual tried to maximize his income by grazing more animals than others /Garret (1968)/.

mechanism fails to reflect the real scarcities of natural resources (e.g., oil, coal, water, forests) because of uneven availability of information[13] and lagged response of market prices to relative resource scarcities indicated by resource-depletion rates[14]; (iii) the projects involve considerably large investment outlay and are associated with costs and benefits of magnitudes significant enough to alter the price relations prevailing in the economy, or (iv) the investment projects are associated with considerable external effects or interdependence[15]. Besides, the rate of return criterion based on the society's macro-objective of maximizing aggregate consumption may well fail to take account of other macro-objectives (e.g., ideal distribution of income or maximization of employment) which the society may like to achieve.

13/ Lamberton (1971) has shown that uneven information availability may distort labour market, prices and political and corporate decision-making. It has been pointed out that in the absence of considerable dissemination of information among buyers and sellers in the present-day complex market economies, the uncontrolled aggregation of small decisions may well result in large-scale ecological chaos.

14/ 'Prices are merely subjective expectations of the availability and are not based on scientific research. Therefore, often severe time lags occur between scientists' warning of increased resource depletion or major ecological disturbances (e.g., accelerating water eutrophication rates) and the point at which economists, bankers, corporate managers, etc., incorporate them into their availability forecasts /Henderson, H. (1973)/. According to Wallich (1972) such lags may not allow enough lead time to change pricing policies appropriately.

15/ As a result of external effects, private benefits and costs diverge from social benefits and costs. Kapp (1950 , 1952) has listed environmental and social effects of private business activities to show that maximization of net income by one set of micro-economic units is likely to reduce the income or utility of another set of micro-economic units and the society at large. PCBA is misleading because it ignores social and environmental costs. The manner in which external effects are treated in SCBA is discussed in Chapter II, Section 2.6.3.

1.4.4 The market prices can hardly be expected to retain their normative significance in effecting efficient allocation of resources among projects in the developing economies of the world because of imperfections owing to any one or more of the following : (i) monopoly elements, (ii) large external economies and diseconomies, (iii) sub-optimality of savings, (iv) inflationary pressures, (v) overvaluation of domestic currency, (vi) inelastic demand for exports, (vii) protection and similar restrictive practices, (viii) imperfect capital market, (ix) high unemployment and underemployment, and (x) skewed distribution of income and wealth. Under these situations, PCBA cannot be expected to satisfy the society's macro-objectives and needs to be replaced by appropriate SCBA which would involve the use of accounting prices (and rates) and take into consideration the costs and benefits other than those reflected in the purchases and sales expressed in monetary terms. The accounting (shadow) prices may be estimated by adjusting the market prices appropriately so as to take account of the distortions resulting from any one or more of the factors (i)-(x) above[16/]. In other words, SCBA as developed in western capitalist countries accepts private net profits to be a correct measure of social gain under ideal competitive conditions, but recognizes that distortions of the types noted above may make profits an unsatisfactory index of projects' contribution to social ends. On the basis of the theorems in Welfare Economics,

16/ Controversies exist over the appropriateness of the use of such computed prices as well as the procedure of estimating them. These are discussed in Chapter II, Section 2.3 paras. 2.3.13 - 2.3.15.

the Western school[17] of SCBA points out that under such distortions, prices and costs need not reflect real benefits and costs to the society and estimates social profits as the difference between social benefits and social costs on the premise that actual receipts and expenditures associated with projects could be appropriately corrected so that the difference between them reflect net social gain.

1.5 The Welfare Base

1.5.1 The Western variants of SCBA rests heavily on the theoretical foundations of economic theory and welfare economics as developed in Western countries. Inasmuch as SCBA purports to ensure rational choice of investment projects, it falls in the domain of General Choice Theory in Economics. The alternative projects are to be ranked and ordered so that the efficient set of projects is chosen. The procedure of such ordering and choice must be such that the alternatives satisfy the axiom of comparability, transitivity and asymmetry (implying no two alternatives are such that each is preferable to the other). Further, assuming that the choices are restricted to the feasible (attainable) region, if something is in the feasible region something will be chosen and the chosen alternatives can never have a ranking less preferable to others in the attainable set of alternatives, the theory ensures a solution if the feasible set is non-empty [Walsh (1970)]. Historically, the most important

17/ The basic works on SCBA as developed in the non-socialist countries includes Maass et.all (1962), Marglin (1967), Mishan (1971), Little & Mirrleese (1969, 1974) and UNIDO Guidelines (1972).

applications of the Pure Choice Theory in Economics led to the literature associated with the name welfare economics which studies the optimal attainment of goals by groups of individuals (including the whole society) and is concerned with the discovery of social orderings of alternatives and with their attainments i.e., with social policy. SCBA as applied to choice of investment projects constitutes an attempt at direct application of Welfare Economics in practice. On the basis of the theory of externalities[18] and public expenditures as well as on the basis of such concepts as consumers' surplus, producers' surplus, willingness to pay, Pareto optimality and compensation criteria, SCBA marshalls available information into meaningful figures measuring costs and benefits to determine the ordering of alternative investment projects and examine whether a particular investment project can be justified on grounds of economic welfare.

1.5.2 Costs and benefits associated with any particular investment project generally involve different groups of people. The possible gainers from the benefit expected to be generated by a particular project may not be the same set of people who sacrifice in terms of the contribution they would have to bear towards the cost of the project. Moreover, different individuals and groups may be affected differently (in terms of benefits accruing to and costs inflicted on them) by a project. For purposes of ranking the projects in terms of a cost benefit index, it is necessary

---

18/ Historically, Alfred Marshall was the first economist to write about externalities. He was mostly concerned with positive externalities, i.e., the rising levels of education of workers and public services provided by the Government from which the entrepreneur of his time had benefited without paying a price. A. C. Pigou (1932), Marshall's younger contemporary at Cambridge identified negative externalities such as smoke and sparks pouring out of factory chimneys.

that the costs and benefits accruing to various sets of individuals be reduced to a common denominator. One way of doing this would mean resort to the compensation principles in Welfare Economics, which requires that only projects involving potential gainers attaining a higher level of welfare than before being able to compensate the potential losers such that the latter are not worse off than what they were in the absence of the project, be chosen. However, the degree of compensation to be actually paid by the gainers to losers cannot be specified without making interpersonal utility comparisons. In other words, subjective value-judgements become essential in the application of pure choice theory for practical public policy purposes. Given that the welfare of any individual depends on not only his own state of affairs but also the state of affairs of other individuals comprising the society, any project involving net gains to a group of individuals without any gain or loss for others, although implies an improvement in the Pareto-Optimal sense, need not imply an increase in Social Welfare unless accompanied by a necessary set of valuejudgements. Inasmuch as ranking and evaluation of projects are made in terms of cost benefit calculations which involve introduction of valuejudgement for comparing interpersonal utility comparisons, SCBA can hardly be said to be purely objective in nature. To compare alternative projects in terms of their net contributions to Social Welfare decisions, judgements have to be made on grounds of ethics, social utility, or something else, as to which individuals should gain and which individual to sacrifice [Livington (1935)].

1.5.3 A society may have multiple objectives to realize and contributions of projects towards the satisfaction of each of these objectives needs to be taken account of for purposes of selecting the set of projects which ensure the best use of the available resources for satisfying these objectives. Under the circumstances, SCBA will evidently involve attachment of weights, implicitly or explicitly, to various objectives if the projects are to be ranked in terms of a priority index. The determination of these weights may not be possible without assuming a set of value-judgements as to which objectives are more important than the others and how much important. As these considerations are introduced, the exercises in SCBA get out of the bounds of objective economics[19].

1.5.4 Thus, valuejudgements have to be made if solutions to practical decision problems of choice among projects in terms of social costs and benefits are to be reached. And this is perfectly legitimate in the sense that it works out, for the different sections of the society, the implications of alternative sets of valuejudgements in terms of costs and benefits[20]. Since valuejudgements enter into SCBA in an essential manner,

---

19/ It is because these considerations were thought to be outside the scope of objective economics that Samuelson and Bergson stopped short of developing specific forms of social welfare functions [Bergson (1938), Samuelson (1963)]. Arrow's work (1963) has formally shown the impossibility of constructing, subject to certain reasonable requirements of consistency, social welfare functions on the basis of individual welfare functions without introducing valuejudgements involving interpersonal comparison of utility.

20/ Welfare Economics is scientific in the sense that 'it is a legitimate exercise' in economic analysis examining 'the consequences of various sets of valuejudgements, whether or not they are shared by the theorists, just as the study of comparative Ethics is itself science like any other branch of anthropology' [Samuelson (1963)].

the degree of discretion enjoyed by the project evaluator or the micro-level decision-maker may become relatively large. It is the narrowing down of this discretion of the project evaluator or decision-makers, which SCBA should aim at so that they may not be able to hide their own interests (material or ideological) behind the terms like social benefits and social costs, which might emanate basically from their own sentiments and ignore the possible differences in sentiments among individuals comprising the society. 21/, 22/

1.6 SCBA under Socialist Setting

1.6.1 In the recent decades, social cost benefit analysis is being increasingly applied in project choice problems in the European socialist countries including U.S.S.R. and Poland [Fiszel (1966); Novozilov(1964,1969-9 Rakowski (1966); Vainshtein (1971)]. Each investment activity in a socialist economy is thought of as being associated with expenditure or

---

21/ 'Social reformers as a rule also fail to notice, or at least they disregard, the fact that individuals entertain different opinions with regard to utility, and that they do so because they get the data they require from their own sentiments. They say, and believe that they are solving an objective problem : 'What is the best form of society ? Actually they are solving a subjective problem : 'What form of society best fits my sentiment ?' The reformer, of course, is certain that his sentiments have to be shared by all honest men and that they are not merely excellent in themselves but are also in the highest degree beneficial to society. Unfortunately that belief in no way alters the realities' [Pareto (Livington (trans.) 1935)]. Similar may be the position of even socially - motivated decision-makers and project evaluators.

22/ Streeten (1971) pointed out that cost benefit analysis has a tendency to convert political, social and moral choices into pseudo-technical ones. In particular, when two objectives like industrialization and environment protection are in conflict, a choice has to be made either on a democratic, oligarchial or dictatorial basis. But, often, cost benefit analysts use their own arbitrary weightings and conceal the political problems of choice concerning value conflicts of the above nature.

outlay of social labour to create as well as to utilise fixed assets (buildings, machines, installations etc.) and with benefits in the form of output produced as well as other secondary and indirect benefits of broader social importance. A rational management of the socialist economy requires the allocation of investment outlays into such projects as would generate maximum results. The basic methodological premise formalizing the universal principle of the economic behaviour of all participants in a socialist economy is that effectiveness (or worth) of any investment project is determined by quantitative assessment of (or comparing) results and all inputs. As in the case of western SCBA, the basic problem in cost-benefit calculations is one of adopting an appropriate system of economic measurement of the effects (costs and benefits) of investment projects. In the first place, the problem is to obtain a proper system of prices, wages and other rates. Secondly, the non-quantifiable economic or extra-economic benefits and costs associated with investment projects are to be taken account of in the assessment exercises.

1.6.2 The theoretical framework of analysis to solve the investment project choice problem in a socialist economy is different from that of the model of the Western Capitalist economies. In these planned economic systems macro-production targets (for each commodity and service) are fixed exogenously by the authority on the basis of a centralized assessment of individual and collective needs. The final bill of goods are thus made independent of market demand, and hence, of the distribution of

income and wealth. The problem for the socialist economy is to so choose projects as to minimise the total labour outlays required to achieve the production targets in the context of the constraints imposed by the limited availability of resources other than labour. Under a single period formulation of this problem of minimizing social costs (social benefits being fixed in terms of production targets set before hand) in accordance with the law of maximum economy of labour, the appropriate criterion of project selection at the micro-level reduces to one of minimizing Differential Costs (production targets for the economy being given, the alternative projects/project variants are assumed to produce the same level of output) which include direct labour costs of production plus the sum of feedback costs of different resources consumed by the project. Total feedback costs in respect of each resource is the amount of the resource required by the project multiplied by the shadow price (norm of feedback cost) per unit of the resource in money terms. Feedback cost of resource used by a project represents the opportunity cost of not using the resource elsewhere in the economy. Since there generally exist possibilities of substitution among different resources and since the productivity of different resources are unlikely to be equal in different projects, the use of a given resource (R), whose supply is limited, for minimizing the direct labour costs of (outlays on) production in one project may preclude the possibility of using R in other projects and may lead to the use of less productive resources in the latter projects. This will tend to raise the direct labour costs of production of the latter projects from the level which could have been achieved

if resource R could be made available for the projects. For ensuring minimum direct labour costs for the economy as a whole, it is necessary to take into account in project selection, the interrelation between direct labour costs of production in different projects. This essentially constitutes the function of feedback costs. The estimated increase in direct labour costs of other projects, which will be associated with the use of an unit of a resource in a given project rather than in the former projects is the feedback cost of that resource.

1.6.3 Mathematically, the problem is to minimize the labour costs of production [Novozilov (1968-9)]

$$\sum_{i=1}^{n} C_i \qquad \ldots (1.8)$$

subject to the constraint that requirements for each resource must equal its supply

i.e. $$\sum_{i=1}^{n} q_{hi} = Q_h \qquad \ldots (1.9)$$

where $C_i = f_i (q_{1i}, q_{2i}, \ldots, q_{mi})$; $\qquad \ldots (1.10)$

$h = 1, \ldots, n; \quad i = 1, \ldots, n$

is the labour outlay required to produce the level of output of i-th product as fixed in the economy's program for final output, q_{hi} is the outlay of the h-th resource on the i-th product and Q_h is the quantity of h-th resource available. Applying the Lagrange method, the problem

is to minimize

$$\phi = C_i + \sum_{h=1}^{m} \lambda_h \left(\sum_{i=1}^{n} q_{hi} - Q_h \right) \quad \ldots \quad (1.11)$$

The necessary conditions for the minimum is

$$\frac{\delta \phi}{\delta q_{hi}} = \frac{\delta}{\delta q_{hi}} \left(C_i + \sum_{h=1}^{m} \lambda_h q_{hi} \right) = 0 \quad \ldots \quad (1.12)$$

The multiplier λ_h represents the shadow price of the h-th resource. Now (1.12) may be replaced by

$$C_i + \sum_{h=1}^{m} \lambda_h q_{hi} = \text{minimum} \quad \ldots \quad (1.13)$$

For, from (1.12)

$$\sum_{i=1}^{n} C_i + \sum_{i}^{n} \sum_{h}^{m} \lambda_h q_{hi} = \text{minimum}$$

i.e. $$\sum_{i=1}^{n} C_i + \sum_{h}^{m} \lambda_h \sum_{i}^{n} q_{hi} = \text{minimum}$$

i.e. $$\sum_{i=1}^{n} C_i + \sum_{h}^{m} \lambda_h Q_h = \text{minimum}$$

or, $$\sum_{i=1}^{n} C_i + H \text{ (constant)} = \text{minimum (for a given values of } \lambda_h$$

$$\sum_{h}^{m} \lambda_h Q_h = H \text{ (constant)}$$

i.e. $$\sum_{i=1}^{n} C_i \quad \text{minimum}$$

Thus, the relations $S_i = C_i + \sum_{h=1}^{m} \lambda_h q_{hi} = \text{minimum}$ ... (1.14)

and $\sum_{i=1}^{n} q_{hi} = Q_h$

imply that ΣC_i is minimum[23/].

Now $S_i = C_i + \sum_{h=1}^{m} \lambda_h q_{hi}$ is nothing but the Differential Costs of the i-th product; C_i is the direct labour cost and λ_h is the feedback cost of resource h per unit.

1.6.4 If investment were the only resource constraint, the differential costs

$S_i = C_i + r.K_i$ (where $\lambda_K = r$ is the norm of investment effectiveness)

and, therefore, projects are to be chosen according to the criterion[24/]:

$$\text{minimum } S_j = C_j + r.K_j \quad \ldots \quad (1.16)$$

or, $$\min K_j + \frac{1}{r} C_j \quad \ldots \quad (1.17)$$

23/ It is unlikely, however, that all the resources will be fully utilized as is implied by the relation (1.9). Moreover, the solution given by (1.13) will not be economically meaningful if for some h and i

$\lambda_h < 0$ and $q_{hi} < 0$.

Therefore, the condition (1.9) may be replaced by

$$\sum_{i=1}^{n} q_{hi} \leq Q_h, \quad q_{hi} \geq 0 \; ; \; \lambda_h \geq 0 \quad \ldots \quad (1.15)$$

This will ensure that the feedback cost of an under-utilized resource is zero

$$\left(\sum_{i}^{n} q_{hi} < Q_h \longrightarrow \lambda_h = 0 \right)$$

and that of a resource fully utilized is non-negative (i.e., $\sum_{i}^{n} q_{hi} = Q_h \longrightarrow \lambda_h \geq 0$).

24/ When projects have different C_s $\left[C_i(t)\right]$ and different K_s $\left[K_i(t)\right]$ for different periods during the time span of their lives, the

contd.../-

1.6.5 The Criterion of Minimum Differential Costs (MDCC) as outlined above is formally the same as the criterion of Minimum Effectiveness of Investment (MEIC) and the criterion of Limiting Recoupment Period (LRPC) which are also referred to in socialist literature on SCBA. This may be shown as follows. Let the investment outlay required by a set of m alternative projects which can produce the same level of output be $K_1, K_2, K_3, \ldots, K_m$. The direct labour costs of production for these projects are $C_1, C_2, C_3, \ldots, C_m$. It is assumed that the projects are so numbered that $K_1 < K_2 < K_3 < \ldots < K_m$ and $C_1 > C_2 > C_3 > \ldots > C_m$. The Marginal Effectiveness of Investment of a project is defined as the savings (economy) in direct labour costs (C) made possible by the project requiring a marginally higher investment (K) than another project. The alternative projects may be arranged in terms of their marginal effectiveness of investment as follows :

$$\frac{C_1 - C_2}{K_2 - K_1} > \frac{C_2 - C_3}{K_3 - K_2} > \ldots\ldots > \frac{C_{f-1} - C_f}{K_f - K_{f-1}} > \frac{C_f - C_{f+1}}{K_{f+1} - K_f} > \ldots\ldots > \frac{C_{m-1} - C_m}{K_m - K_{m-1}} \quad \ldots (1.19)$$

Let the minimum allowable effectiveness for a project selected in the economy be set equal to e*. According to MEIC, the project f is chosen for which

$$e^* - \frac{C_{f-1} - C_f}{K_f - K_{f-1}} = \text{minimum} \geq 0 \qquad \ldots (1.20)$$

---

footnote 24/- contd/-

criterion (1.17) becomes

$$\text{minimize} \sum_{t=1}^{T} \frac{K_i(t)}{[1+r(t)]^t} + \frac{C_i(t)}{[1+r(t)]^t} \qquad \ldots (1.18)$$

where r(t) is the norm of investment effectiveness (feedback costs per rupee of investment) for period t and T is the projects' life period. The discount factor r(t) makes costs incurred in different periods additive.

Projects (f+1), ..., m are rejected because the marginal investment effectiveness in their case is less than e*. Compared to projects 1,2,...,(f-1) project f involves the application of minimum direct labour costs for the production of the given level of output. The inequalities in (1.19) may be rewritten as follows :

$$\frac{C_1-C_2}{K_2-K_1} > \frac{C_2-C_3}{K_3-K_2} > \ldots > \frac{C_{f-2}-C_{f-1}}{K_{f-1}-K_{f-2}} > e^* > \frac{C_f-C_{f+1}}{K_{f+1}-K_f} > \ldots > \frac{C_{m-1}-C_m}{K_m-K_{m-1}} \quad \ldots (1.21)$$

from which it follows that

$$C_1 + K_1 e^* > C_2 + K_2 e^* > C_3 + K_3 e^* > \ldots > C_{f-1} + K_{f-1} e^* >$$

$$C_f + K_f e^* < C_{f+1} + K_{f+1} e^* < \ldots < C_m + K_m e^* \quad \ldots (1.22)$$

In other words, MIEC requires that the projects be chosen on the basis of

$$\min_i \; C_i + K_i e^* \qquad \ldots \quad (1.23)$$

Now, e*, the minimum allowable investment effectiveness, represents the social opportunity cost of not employing additional investments elsewhere in the economy and therefore e* and r (norm of feedback costs) are similar in nature. It is easily seen if e* = r, MEIC and MDCC are equivalent.

1.6.6 According to the LRPC, the projects are to be selected on the basis of

$$\min_i \; \frac{1}{T^*} K_i + C_i \qquad \ldots . (1.24)$$

where T* is the maximum allowable recoupment period for investments [Rakowski (1966)]. In other words, any project j which is chosen should have a recoupment period $T_j = \frac{K_j - K_{j-1}}{C_{j-1} - C_j} \leq T^*$. Let there be a project p* such that if a modern project among existing ones in the economy is

replaced by a project p* the national income may be expected to remain the same before and after this change. T* is equal to the estimated minimum recoupment period that project p* will be associated with. Clearly, T* is a concept similar to that of c* or r; if $\frac{1}{T*} = e* = r$, then LRPC becomes formally equivalent to MDCC and MIPC. In Chapter III, an attempt has been made to establish the formal equivalence of the above criterioa of socialist countries and the various investment criteria used in SCBA in the non-socialist world.

1.6.7 The use of the Criterion of Minimum Differential Costs is in accordance with the law of maximum growth labour productivity and ensure maximum rate of growth of national output. This may be shown as follows: Let K_1 K_2 and K_3 (such that $K_3 > K_2 > K_1$) be the investments required in three alternatives, β be the prescribed rate of growth of national output E_{21} is actual effectiveness of additional investment in alternative 2 in comparison with alternative 1, and E_{32} is the actual effectiveness of additional investments in alternative 3 in comparison with alternative 2.

For project 2 to be preferable to both the projects 1 and 3

$$(K_2 - K_1)\, E_{21} > (K_2 - K_1)\, \beta \qquad \ldots (1.25)$$

and

$$(K_3 - K_2)\, E_{32} < (K_3 - K_2)\beta \qquad \ldots (1.26)$$

where (1.25) means that project 2 compared to project 1, contributes in each period an additional amount equal to $(K_2 - K_1)\, E_{21}$ towards accumulation of the nation and draws in each period on the national accumulation, an additional amount equal to $(K_2 - K_1)\beta$; since the benefits $(K_2 - K_1)E_{21}$

are greater than the costs $(K_2 - K_1)\beta$ project 2 is preferable to project 1. Similarly from (1.26), project 2 is preferable to project 3.

From (1.25) and (1.26), $E_{21} > \beta > E_{32}$ ... (1.27)

i.e. $$\frac{C_1 - C_2}{K_2 - K_1} > \beta > \frac{C_3 - C_2}{K_3 - K_1}$$

i.e. $C_1 + \beta K_1 > C_2 + \beta K_2 < C_3 + \beta K_3$.

In other words, among a sufficiently large number of projects, the optimal project is the one for which

$C + \beta K$ is minimum

i.e. $$\left(-\frac{dC}{dK} \right) = \beta \qquad \text{... (1.28)}$$ 25/

Now, optimal planning in an economy must ensure that all potentialities of growth are utilized so that β is maximized. Again, the optimal project is the one for which $C + r.K$ is minimum

i.e., $$\left(-\frac{dC}{dK} \right) = r \qquad \text{... (1.29)}$$

From (1.28) and (1.29)

$$\beta = r \qquad \text{... (1.30)}$$

In other words, the norm of effectiveness of investment is equal to the rate of growth of production. Since the norm of effectiveness of investment (r) expresses the permissible minimum effectiveness of investment, the real optimum is expressed by the equality

$$\min r = \max \beta \qquad \text{... (1.31)}$$

25/ $-\frac{dC}{dK}$ is the marginal effectiveness of investment.

1.6.8 This equality of marginal effectiveness of investment and the rate of growth of production (income) is termed 'Golden rule of Accumulation'. In other words, maximisation of the growth rate of output requires, under planned socialist economic setting, that the selection of projects be made according to the criterion of Minimum Differential Costs or Limiting Recoupment Period. As noted earlier, under a capitalist market economy the same task of maximizing the growth rate of output, under certain assumptions, is ensured by the criterion of maximizing rate of profit (or surplus) on investment.

1.6.9 This formal similarity in results, however, cannot obscure the basic differences in the approaches of the two different systems towards social cost benefit analysis as applied to the problem of appraisal and selection of investment projects. In capitalist market economies consumer demand and individual willingness and ability to pay play important roles in the determination of the final bill of goods that is produced and SCBA, under such setting, is applied to make corrections for the imperfections/ distortions in the market, so that any possible non-optimality in the final bill of goods is avoided (non-optimality here refers to a situation where the final bill of goods — that is eventually produced — favours a particular section of the society at the cost of another section in a manner that cannot be justified on welfare considerations). By constrast, in a socialist economy SCBA is regarded as an instrument for the realization of the socialist goals laid down by a central authority. The final

bill of goods, under socialist planning, is fixed by the planning authority. With the help of the criterion based on norm of investment effectiveness, the micro-level decisions regarding project choice are sought to be controlled for purposes of maxinizing the rate of growth of output.

1.6.10 The general rate of profit in capitalist market economy and the norm of investment effectiveness in a socialist economy are similar ~~as~~ inasmuch as they both serve to measure feedback costs. As a result of the general striving for profits and the existence of competition in a market economy, the profits/surplus on capital employed in production spontaneously and roughly helps in the measurement of feedback costs which is essential for ensuring compatibility or consistency among all the projects selected on the basis of the rate of profit criterion. But the rate of profit is not just an instrument for measuring feedback costs and ensuring compatibility of projects selected; in a capitalist economy it acts also as a regulator of production and forms of distribution. Profits find their way into the hands of private capitalists and serve both as a fund for accumulation of new capital and the fund of revenue intended for capitalists' consumption. The rate of accumulation, thus, entirely depends on a section of private individuals which, according to the socialist school, need not be in the best interests of the country. In particular, in a capitalist economy, consumer demand and willingness to pay is also responsible for the determination of the distribution of investment along different lines and the resultant final bill of goods

need not lead to maximum social welfare. For market demand cannot correctly reflect the real needs of the society unless there is an ideal distribution of income. An ideal distribution of income under a socialist setting, is the one that ensures material and cultural goods according to the needs, requirements and taste of an individual. On the one hand, an ideal distribution of incomes should stimulate cost savings and the growth of national output and, on the other, it should ensure maximization of the general level of satisfaction of needs that is possible with a given level of national output. In the absence of an ideal distribution of income, the maximization of the society's welfare cannot be solved in terms of an extremal problem of minimum costs and maximum benefits.

1.6.11 Although the model of general equilibrium for a capitalist market economy and that of the law of economy of labour in a socialist economy may appear similar in view of the use of identical mathematical techniques, the fundamental differences between them, according to the socialist school lies in the definition of costs. While the former proceeds from prices (or utility) of consumer goods to prices of factors of production (including labour), the latter proceeds from labour costs to the valuation of consumer goods. Under the law of economy of labour, it is through an effective utilization of the means of production (resources other than labour) that the direct labour costs of production in a socialist economy is minimized. In the case of general equilibrium in a market economy costs mean the sum of the prices of the factors of production, namely, labour, capital and

land. While in the general equilibrium system the profit rate or rate of return on investment and utility derived by consumers are maximized subject to constraints on the availability of resources including labour, in a socialist economy, social outlays of labour is the objective function to be minimised, and other resources are treated as constraints. In the latter, therefore, unit of labour serves as the unit of measurement for not only the prices (auxiliary/Lagrange multipliers) but also the results or outputs.[26/]

1.6.12 The maximization of social welfare in a socialist economy is sought to be solved through a trial and error process of the costs of the national economy's final output and estimating the requirement of different goods on the basis of data on labour costs of these goods obtained at the preceding stage of calculation of minimum costs. A most probable set of cost data is assumed to start with. The consumption requirements (in terms of commodity targets) corresponding to this set of costs is worked out (since labour costs determine the incomes of the individuals and hence their demand for goods and services). Next, the problem is to minimize the costs necessary for satisfying the requirements. The solution of this problem generate a set of costs which helps in the recalculation

---

26/ The consumption valuations are expressed in terms of average payment of one hour of labour or units of average working time.

of requirements and again to solve a problem of minimization of labour costs with the corrected pattern of requirements[27].

27/ The dual problem of minimizing labour costs is one of maximization of national income which allows the determination of prices of final output that corresponds to the society's needs. This may be shown as follows :

The primal problem under static (single period) framework for the socialist economic planning is to find the production programme

$$q_i^l \geq 0 \qquad (i = 1, 2, \ldots, n;\ l = 1, 2, \ldots, s)$$

which minimize the total direct labour costs given by

$$\sum_{i,l} c_i^l q_i^l \quad \text{subject to the constraints}$$

(a) the demand for any resource j must not exceed it availability

$$\text{i.e.} \quad \sum_{i,j} a_{ij}^l q_i^l \leq R_j \qquad (j = 1, 2, \ldots, m)$$

and (b) the output of any product i must not be less than the demand for it,

$$\text{i.e.,} \quad \sum_l q_i^l \geq q_i$$

where a_{ij}^l is the requirement of resource j per unit of output of product i in the l-th project;

q_i^l is the level of output of product i generated by project l;

R_j is the amount of resource j available; and

q_i is the demand for final product i (determined on the basis of the individual and collective needs of the society, which in turn, depends, among other things, on the producers' incomes and labour costs).

The Dual problem is to find the non-negative p_i (consumption valuation of an unit of product i) and r_j (norm of effectiveness of resource j) which maximize national income given by

$$\sum_i p_i q_i - \sum_j r_j Q_j$$

subject to the constraint $p_i \leq c_i^l + \sum a_{ij}^l r_j$ i.e., the social consumption valuation of each product must not be higher than the national economy's total cost (differential costs) for the product. It is easily seen (by Duality Theorem) that the minimum value of labour costs is equal to the maximum value of national income. Thus, social welfare is maximized by minimizing the direct labour costs of production because this ensure that the production programme of the economy corresponds to the needs of the society.

1.7 SCBA and Planning

1.7.1 The management of the socialist economic system is made through a system of economic planning. The role of SCBA under such a system lies in helping the planning mechanism become more effective in realizing the desired social goals. Centralization of powers for purposes of economic planning is necessary because in the interest of the optimal development of the socialist economy requires social consumption valuations for different individual (personal) or collective needs (requirements/products). Such valuations are necessary for solving the problem of distribution of income and influence the long-term structure, rates and direction of the development of the economy. It is in conformity with the general premises and proportions (product-mix) assumed in the Central Plan that the choice of investment projects are to be made. Decisions at both the macro-level and the micro-level are based on comparison of social costs and social benefits (appropriately defined). But, SCBA may be considered primarily as an aid to micro-level decision-making where central macro-level planning leaves enough room for micro-level choice. At the macro-level only the main trends and proportions of output or product-mix (what social needs are to be satisfied and to what extent etc.) are determined; at the micro-level SCBA is a comparative calculation process by which different ways and means (alternative technical solutions) of satisfying specific social needs are evaluated and compared.

1.7.2 The decisions at the micro-level in regard to the choice of projects, again, may affect the general premises and proportions laid down in the Central Plan so that revisions in the latter may appear necessary. Thus, effectiveness of social cost benefit analysis in a socialist economy depends also on the 'feedback' coupling the decisions at the micro-level and the macro-level.

1.7.3 SCBA as developed by Western economists having faith in competitive general equilibrium for application in non-planned economies—both advanced capitalist economies and developing economies where sophisticated decentralized planning procedures are much beyond the existing organization capacity, it is thought of being general so as not to be inconsistent with any planning mechanism (unless planning is totally rigid). It is pointed out that the Central Plan cannot be formulated simply on the basis of economic theory and immagination. To be operationally meaningful it must be based on a sound self-knowledge of the pace at which good projects can be drawn up, initiated and effectively implemented. In other words, past experience with the selected projects will help ensure the feasibility and consistency in the Central Plan. Social Cost Benefit Analysis of projects initiated, implemented and formulated is necessary to ensure optimality of the Central Plan. Although valuejudgements and hunches enter in this process — 'good realistic plans can hardly be formulated in the absence of a great deal of project planning and without proper economic appraisal of projects' [Little and Mirrleese(1969 and 1974)]. On the

other hand, micro-level project choice decisions can only be made effectively if there is a Central Plan providing a clear picture of the trends and pattern of demand and supply — current and future — and the long-ter nature of economic development (e.g., equilibrium prices estimated on the basis of the society's preference function and time configuration of relative scarcities of different goods and services may be laid down in the Central Plan). Thus, decisions at both levels hang together and improve with feedback and successive approximations; through such iteration and reiteration it is possible to arrive at solutions nearer to an optimal plan.

Chapter II

PROBLEMS OF SOCIAL COST BENEFIT ANALYSIS

2.1 Introduction

2.1.1 A relatively young branch of economics, Social Cost Benefit Analysis (SCBA) is beset with a host of problems many of which have so far eluded satisfactory solutions acceptable to most. Considering the intricate nature of such problems, one is tempted to reject altogether the approach of SCBA. Search for an alternative approach to the problem of project evaluation and selection may appear warranted. But, human instinct with its strong materialistic orientation in regard to gains and sacrifices, is bent on appraising projects and making choice decisions on the basis of a comparison of expected costs and benefits associated with the projects. Rational choice by human beings — be it in the interest of an individual or group of individuals or the whole society — will necessarily involve a cost-benefit appraisal. Thus, despite all the problems with which SCBA is confronted with, it has been felt that SCBA cannot be rejected outright.

2.1.2 Generally speaking, the problem which SCBA is intended to solve is one of maximizing benefits (minimizing costs) subject to a constraint on costs (a given measure of benefits sought to be achieved). Optimum decisions would ensure equality of incremental social costs and incremental social benefits at the margin. So far so good. But as one attempts at applying SCBA to actual decision-making problems of choice,

a number of theoretical and practical issues arise. These may be classified as follows :

(i) those relating to the identification of society's macro-level objectives and their interrelation and the interpretation of these goals of economic policy in terms of social benefits and costs associated with investment projects;

(ii) those relating to the identification of resource constraints and their interpretation in terms of social costs;

(iii) those relating to the determination of appropriate prices for the valuation of social costs and social benefits;

(iv) those relating to the aggregation of social benefits and costs distributed over time;

(v) those relating to the design or choice of appropriate decision-making formula which will help ensure the selection of viable and compatible investment projects which together maximizes social welfare under the given constraints (i.e., the set of projects which contributes maximum towards the realization of the society's macro-objectives); and

(vi) those arising out of linkages, externalities, risk and uncertainties associated with projects and having bearing on (i)-(v) above.

The sections that follow outline a brief survey of the vast literature on the above aspects of SCBA (primarily on the basis of the literature in the non-socialist world).

2.2 Objectives of Economic Policy and SCBA

2.2.1 Any effect of undertaking an investment project that implies a positive contribution towards the attainment of specified macro-level objective/s of the society is regarded as benefit. Correspondingly, an effect involving a negative contribution towards or sacrifice in terms of any objective is a cost to the society. The identification of all such benefits and costs as well as their measurement and appraisal (evaluation) in terms of an appropriate criterion for purposes for investment project selection cannot be done unless the society's objectives/goals are explicitly specified beforehand. Any concept of benefit or cost is unlikely to be appropriate from the point of view of all the macro-objectives of a society; the index of contribution of a projects towards one macro-objective (say, aggregate consumption) may not be able to measure the contribution of the projects towards another macro-objective (say, employment generation). The prices to be applied for valuation of the benefits and costs also should depend on the macro-objectives of the society and their relative importance. Similarly, the appropriateness of adopting any particular criterion function for project choice/appraisal would depend, among other things, on the macro-objectives a society intends to achieve. It is, therefore, extremely important for SCBA that the macro-objectives and their relative importance are specified. It is in the light of these specifications that the appropriate concepts of social benefits and costs, appropriate prices for their valuation and appropriate criterion function for comparing benefits and costs are to be

determined. It may also be necessary for this purpose to examine the nature of inter-relationship and inter-dependence, if any, among the objectives. Two macro-objectives may be conflicting, i.e., the satisfaction of one may be at the cost of the other, in which case it will be of help to know the extent to which they are conflicting. The sharper the conflict between two objectives, the greater is the need for specifying their relative importance; if the degree of conflict is insignificant, it may not be meaningful to treat the two objectives as independent ones. When, however, the conflict is sharper, the society is to be made aware of the cost of attaining one objective in terms another, which is involved in selecting one set of investment projects rather than any other set[28/]. This piece of knowledge may be necessary for the society before it specifies the relative importance of the objectives.

2.2.2 Recognizing the possibility of multiple objectives of the society, Marglin (1967) proposed two different ways of dealing with problem. One is to attach explicit weightage to each social objective and maximize a weighted preference function of multiple objectives through project selection. The alternative is to maximize benefits relevant to one objective with constraints on the level or degree to which other objectives are to be satisfied through project selection. The difficulty with the former method of assigning relative weights to

28/ Project A may offer opportunities for increasing capital formation at a higher rate than does Project B; but the latter may generate more equal distribution of income (or say, employment opportunities) than the former. In such a situation, choice of A implies a cost to or sacrifice on the part of the society-obtaining higher capital formation at the cost of equity in income distribution (or employment).

different national objectives and maximizing a social welfare function of the nature of an weighted aggregation of contributions towards different objectives lies in the fact that the weights at the macro-level cannot always be straight away used in the criterion at the micro-level. In Chapter IV, assuming growth of output and employment as the twin national objectives, the possibility of using relative weights at the micro-level decision-making stage consistent with the relative weights at macro-level has been examined. As regards the alternative method, although it does not involve assigning weights explicitly, the specification of the constraints on the objectives, however, imply, in the ultimate analysis, a particular set of weights for the objectives. The difficulty of working out a micro-level criterion consistent with the macro-level objectives appears to be greater under the second method compared to the first method.

2.2.3 Whether the weights are assigned explicitly or implicitly, SCBA of investment projects will involve an examination of the interrelationships (i) among different macro-objectives, (ii) between macro-objectives and concepts of cost and benefits, (iii) between macro-objectives and resources constraints and shadow prices, (iv) between macro-objectives and aggregation of costs and benefits spread over time and (v) between macro-objectives and micro-level choice criterion. In the remaining part of this section a discussion on (i) and (ii) is presented. Sections 3 and 4 are brief resumes on the literature relating to, respectively, (iii) and (iv). The literature relating to (v) is reviewed in section 5. In Section 6, some special problems having bearing on (i)-(v) are discussed.

2.2.4 The macro-objectives referred to in SCBA literature include maximization of aggregate consumption, maximization of the rate of growth of national output, greater equality in income distribution, higher employment generation (to reduce the degree of unemployment), self-reliance (reduction of dependence of a poor country on external assistance) and so on. In most cases, however, the objective of aggregate consumption has been regarded, explicitly or implicitly, the sole important objective and the subsequent steps in SCBA has been guided primarily by this objective. In other words, any effect on social welfare which may result from possible changes in income distribution or level of employment consequent upon the undertaking of an investment project has been either ignored or considered unimportant; seldom any explicit weight has been assigned to objectives other than aggregate consumption in judging the worth of an investment project.

Aggregate Consumption

2.2.5 The basis for treating aggregate consumption as an important macro-objective is that an increase in the standard of living constitutes a major determinant of any increase in social welfare. Aggregate consumption per head is an index of the standard of living enjoyed by a society. Thus, raising the standard of living is the essence of aggregate consumption objective. The concept of social benefit under this objective is the increase in the possibilities of consumption (of goods and services such as rice, potato, milk, egg, meat, beverages, shirts, sarees, housing, travel, cinema show, etc.) associated with the undertaking of an investment

project. The maximum consumption possibilities foregone by investing in a project rather than investing the same sum elsewhere in the economy or directly consuming the amount is regarded as social cost. The net outputs of a project implies a gain in consumption possibilities and, therefore, constitutes a social benefit; the net inputs of a project reflect a foregoing of consumption possibilities (they could have been used elsewhere for generating outputs or directly consumed) and, therefore, constitute a social cost.

Distributional Equity

2.2.6 Attempts have been made by some economists to integrate distributional effects into the social welfare function by assigning weights to aggregate consumption benefits accruing to different individuals or groups of individuals. The net social benefit associated with a project A is, thus, defined as

$$b_A^* = w_1 b_{A1} + w_2 b_{A2} + \ldots + w_n b_{An}$$

where $b_{A1}, b_{A2}, \ldots, b_{An}$ are the net consumption benefits (from project A) accruing to individuals 1, ..., n and $w_1, w_2, \ldots, w_n$ are the weights attached to the consumption of the individuals. In most SCBA exercises it is assumed that $w_1 = w_2 = \ldots = w_n = 1$ and $\sum_{i=1}^{n} w_i b_{Ai} = b_A$ is regarded as net social benefits from the point of view of consumption objective. It has been argued that distributional effect of any

investment project is marginal [Krutilla (1958); Eckstein (1958)]. Even if this is true for any one project, the total distributional effect of many investment projects may well be significant and insofar as taxation/transfer measures need not always be feasible or desirable for making appropriate distributional readjustments, the assumption of equal weights seems unrealistic. From the point of view of the society it may be desirable to consider a unit of consumption benefit accruing to richer individual less valuable than a unit of consumption benefit accruing to a poor individual. Foster (1966) suggested that each gain or loss be weighted by

$$w_i = \frac{\bar{Z}}{Z_i}$$

where $\bar{Z}$ is the per capita national income and Z_i is the income of the i-th individual in the society. Inasmuch as "the economist qua economist has no right to attach these social utilities to the incomes of individuals' [Eckstein (1958)] some economists have recommended the derivation these weights from the analysis of past decisions concerning distributional issues made by Governments [Maass (1962); Weisbrod (1968); McGuire and Garn(1969b)]. Taking a closely similar approach Krutilla and Eckstein (1966) adopted the use of inverse of the marginal rates of tax as weights.

2.2.7 The above method of adjusting net aggregate consumption benefit in the light of a second objective (distribution) and ranking projects in terms of adjusted net benefits given by a weighted sum of benefits

accruing to individuals ($b^*_\bullet$), however, makes it difficult to ascertain the relative importance assigned to the two objectives of the society. For example, for two projects A and B, unadjusted aggregate consumption benefits are such that, $b_B < b_A$ but the adjusted aggregate consumption benefits are such that $b^*_B > b^*_A$. Now, if project B is chosen, this does not make explicit the relative importance of aggregate consumption and distribution objectives; the choice of projects on the basis of $b^*_\bullet$ is unable to indicate the cost (or sacrifice) involved in having a better distribution of benefits in terms of not having a higher level of aggregate consumption benefit. To make explicit the implication of project choice in terms of trade-off between two conflicting objectives, it seems advisable to adopt a method of explicit weighting of the objectives. Explicit weights may be assigned to the macro-objectives of aggregate consumption and distribution and the projects are ranked on the basis of the weighted sum of contributions towards these objectives. The set of projects maximizing the weighted sum of contributions under different values of the weights may also be determined so as to make explicit the trade-off implication of choosing one set of projects rather than the other; this would help the society to choose the weights in accordance with the relative importance with which it treats the different objectives. (In Chapter V, a choice criterion has been suggested which ranks and selects projects on the basis of a weighted sum of their contributions towards the macro-objectives of output growth and employment growth.)

In the ultimate sense, however, the method of adjusted benefits and the method of explicit weighting may be equivalent. For example, let there be two classes — rich and poor. The distribution of aggregate consumption benefits be b_{A1} and b_{A2} for project A (1 denotes rich and 2 poor). According to the first method, social benefit is given by $b_A^* = w_1 b_{A1} + w_2 b_{A2}$. Let the distribution benefit be measured by the benefit accruing to poor i.e., by b_{A2}. Now, if $\bar{w}_1$ be the weight on aggregate consumption objective and $\bar{w}_2$ be the weight on distribution objective, the weighted sum of contributions is given by $Z = \bar{w}_1 (b_{A1} + b_{A2}) + \bar{w}_2 b_{A2} = \bar{w}_1 b_A + \bar{w}_2 b_{A2}$. It is easily seen $b_A^* = Z$ if $w_1 = \bar{w}_1$ and $w_2 = \bar{w}_1 + \bar{w}_2$.

Output Growth

2.2.8 In developing countries maximization of the rate of economic growth (measured in terms of rate of increase in GNP or per capita GNP) is one of the most important national objectives. As has been noted in para 1.3.6 of Chapter I, the rate of return (surplus or profit) on investment outlay, in perfectly competitive market economy, as a project choice criterion ensures maximization of the rate of growth of national income. It has been shown in Economic Theory that investment should be made upto the point at which marginal rate of profit on investment is equal to the marginal opportunity cost of investment and all projects chosen must yield rates of profit higher than or equal to this minimum admissible marginal rate of profit which is equal to the rate of growth of production and also the rate of growth of accumulation (Golden Rule of Accumulation)

The criterion of 'Minimum Differential Costs' or 'Limiting Recoupment Period' used in the socialist economies, as has been shown in para 1.6.8 of Chapter I, also ensures maximization of the growth rate of production. These criteria have been deduced on the principle of maximum economy of labour outlay which implies maximum growth of labour productivity which, in turn, implies maximum growth rate of production and accumulation. Under the assumptions of the socialist model of the economy, the norm of marginal effectiveness of investment involved in the criteria of "Minimum Differential Costs" or "Limiting Recoupment Period"is equal to rate of growth of accumulation and also the growth rate of national output. The concept of social benefit under the objective of output growth is, it is clearly seen from above, the surplus available for future investments. The investible surplus consumed in a project represents the social cost. Evidently, the rate of (unconsumed) profit represents a benefit-cost ratio or priority index like 'I' in para 1.2.1 in Chapter I. The relevance of these concepts of social costs and benefits in the context of the output growth objective has also been examined in Chapter IV of the present study.

2.2.9 Sometimes it has been pointed out that if aggregate consumption is taken as a macro-objective, it is not necessary to treat output growth as a desparate objective [UNIDO Guidelines (1972)]. It has been argued that by taking account of changes in both present and future consumption possibilities in defining social costs and social benefits under aggregate consumption objective, the present and future output generation consequent

upon the undertaking of an investment project is also taken into account, albeit indirectly. Moreover, the very purpose of achieving a higher rate of capital accumulation by restricting current consumption possibilities is to ensure a larger consumption possibilities in future. It is, however, felt that for countries trying to break through the low-level of stagnation, a higher growth rate of output may be more important than a higher growth rate of consumption so far as the immediate future is concerned. For a faster rate of growth, the country may wish to choose projects which make higher contribution towards surplus generation and capital accumulation irrespective of their contribution towards current consumption (most projects, in any case, would generate some present consumption possibilities). But, under the aggregate consumption objective, present and future consumption possibilities are aggregated with the help of a positive time-preference discount factor. Therefore, it is possible that a project offering relatively high present consumption and relatively low future consumption possibilities compared to another project, is chosen under this objective. This may not be acceptable to the planner of a country where present consumption is sought to be tightened and restricted in order to increase capital accumulation as far as practicable. One might suggest that this actually implies that future consumption possibilities should be discounted at a sufficiently low rate. But in a developing economy faced with inadequate investible funds, given the available savings to be allocated among the investment projects in a

particular period, present consumption possibilities may actually be considered less valuable than future consumption potential indicated by present surplus generation (this, however, need not imply that the country as a whole is consuming nothing to achieve faster growth; for, one thing, investment projects undertaken in any period will be associated with some current consumption any way, and, secondly, the higher value assigned to surplus generation from investment projects need not imply that labour elsewhere employed in the economy should stop consuming anything). If a society considers both aggregate consumption and output growth to be important objectives, the contribution of projects may be separately worked out and projects may be ranked and selected on the basis of a weighted sum of their contributions towards these objectives (the procedure suggested in para 2.2.7). If there does not exist any conflict between these two objectives, this procedure will yield the same result if aggregate consumption were treated as the sole objective[29]. If a conflict does exist (and this is likely to be the case), the society should know they trade-off implications which the suggested method is capable of revealing.

29/ Contributions of project A to objectives 1 and 2 are x_A and y_A; those of project B are x_B and y_B. If there is no conflict among the objectives, $x_A > x_B$ implies $y_A > y_B$. This, however, means $w_1 x_A > w_1 x_B$ and $w_2 y_A > w_2 y_B$ and therefore $w_1 x_A + w_2 y_A > w_1 x_B + w_2 y_B$ (w_1 and w_2 are weights on objectives 1 and 2, respectively).

Employment Growth

2.2.10 Generation of employment opportunities constitutes another macro-objective which has seldom been assigned importance in SCBA literature. It has been argued that employment is a means to the end of attaining objectives such as aggregate consumption and distribution; it cannot be an end in itself [UNIDO Guidelines (1972)]. Employment of hitherto unemployed persons in a project implies income to them which tends to increase consumption and, therefore, is a source of aggregate consumption benefit. Again, income for hithertoo unemployed persons tends to improve income distribution in the economy and, therefore, employment is a source of distribution benefit. On the other hand, displacement of labour from employment as a result of undertaking an investment project (say, mechanization of farm operations) is a source of social cost from the point of view of these two objectives. But, it is also true that aggregate consumption benefits and distribution benefits may be increased even without an increase in productive employment (by raising the productivity of the employed and paying doles to the unemployed). Besides, employment may be desired for its own sake — unemployment may be regarded as denial of human dignity and may lead to environmental chaos (these points have been discussed further in Section 5.1 of Chapter V). In the SCBA literature, however, yet another reason has been put forward for not treating employment as a disparate objective; it is pointed out that there does not exist any real conflict between output and employment [Little and Mirrlees(1974)]. But in Chapter IV of the present study, conditions under which output growth and

employment growth could be conflicting have been established and the sources of such conflict analysed. Moreover, empirical evidences in the recent past generally do not reveal any positive relation between output growth and employment growth. In view of this in Chapter V, a criterion of weighted sum of contributions of projects towards the objectives of output growth and employment growth has been suggested. As noted in para 2.2.9, if there is really a conflict between the objectives the criterion is warranted; if not, it does no harm.

2.2.11 With employment as a macro-objective, the size of reduction/increase in unemployment in the economy is the measure of benefit/cost. Employment benefits may be measured in terms of labour unit (man-hours, number of workers, etc.) or labour input (wages bill). Employment generated by a project may be seasonal, intermittent or regular within a given year. Part of employment opportunities generated by a project may provide part-time jobs to some individuals besides providing full time job to others. Again, employment of male workers may not as valuable as that of female workers. The flow of employment opportunities over different periods of the project life could be uneven. It is difficult to arrive at an index of employment potential of projects which could suitably aggregate the different types of employment opportunities generated. Similarly, employment generated by a project may require various category of skill and it is difficult to add up straightway employment opportunities requiring varying degrees of skill. One possible way of aggregation in such situations

would be to attach weights on different category of employment in the light of prevailing structure of unemployment in a country. In the so-called labour-surplus developing countries, however, it is the unemployment of unskilled labour which constitutes one of the major bugbear of development. Accordingly, the calculation of employment opportunities for unskilled labour in a project could adequately serve the purpose.

2.2.12 The upshot of the discussion on macro-objectives vis-a-vis SCBA is that with the introduction of multiple objectives, problems arise in connection with the identification and quantification of the relevant benefits as well as the procedure to be adopted for aggregating the benefits accruing to different individuals/groups comprising the society. Moreover, the weights to be assigned to different objectives on the basis of their relative importance to a society may not be easy to determine. It is difficult under the circumstances to devise a set of neat formula for project selection to suit all occasions. The existence of multiple objectives underscores the need for analysis of all information regarding benefits and costs relevant from the point of view of each of the objectives, even though, it may not be possible to compare all benefits and costs in terms of a single project choice criterion. Such analysis would help ensure more informed judgements in project selection and at the same time reduce the degree of discretion at the hands of the project evaluator or decision-maker.

2.3 Valuation of Benefits and Costs

Shadow Prices :

2.3.1 The valuation of benefits and costs in terms of appropriate prices has an important relation to the macro-objectives of the society. Recognizing the fact that in a real economy perfect competition never obtains, it is easily shown in economic theory that the market prices of commodities and services seldom reflect marginal social costs incurred/ benefits derived by the society on/from a unit of any given commodity or service. The marginal social cost of a unit of output is the sum of the social costs of each resource used as input. Cost of a unit of any input is essentially the social opportunity cost (i.e., benefits foregone) involved in the transfer of a unit of the input from other alternative uses to the project under consideration. Market prices generally differ from the social opportunity cost. Therefore, in SCBA literature the use of shadow or accounting prices which are supposed to be the best possible estimates of social opportunity costs of goods and services has been recommended. According to Tinbergen (1958, p. 39) 'market prices, particularly those of the factors of production (capital, labour, foreign exchange) often diverge from the intrinsic value or accounting prices that would prevail if (i) the investment pattern under discussion were actually carried out, and (ii) equilibrium existed in the market'. Here equilibrium is defined in terms of equality of demand and supply in respect of outputs and resources in a perfectly competitive economy with complete mobility

of all factor of production [UN, ECLA (1958)]. Specific instances of shadow prices are : use of zero or low notional wage rate where a project employs a large force of unskilled labour in a labour-abundant economy, of accounting interest rates in place of market rates of interest for purposes of discounting and of higher than 'nominal values for capital funds employed in a public investment project when it is expected to displace private investment at the margin. Shadow prices have also been recommended for inputs other than labour services and for outputs and also for foreign exchange (particularly, for developing countries in balance of payments difficulties)[30/].

Shadow Prices as Dual Solution :

2.3.2 There exist considerable differences in the procedures adopted in the SCBA literature for the estimation of shadow prices. Shadow prices have been identified as the auxiliary multipliers in a constrained optimising problem solved by the Langrange method or as the values of the variables in the dual solution to a linear programming problem [Flemming and Feldstein (1968); Ostrowski and Sadowski (1968)]. In other words, shadow prices of a resource input is equal to the increase/decrease in the optimal value of maximand/minimand (in constrained optimising problem) resulting from a marginal change in the availability of that resource/input.

30/ The terms 'shadow price' and 'accounting price' have not always been used synonymously [Sait (1971b)]; while Sen (1968b) uses these as synonymous, accounting prices have been defined as approximations to shadow prices in [Feldstein and Flemming (1968); Ostrowski and Sandowski (1968)].

This concept is similar to that of 'equilibrium' prices referred to in para 1.3.4 of the Chapter I. The socialist criterion of Minimum Differential Costs involves the use of shadow prices of inputs other than labour, which are formally nothing but auxiliary multipliers in a Lagrange constrained problem [vide para 1.6.3 of Chapter I; also footnote 27/ in Chapter I].

2.3.3 Clearly, shadow prices as dual solutions are dependent on the objective function(and also constraints) in the optimizing problem. With multiple macro-objectives of the society, since there exists considerable differences in opinion as to the relative importance of these objectives, it may be difficult to precisely specify the objective function for the optimizing problem. Under such circumstances, it would be operationally very helpful to use shadow prices if it is found that the shadow prices are relatively insensitive to marginal changes in the parametric values of objective functions. For, in that case small errors in specifying the relative weights on the macro-objectives may not lead to the choice of a set of projects which differs substantially from the optimal set. Similarly, the shadow prices become operationally meaningful instruments of planning if they remain more or less invariant to small changes in the data on production relations and if they satisfy the property of inter-temporal stability (i.e., the prices do not change much over time [Sau (1971b)].

Corrections to Market Prices

2.3.4 Another procedure of estimating shadow prices adopted by economists involves application of corrections to market prices; the shadow prices on the basis of such corrections to market prices are thought to provide first approximation to social costs and usefulness of the commodities used up or produced by a project [Marglin (1967); Tintner and Patel (1966-67); Eckstein (1961); Flemming and Feldstein (1968); McKean (1958)]. The existing market price of a commodity may reflect the consumers' willingness to pay for a unit of the commodity and, hence, may measure the social usefulness of the commodity. But, as a result of undertaking the project under consideration, the supply of the commodity may increase and, hence, the market price may decline. This would imply that the consumers make a gain on not only their additional quantity of purchase but also the quantity used to be purchased when the prices were higher. In other words, there is an increase in consumers' surplus on the entire pruchases made of the commodity and not just on the purchase made from the new project. Some economists have, therefore, suggested that for consumer goods, the arithmetic mean of market prices with (estimated) and without the project in question (assuming demand curve to be linear) may be taken as the first approximation to per unit gain in social welfare and, hence, to shadow prices. The corrections to be applied depends on the explicit assumptions made about the nature of the market forces of demand and supply of each commodity as well as it complementaries and substitutes.

In the case of inputs, the shadow prices should reflect the social opportunity cost which depends on the nature of the markets for the inputs and their substitutes and the production relations (increasing, decreasing or constant returns to scale, etc).

UNIDO Guidelines

2.3.5 This procedure of adjusting market prices to take account of distortions in market imperfections and, thereby, arriving at shadow prices has been recommended in the UNIDO Guidelines [~~Little and Mirrlees~~ (1972)]. The value of social (consumption) benefits is equal to the net output of the goods and services physically produced by projects evaluated at the shadow prices equal to the 'willingness to pay' of the purchases (as reflected in actual price paid) subject to corrections for monopoly power on the consumer side, decline in price as a result of increased supply consequent upon the implementation of the project and distribution of commodities through rationing (in which cases the consumers' willingness to pay may be higher than what they actually pay). Such corrections naturally would require prior estimation of the demand curves of the commodities. Similarly, inputs used by a project are valued at market prices corrected appropriately, to take account of underemployment of inputs, under-utilization of capacity in the industries producing these inputs, rise in market price of the inputs as a result of increased demand consequent upon the project, rationed distribution of inputs and existence of monopolistic elements in the markets for the inputs.

2.3.6 Inasmuch as reinvestment of surplus generated by a project implies future consumption possibilities, the generation of surplus (unconsumed part of income generated) is regarded as an indirect benefit under the aggregate consumption objective. So long as the aggregate savings (investment) in an economy is less than what is socially desirable, a unit of re-investment possibility (surplus) generated by or a unit of investment required in a project should be more valuable than a unit of current consumption associated with a project. In other words, the shadow price of investment (savings) in terms of consumption should be greater than unity. The shadow price of investment is its opportunity cost i.e., the maximum consumption possibilites foregone by employing a unit of investment in a particular project rather than elsewhere in the economy. The net present value of aggregate consumption possibilities (discounted at consumption time preference rate) on a marginal unit of investment in an economy reflects the opportunity cost of investment. Clearly, the shadow price of investment depends on (i) social consumption time-preference rate of discount, (ii) social rate of return on marginal investment (i.e., the marginal productivity of capital) and (iii) re-investment opportunities associated with a marginal project (i.e., the rate of capital accumulation).

2.3.7 As in the case of investment, shadow price of labour is also not related to demand-supply forces in UNIDO Guidelines. Employment of a unit of labour increases consumption and, hence, is an indirect social benefit.

But it also entails a social cost for increased consumption imply a foregoing of reinvestment opportunity which could have generated future consumption possibility. The shadow price of labour, therefore, is the net social cost as measured by the difference between the value of increased consumption due to a unit employment and the value of reinvestment opportunity foregone. Clearly, the shadow price of labour depends on (i) nominal consumption cost of labour (consumption of a unit labour employed in a project), (ii) opportunity cost of labour (fall in production in the activity from which this unit of labour is drawn) and (iii) the shadow price of investment.

2.3.8 Developing economies are generally characterized by rationed allocation of the severely limited amount of foreign exchange available; at the official exchange rate, demand for foreign exchange is much greater than its supply. The willingness of the purchasers of foreign currency is higher than the official (over-valued) foreign exchange rate at which foreign exchange is available under controlled allocation by Government. This means the shadow price of foreign exchange is greater than unity. This shadow price is used in SCBA of such projects as are expected to have an impact on the foreign exchange availability in the economy. Outputs which substitute for imports or adds to exports c/ inputs which are imported or potential exports implies benefits / costs in terms of increased availability c/r sacrifice of foreign exchange. The shadow price of foreign exchange is applied to convert such foreign exchange benefits and costs

into consumption benefits in domestic currency. In the UNIDO approach the shadow prices of foreign exchange, savings and unskilled labour are centrally determined parameters provided by the Government to project evaluator at the micro-level.

OECD Approach :

2.3.9 In the OECD approach [Little and Mirrleese(1969)], foreign exchange is the yardstick of measurement for goods and services. The shadow prices of the traded goods and services (those which are actually exported or imported and which would be exported or imported had the country followed commercial policies conductive to optimum economic development) should be the prevailing world prices. As regards non-traded goods (e.g., construction work and electricity work,etc.), shadow prices are the marginal social costs of production estimated on the basis of all inputs (broken down into traded goods) except labour valued at their respective shadow prices (i.e., world prices which reflect marginal import cost or marginal export revenue as the case may be).[31] The shadow wage rate and the shadow price of investment in terms of consumption are derived in a manner similar to that of UNIDO.

31/ The marginal import cost may be the c.i.f. prices; the marginal export revenue may be measured by the f.o.b. prices depending on the elasticity of foreign supply and demand for traded goods. For inputs or outputs which are rather unimportant or in respect of which information on production relations are hard to obtain, the use of standard conversion factors worked out on the basis of average ratio of shadow prices to market prices for major groups of important commodities and services may be applied to market prices to arrive at shadow prices.

2.3.10 In both the UNIDO Guidelines and OECD Manual, although aggregate consumption has been treated as the sole macro-objective, other objectives such as output growth and employment have been indirectly taken into account through the use of shadow price of investment and shadow wage rate for labour. Since shadow price of investment in terms of consumption is taken to be greater than unity, projects associated with relatively higher re-investible surplus tend to be favoured compared to projects which allow a relatively high proportion of net social benefits to be actually consumed rather than reinvested. Similarly, since the market wage rate is higher than the computed shadow wage rate, the net social benefits of a relatively labour-intensive project tends to be higher than that of a capital-intensive project. It seems, therefore, that the shadow prices are so worked out that, even within a framework of maximizing aggregate consumption, projects which make higher contributions to the objective of output growth (capital accumulation) and employment growth tends to get priority over others. But net social benefits associated with a project computed on the basis of the these shadow prices reflects the projects' contribution towards the aggregate consumption objective only. Aggregate consumption benefits in any period, however, consists of current consumption and reinvestment. Inasmuch as shadow prices are used to add these benefits, the aggregation procedure itself amounts to assigning relative weights on consumption, capital accumulation and employment. As will be shown in paras 5.2.10 & 5.2.11 of Chapter V, the shadow wage rate formula

of OECD Manual and UNIDO Guidelines corresponds to a particular weighting pattern of the objectives of output growth and employment. If employment is the sole objective of the society, employment created in any project is all benefit. Therefore, shadow price of labour, it has been shown, should be negative[6]

Resources Under-Utilization and Shadow Prices

2.3.11 In both UNIDO and OECD approaches the shadow prices of (unskilled) labour and savings have been worked out without any explicit reference to the demand-supply situation in the labour and capital markets; but the shadow prices of other inputs and outputs are nothing but market prices corrected for market distortions. Marglin [Maass (1962)] suggested that the market demand-supply imbalances should be taken into account in the determination of the shadow prices of labour and capital also. Use of factor market prices as the opportunity cost of resources assumes that both factor mobility and effective demand are sufficient to ensure full-employment in the economy. But, there exists various degrees of unemployment of labour and underutilization of capacities in real economy. Therefore, a project need not necessarily displace labour and capital employed elsewhere in the economy by the amount of such resources the project actually consumes. Thus, the opportunity cost of these factors should be less than market prices. For example, the 'appropriate shadow wage rate is the marginal opportunity cost of the force actually drawn from alternative employment (market wage rate) multiplied by the percentage which this force forms of the total labour force employed in this category'. If the macro-objective of the society is to maximize aggregate consumption, the shadow price of investment in a public sector project, according to

Marglin (1967), should be equal to

$$'a' = Q. \frac{P}{\bar{r}} + Q^*$$

where one unit of public investment is thought of being made at the cost of Q units of private investment and at the cost of Q^* units of private consumption or unutilised private savings, P is the social rate of return (in terms of aggregate consumption) to private investment and $\bar{r}$ is the marginal social rate of discount (i.e., $\bar{P}/r$ is the present value of the perpetual stream of consumption of P rupees per year evaluated at discount rate of $\bar{r}$). Evidently, 'a' defines the minimum allowable Benefit-Cost ratio (ratio of present value of net benefits to investment outlay) for any increase in public sector outlay. The shadow price of labour in a labour-surplus economy where the government may undertake public works investment programmes should be $w^* = Q\left(\frac{P}{\bar{r}} - 1\right)w$, where w is the market wage rate for labour and assumed to be wholly consumed. $Q.\frac{P}{\bar{r}}$ is the loss in terms of aggregate consumption benefits resulting from a deduction of Q units of private investment (consequent upon a unit of public investment), and Q measures the gain in consumption. However, it has been shown that these shadow prices are dependent on the assumptions relating to not only the changes in private investment and consumption but also the shape of the consumption stream generated by private investment and reinvestment of a portion of the net benefits associated with a public sector project.

2.3.12 Attempt has been made by some economists [Havenan and Krutilla (1968)] to estimate the probability of drawing from idle resources (underutilized capacity and unemployed labour) by a public sector project. On the basis of actual data, best-fit market response functions for labour and capital are estimated. The labour response function gives the probability (p_1) of drawing from idle labour force by any new investment project at different rates of unemployment in the economy. The capital response function gives the probability (p_2) of utilizing unutilized capacity by a project at different rates of capacity utilization of capital in the economy. If it is assumed that the opportunity cost of idle resources is zero, the shadow price labour is ($1-p_1$) multiplied by nominal cost of capital and the shadow price of capital is ($1-p_2$) multiplied by the nominal cost of capital.

Problems with Shadow Prices - A Digression

2.3.13 Although economists have been increasingly using shadow prices in SCBA as applied to project evaluation and selection, serious objections have also been made on grounds of theoretical soundness and operational usefulness. Formally, shadow prices have been shown to be the dual solutions to an optimizing programming problem or auxiliary multipliers in a constrained optimizing problem solved by the Lagrange's method. In a real economy, the number of commodities for which shadow prices are to be computed is really large enough to make such computation job a Harculean task [Sen (1970b)]. Moreover, the dual solutions are unlikely to satisfy the desirable properties

of insensitivity (to changes in the parameters of the objective functions and production relations) and inter-temporal stability so that they lose much of operational significance [Brody (1965); Chandra (1970); UN, UCE (1970); Raiman (1966); Sau (1971a)]. Another theoretical argument rests on the programming result that the dual solutions (shadow prices of resources) are obtained simultaneously with the optimum output levels i.e., when project choice problems have already been solved. In other words, the use of shadow prices defined as dual solutions in project evaluation and selection can hardly be meaningful[32] [Rudra (1970)]. It is only under decentralized planning mechanism that trial shadow prices may prove to be useful instruments. But, it has been argued [Sen (1970a)] that since there is no unique relation between optimal activity levels and optimal prices, one set of optimal prices may be used in project selection to arrive at any one of the multiple sets of optimal activity levels consistent with the optimal prices, particularly in such cases where optimal prices are relatively insensitive to underlying technical and demand conditions. Moreover, if the projects evaluated are small enough to leave the market prices and shadow prices unaffected, shadow prices estimated as dual solutions prior to the inclusion of the new project may be used.

32/ This point may be traced back to Hirscheleifer (1958), 'The discount rate to be used for calculating present values ..... cannot be discovered until the solution, and so is of no assistance in reaching the solution'.

2.3.14 The appropriateness of using adjusted market prices as shadow prices in SCBA has also been questioned. "It is a perfectly valid question and no hollow purism to insist upon something more than mere intuition or strong feeling to be advanced in favour of the contention" that the use of shadow prices under pragmatic considerations really leads to improvements [Rudra (1970)]. This objection, however, is applicable to not only the use of shadow prices in project selection but all economic planning techniques developed so far [Sen (1970a)]. For example, even in a practically manageable decentralized planning model, commodities are grouped so that one may at best have shadow prices of not any individual commodity but a group of commodities. Moreover, such planning models are most likely to be based on incorrect specification of technical data and one is not certain how such models can really lead to optimum results. In a sense, therefore, reliance on 'intuition' cannot be totally done away with in planning techniques devised so far.

2.3.15 A closely related problem has long been recognized by economists; it is possible that the use of shadow price in a particular sector allowing the other sectors to operate on the basis of market prices may not necessarily increase social welfare. The issue relates to the 'theory of Second Best' of Welfare Economics. Although this problem had been recognized and discussed previously, the first attempt at its formalization was made by Lipsey and Lancaster (1957). The basic proposition of the second-best theorem is that if the maximization of the social welfare function is

constrained by not only the production possibilities but also one or more additional constraints, the necessary conditions for optimal solution would be different from the usual ones (where the additional constraints are absent) and would turn out to be much more complex. In other words, attaining the maximum welfare position under additional constraints may well require that the pricing formula implicit in the familiar optimum welfare conditions ~~are~~ be replaced by those which are appropriate in view of the additional constraints. In practice, however, it is unlikely that the cost-benefit analyst will be able to collect all necessary data to calculate the exact second-best solutions. The practical alternative is to find the conditions under which the analyst can, with reasonable degree of confidence, make use of the marginal social opportunity cost pricing or some other simple rule of determining appropriate shadow prices in the interest of ensuring welfare improvement [Mishan (1971)]. The major factor which is responsible for making it difficult to find situations under which marginal cost pricing is applicable is the existence of large spill-over (external) effects even in a highly competitive economy. In the absence of any self-correcting tendency, large spill-over effects (which again are generally unevenly distributed throughout the economy) reduce the degree to which the analyst may rely on the economy's ability to allocate resources in the socially desirable manner. Despite this, however, economists are in a position to set guiding rules for pricing under various circumstances. For example, in Green(1961) mathematically

exact rules for pricing of commodities given the price marginal cost ratios of related goods (which are identified as the additional constraints to welfare maximization in view of the fact that pricing of these goods deviate from the requirements of perfect competition) have been derived. "If the general belief, that the predominating relationship between goods is that of substitutes, is accepted, it is also possible to justify, in a rough and ready way, marginal cost pricing of the free sectors irrespective of the deviations from marginal cost pricing in the constrained sector" [Mishan (1971)]. The guiding rule under such situation would be that prices of the free sector should not be less than their marginal costs [Farrell (1958)]. The exact mark-up over costs may be roughly calculated on the basis of intuition. Straightforward application of Marginal Cost Pricing for a group of industries or for all industries, within a geographical area can also be made if the changes in prices or outputs of that region are unlikely to have significant repercussions on the prices and outputs of the remaining areas of the country. This would effect a re-allocation of factors which maximizes the value of net benefits in the particular area leaving the constrained activities in the rest of the country unaffected. In particular, where a project uses some factor which are specific to it and, therefore, has a zero-opportunity cost, the price of the project's output X may be set low enough to utilize such project-specific factors. Inasmuch as these factors involve no real cost to the economy, it is desirable to induce increase in demand and output of X even

at the cost of substitute goods in the constrained sectors since the non-specific factors having positive opportunity cost would be diverted from the substitute goods to other goods and add value there. Finally, a new investment project may result in a Pareto-optimal improvement if the marginal product of a factor used in the project exceeds its opportunity costs provided that the secondary repercusion of such factor movements on the distribution of earnings, pattern of demand and product prices in the economy at large is negligible.

2.3.16 Controversy, however, exists among economists, as to whether shadow prices should be net of taxes and subsidies or should include them. A private entreprenuer may exclude the taxes in evaluating his firm's profitability. But, from the society's point of view these taxes are transfer payments confering benefits to some sections of the society and, therefore, should be taken account of in shadow prices [Mishan (1971)]. Since, consumers purchase commodities at market prices which includes taxes and subsidies, consumers' willingness to pay cannot be measured by such shadow prices which do not include them [Flemming and Feldstein (1968); Harberger (1968)]. Little and Mirrlees (1969, 1974) argue that taxes and subsidies are imposed by the authorities as correctives to market forces. Taxes on luxury items are kept deliberately high on consideration of distributional equity or to restrict consumption of scarce resources. From the point of view of the society prices inclusive of taxes do not measure the marginal social usefulness of the commodities. Therefore,

shadow prices which do not include taxes and subsidies are a better measure of the social usefulness of commodities. This view, however, seems to be equivalent to measurement of aggregate consumption benefit subject to distributional or other considerations. It may be better to work out the implications of projects on aggregate consumption and distribution objectives separately.

2.4 Time Factor in SCBA : Problem of Intertemporal Valuation

2.4.1 The projects/project variants which are subjected to SCBA are generally associated with costs and benefits distributed over different periods during the span of their servicable lives. It is necessary for comparison of projects that the benefits and costs relating to different periods are aggregated suitably to a single measure of net benefits for the entire life period (otherwise, the problem would be one of vector comparison which cannot give unambigous results unless there is point-wise dominance). Usually, benefits and costs of all future periods are discounted by a factor to find out their present equivalents. Two questions are evidently pertinent in respect of the use of such a discount factor. In the first place, should there at all be a positive discount factor ? Secondly, if it is necessary to use a positive discount factor, what should be the basis for estimating the value of the discount factor or the discount rate?[33/]

33/ If an unit of benefit (or cost) in period (t+1) is equivalent to ρ units ($\rho < 1$) of benefit (or cost) in period t, then ρ is the discount factor and ($\rho - 1$) is the discount rate.

2.4.2 From the point of view of the generation which undertakes an investment project, there are reasons to believe that it would be rational for it to prefer projects yielding benefits in the immediate future to the one yielding benefits in a much later period. Inevitability of death which makes benefits in distant future irrelevant may influence the present generation to use a positive discount rate in evaluating alternative time streams of net benefits. Uncertainties associated with benefits expected at distant points of time may be yet another reason for using a positive social time preference rate of discount. But when the interests of the future generations are taken into account, it would be necessary to discount present benefits to future benefits which imply a negative rate of discount rate. In other words, the use of a positive social time preference rate implies a valuejudgement to the effect that the relative importance of benefits accruing to the present generation is greater than those which will accrue to future generations.

Consumption Time Preference

2.4.3 In economic theory and SCBA literature alternative basis for determining social time preference rate has been suggested. It has been argued that,as per capita consumption of the society is expected to grow over time, consumption benefits at present should be more valuable than consumption benefits in future if the law of diminishing marginal utility holds good. Therefore, future consumption benefits are required to be discounted at a positive rate to find out their present equivalents. Clearly,

this social consumption time preference rate (STP) which depends on the marginal utility function of the society is relevant for discounting purposes when the objective of the society is to maximize aggregate consumption.

Opportunity Cost

2.4.4 A second line of argument for positive rate of discount is based on the concept of opportunity cost of investment. The opportunity cost of investment in a project is the social valuation of the stream of net benefits which would have been realized by the society had the resources not been employed in this project but utilized elsewhere in the economy. The opportunity cost rate of discount (OC) is equal to the marginal rate of return on comparable investments which is thought to be displaced as a result of the diversion of resources to the project in question. If the benefits, net of all costs other than capital costs, discounted at the opportunity cost rate exceeds the money cost of capital, a project is regarded as worthwhile.

Synthetic Discounting

2.4.5 In equilibrium under perfect competition, the social consumption time preference rate of discount (STP) and the social opportunity cost rate of return (SOC) should be equal. In a real economy because of market distortions such an equilibrium never obtains. In particular, the underdeveloped and developing economies suffer from sub-optimality of savings which implies

that STP < SOC. This, then, gives rise to the question : which rate of discount should be adopted in SCBA. Clearly, this would depend on the macro-objectives of the society. If the macro-objective is to raise the rate of growth of national output, and to the extent the rate of capital accumulation determines the rate of output growth, SOC is the relevant discount factor provided that the entire surplus generated by a project is reinvested. In Chapters IV and V of the present study, SOC is used as the discount factor for working out the contribution of projects towards the output growth objective (the rate of return ($\bar{r}$) and rate of depreciation (δ) on investments — two of the three sources of capital accumulation, are assumed to depend on SOC (i) in Model A of Chapter IV and in the project criterion suggested in Chapter V). This is true under socialist planning also. As has been indicated in para 1.6.4 of Chapter I, SCBA for project appraisal in the socialist economy aiming at maximizing the rate of growth of production, involves discounting of time-stream of costs (and benefits) on the basis of the norm of effectiveness of investment — which is nothing but an index of opportunity cost of investment. Once wage earners in an economy are also assumed to save and contribute towards capital accumulation and given an assumed rate of growth of output for the economy, a rate of discount which depends on both productivity of investment (SOC) and thrift (STP) may be used in project appraisal [Mutho (1970); Chakravorty (1964)]. But this procedure of discounting is not relevant when the objective is to increase the growth rate of output of the national

economy by choosing such projects as offer relatively high rates of reinvestible surplus (including savings of wage earners); an opportunity cost rate of return is necessary to discount the time-stream of reinvestible surplus generated by a project (vide Chapter V).

2.4.6 If the macro-objective of the society is aggregate consumption, both STP and SOC are relevant. In SCBA literature two alternative approaches have been suggested for the use of a synthetic rate of discount which incorporates both STP and SOC. According to one approach [Marglin (1967); UNIDO (1972)], net social (consumption) benefits consists of direct consumption benefits plus re-investment benefits valued at a shadow price of investment. The shadow price of investment is given by $P^{inv} = \frac{(1-s)q}{i-sq}$, where 'i' is the social time preference rate of discount, q is the marginal productivity of capital and s is the rate of reinvestment out of net benefits. Clearly, P^{inv} is equal to the present value of the time stream of direct consumption benefits associated with marginal investment [i.e., (1-s).q], discounted at a synthetic rate of discount (i-sq). Once the net social benefits are computed in the above manner for each period, these are then aggregated by using the social time preference discount rate — the resultant present value net social benefits indicates the worth of a project from the point of view of aggregate consumption objective.

2.4.7 The alternative approach of synthetic discounting has been suggested in OECD Manual (1969). The shadow price of investment is

given by the present value of direct consumption benefits associated with marginal investment, i.e., $(1-s)q$, discounted at a synthetic rate $\frac{(1+i)}{(1+q)}$. The present value of the time-stream of (a) direct consumption benefits plus (b) the investment benefits valued at the shadow price of investment, worked out on the basis of a discount rate called the accounting rate of interest indicates the worth of the project from the point of view of aggregate consumption objective (accounting rate of interest is the rate of discount at which demand for investment funds from all projects having positive present value is equal to the available supply of investment funds). It is easily shown that the alternative approaches of discounting will give the same results; a project having positive present value under the first approach will also have a present value under the second approach [Das Gupta (1972)]. However, inasmuch as in the calculation of net social profit for each period labour has been evaluated at the shadow wage rate which itself is dependent on the social discount rate (vide para 2.3.6 and 2.3.7), further discounting of the time-stream of net social profit of a project at the social discount rate appears to involve double discounting of a part of the benefits (or costs). For example, since in [Marglin (1967)], labour has been already shadow priced, the use of a SOC rate for discounting time-stream of net benefits causes the adjustment of labour content of costs twice [Mutho (1971)]. In the criterion function developed in Chapter V, the possibility of double discounting has been sought to be avoided.

2.4.8 In SCBA literature the discussion on the rate of discount so far centred round the objective of aggregate consumption or national output growth only. The problem of inter-temporal valuation, however, can also arise when the macro-level objective is income-distribution or employment. A project may be associated with a flow of benefits over time such that the benefits are distributed among different income classes differently in different periods; in the initial period benefits may be flowing more to richer sections of the society while in the later years of the projects accrual of benefits may be concentrated among the poorer sections of the society. How can these non-uniform distributional effects of a project during different periods be aggregated ? How can two projects of the above nature be compared in terms of their contribution towards the distributional objective of the society? Again, a project may initially absorb a large labour force in construction work but employ a small number of people during its operative stage for operation and maintenance. What should be the discount rate for adding up employment benefits/costs flowing from a project in different periods ? These issues have scarcely been considered in the literature [Moratwetz (1974)]. So far as the objective of employment is concerned it may be noted that STP rate of discount for aggregate consumption is not relevant; value of employment need not decrease or decrease at the same rate as the value of consumption does as total employment increases over time. However, the greater the intensity of unemployment in the economy in the short-run, the higher is the discount rate for future employment benefits; as the rate of unemployment decreases overtime, the discount rate for employment may fall. It is also possible to think of a opportunity cost rate of return employment. The employment per unit of investment on comparable projects which are expected to be displaced as a result of diversion of investible resource to a given/particular project is an index of the employment opportunity cost of the investment made in the project.

Estimation Difficulties : A Digression

2.4.9 In equilibrium under perfect competition STP should equal SOC and the difference between different approaches to discounting rate would disappear. In the presence of disequilibrium, however, all these approaches are faced with the practical problem of estimating the appropriate discount rates. Quite a large number of alternative bases of calculating the social discount rate have been adopted in SCBA literature [Mutho (1971)]. The problem of arriving, on the basis of individual consumption time preferences, at the social time preference rate remains to be solved satisfactorily. In particular, inter-temporal choices made by the individuals in a real economy apparently lack rationality and it is not advisable to use an average of the rates of interest earned by different classes of savers and paid by different classes of borrowers for purposes of discounting social benefits and costs [UNIDO (1972)]. While calculations of STP based on the risk of death have been attempted [Ecksteien (1961)], no direct method of estimating, with a reasonable degree of simplicity, the STP has been developed so far. Often social cost benefit analysis of projects are made on the assumption that the long-term rate of interest implied in government's monetary and fiscal policies is the appropriate STP. As for the opportunity cost rate, it is difficult to conceive of a situation where a single SOC would be uniformly applicable in all sectors of the economy. Moreover, when both STP and SOC are simultaneously used for discounting different types of benefits and costs (i.e., synthetic discounting), it is necessary to estimate the extent of displacement of

current consumption and current investment elsewhere in the economy as a result of the investment expenditure in a new project. In view of the fact that institutional barriers and existence of risk will always counteract any tendency of equalization of STP and SOC in equilibrium, the choice of discount rates, according to Baumol (1965b) will remain 'indeterminate' in this sense. In UNIDO (1972), the determination of the social rate of discount has been left to the policy-makers to chose on behalf of the society on this basis of their own assessment of the appropriate set of valuejudgements concerning relative importance of increments to consumption in different periods. It has been felt that neither the individuals' market revealed 'preferences' nor the observed values of capital productivity is able to determine the social rate of discount; a centrally specified value of the rate of discount is, therefore, necessary for the appraisal of investment projects at the micro-level.

2.5 Choice of Investment Criteria

2.5.1 The ranking and selection of the projects at the micro-level are solved on the basis of a decision algorithm or decision formula (usually called the project choice criterion). The benefits and costs valued at appropriate shadow prices and wage rates and discounted at appropriate social discount rate are compared in terms of a choice criterion which indicates the worth of a project. In other words, the choice criterion i the objective function at the micro-level; the project or the set of projects which satisfies the objective function most are selected for

implementation. Clearly, the micro-level objective function (choice criterion) has to be consistent with macro-level objectives the society intends to pursue. A general choice criterion has been described in Chapter I (section 1.3). Specific forms of this criterion consistent with different macro-objectives may be derived; it is difficult to specify a single choice criterion that would be consistent with all plausible macro-objectives. With multiple macro-objectives, the derivation of a consistent micro-level choice criterion becomes difficult. In what follows different investment project choice criteria referred to in SCBA literature are discussed with reference to their relation to the macro-objectives of the society.

Some Crude Criteria

2.5.2 Under situations of uncertainty with respect to prices of output and inputs of a project as well as the prices of their existing and potential complimentaries and substitutes and/or with respect to the stability of socio-economic environment, micro-level business decisions in a market economy tend to be conservative and investors may try to play safe by undertaking projects which are relatively quick yielding. The investment projects are, therefore, often ranked in terms of the Pay-back period — the period required to fully recoup the initial capital expenditure. According to the Pay-back Period Criterion (PPC), between two projects A and B, project A is preferrable to B or vice-versa,

according as $T_A \lessgtr T_B$ [34/]

34/ Sometimes this criterion is expressed in terms of the Pay-back period rate of return which is equal to Pay-back period divided 100 i.e., $T_A/100$ for project A and $T_B/100$ for project B.

where $\sum_{t=1}^{T_A} b_t^A - K = 0$ and $\sum_{t=1}^{T_B} b_t^B - K = 0$ .... (2.1)

(b^A is the benefit net of the all costs other than initial investment cost K_A in period t). It is easily seen that the objective underlying PPC is the generation of adequate surpluses to replenish the pool of resources from which the initial investment outlay has been drawn, within the shortest possible time. From the private entrepreneur's point of view this criterion reflects a risk aversion conservative attitude with regard to the flow of benefits in the distant future. From the point of view of the society PPC ensures faster growth of investible resources in the short-run. To the extent capital accumulation influences the rate of output growth, PPC is consistent with the macro-objective of output growth. However, in view of certain drawbacks discussed in Section 3.2 of Chater III, PPC may not always be an appropriate indicator of a project's contribution towards the output growth objective.

2.5.3 Often a cut-off period T* is chosen and among investment projects with Pay-back Period (T_i) are undertaken or rejected according as $T_i \leq T^*$ or $T_i > T^*$. The socialist criterion of Limiting Recoupment Period (LRPC) is a variant of the Cut-off Period Criterion (COPC). While for business investments in a market economy, the value of T* is chosen sufficiently low enough to take account of the future uncertainties referred to earlier, in the case LRPC the value of T* reflects the opportunity cost of investment. It is evident that the Cut-off Period Criterion or the PPC discriminates against projects which have relatively long gestation periods although

such projects may be of greater importance from the point of view certain socio-economic macro-objectives of the society. Clearly, therefore, PPC may well be an arbitary decision formula unless the value of T* is determined in a manner that take accounts of the national objectives at the macro-level. Moreover, PPC does not take account of all the benefits and costs over the entire period of a projects servicable life, those after the Pay-back period are ignored altogether [para 3.2.3 of Chapter III].

2.5.4 Another crude criterion often adopted in business is the Annual Average Rate of Return Criterion (ARC). The rate expresses the sum of benefits net of all costs (except initial investment outlay) associated with a project over its servicable life period as percentage to initial investment outlay. Sometimes, a variant of this criterion — the Annual Net Average Rate of Return Criterion (NARC) is used where the relevant rate is the sum of benefits net of all costs (including investment outlays) over the serviceable life period of a project as percentage to initial investment outlay. Insofar as ARC and NARC take account of the entire time-stream of benefits and costs they are superior to PPC or COPC. But while adding up net benefits in different periods, ARM and NARM values them equally and involves no discounting of future benefits. With output-growth as the macro-objectives, the marginal output-capital ratio criterion (MOCRM) has been recommended as an appropriate criterion (output measured in terms of value added). Higher is the ratio, the more desirable is a project. The difficulty with MOCRM is that the relevant ratio is not constant over time

in the case of most projects. Moreover, the rate of growth of output in an economy depends not only on the output produced per unit of capital invested, but also on the distribution of output produced among consumption and investment.

Explicit Treatment of Time Factor

2.5.5 Some of the more sophisticated criteria take explicit account of the time profile of net benefits by reducing them to equivalent net benefits at a particular (usually the initial) point of time by means of a weighting device namely, discounting. The more popular among these criteria are Present Value Criterion (PVC), Internal Rate of Return Criterion (IRORC) and the True or Effective Rate of Return Criterion (TRORC). According to PVC, a project A is acceptable if the present value of project A is positive,

$$\text{i.e.,} \quad PV_A = \sum_{t=1}^{T} \frac{b_t^A}{(1+r)^t} - K_A > 0 \qquad \ldots \quad (2.2)$$

and project A is preferable to project B if $PV_A > PV_B$ where r is the discount rate[35].

35/ A variant of the PVC is expressed in terms of the ratio of net present value to initial investment cost i.e., project A is preferable to project B, if

$$\frac{PV_A}{K_A} > \frac{PV_B}{K_B}$$

or, according to another variant

if $$\frac{PV_A - K_A}{K_A} > \frac{PV_B - K_B}{K_B}$$

2.5.6 For any project A, the internal rate of return (ρ_A) is determined as follows :

$$\sum_{t=1}^{T} \frac{b_t^A}{(1+\rho_A)^t} = K_A \qquad \ldots (2.3)$$

In other words, internal rate of return of a project is the rate of discount at which present value of benefits net of all costs is equal to zero. According to IRORC, a project A is acceptable if

$\rho_{k_A} > \rho^*$ where ρ^* is the opportunity cost of investment,

and, it is preferable to project B if

$$\rho_A > \rho_B$$

TRORC is a generalized version of IRORC. The true rate of return $\bar{r}_A$ of project A is determined from the equation :

$$\sum_{t=1}^{T} (b_t^A - \bar{r}_A \cdot K_A)\ (1+i)^{T-t} = K_A \qquad \ldots (2.4)$$

where i is the opportunity cost rate of return. Project A, according to TRORC, is acceptable if $\bar{r}_A > i$, and, it is preferable to project B if $\bar{r}_A > \bar{r}_B$.

2.5.7 PVC, IRORC and IRORC may be consistent with both the aggregate consumption objective and output growth objective depending upon the definition of benefits and costs(b_t^A) and the choice of the rate of discount. If the benefits include only the re-investment surplus generated by projects and the discount rate is the re-investment rate of return on marginal projects,

all these criteria are consistent with the objective of faster capital accumulation or output growth (on the basis of a comparison of the criteria consistent with output growth objective, an attempt has been made in Chapter III, to determine the most suitable criterion). If, however, the benefits are split into two parts — direct consumption benefits and re-investment benefits, and, if direct consumption benefits over time are discounted at the consumption time preference rate while the re-investment benefits are discounted at a synthetic rate based on consumption time preference rate, re-investment rate of return on marginal project and marginal productivity of capital, these criteria become consistent with the aggregate consumption objective. In both UNIDO Guidelines (1972) and OECD Manual (1969), PVC has been used on the basis of such distinction between two types of benefits and such discounting procedure as are consistent with aggregate consumption objective (paras 2.4.6 and 2.4.7 above).

Conflicting Criteria

2.5.8 The acceptability or otherwise of a project, the ranking of projects, or the selection of projects under a constraint on the availability of investment funds on the basis of the different criteria referred to above, as has been shown in the literature, can well be conflicting. In particular, the ranking of investment projects in terms of the IRORC and in terms of different variants of PVC may differ because either the projects under consideration do not have a common investment outlay and/or common serviceable life or because the implicit assumptions of IRORC

regarding the re-investment opportunities and their utilization are at variance with the real situation and the rate of discount assumed by PVC[36] [Mishan (1971); Solomon (1956, 1959)]. One defect of IRORC – it may fail to take account of the actual re-investment possibilities in a given situation. Attempts have been made to show the superiority of PVC even IRORC because of this reason [Rangarajan & Maumpilly (1971)]. Possibility of multiplicity of solutions is yet another source of difficulty with IRORC. It has also been shown that when two projects are mutually exclusive (i.e., choice one of project preclude the choice of the other), IRORC is irrelevant. However, if the internal rate of return of the project under consideration exceeds the rate of discount adopted for PVC, despite the conflict in ranking the two criteria may reveal, under a constraint on availability of investment funds, choice of projects may well be made on the basis of IRORC [McKean (1958)]. While for PVC the choice of the discount rate affects the computations, for IRORC it is not so. The problem for depreciation is easily taken care of if the IRORC is applied. In view of these, IRORC has been preferred by some [Dave and Bhatt (1971)].

A Normalization Procedure

2.5.9 In view of the possible conflict in ranking by the IRORC and PVC Mishan (1967b, 1971) suggested a normalization procedure under which the time profile of benefits less costs (K_o, b_1, b_2, ..., b_n) of any investment

---

36/ The differences in outlays and project lives are sufficient conditions for existence of conflict, but not necessary [Gould (1972)]. Even if projects have the same outlays and same servicable lives, ranking in terms of PVC and IRORC may be conflicting.

project is converted into $[0, 0, 0, \ldots, TV^n(b) - TV^n(K)]$ where $TV^n(b)$ is the maximum normalized terminal value of the sum of all the positive benefits in the n-th (terminal) period, $TV^n(K)$ is the same for the negative benefits (outlays). The terminal period n (the common period of life of projects) is the minimum period after which none of the projects has any scope for specific investment opportunities with yield rates higher than the other projects. By taking the largest investment outlays among the projects as the common outlay for all projects and employing the surplus investible funds for projects actually requiring investment outlays smaller than the common outlay in the most advantageous form (i.e., in alternative investment opportunities offering highest rates of return) the value of $TV^n(K)$ is made equal for all projects. The net re-investment benefits in any period is deployed in alternative investment opportunities such that their value at the terminal period is maximized and net benefits which could not be invested is compounded at the social time preference rate to the terminal period. Under the Normalized Terminal Value Criterion (NTVC), project A is acceptable if $TV^n_A(b_A) - TV^n_A(K_A) > 0$ and it is preferable to project B if $TV^n_A(b_A) - TV^n_A(K_A) > TV^n(b_B) - TV^n_B(K_B)$ It is easily shown that NTVC, PVC and IRORC under the normalization procedure give identical results.[37]

37/ Normalized Present Value of Benefits and Costs are defined as $PV^*_A(b_A) = TV^n_A(b_A) \times 1/1(1+d)^n$ and $PV^*_A(K_A) = PV^n_A(K_A) \times 1/(1+d)^n$ where d is any rate of discount. Similarly, normalized internal rate of return is defined as the λ^* for which

$$TV^n_A(b_A) \times 1/(1+\lambda^*)^n = PV^*_A(K_A)$$

Thus, $TV^n_A(b_A) - TV^n_A(K_A) > 0$ implies $PV^*_A(b_A) - PV^*_A(K_A) > 0$. Since $TV^n_A(K_A) = TV^n_B(K_B)$, $TV^n_A(b_A) - TV^n_A(K_A) > TV^n_B(b_B) - TV^n_B(K_B)$ implies $PV^*_A(b_A) - PV^*_A(K_A) > PV^*_B(b_B) - PV^*_B(K_B)$. Also, $PV^n_A(b_A) - TV^n_A(K_A) > TV^n_B(b_B) - TV^n_B(K_B)$ implies $(1+\lambda^*_A)^n PV^*_A(K_A) > (1+\lambda^*_B)^n PV^*_B(K_B)$ i.e., $\lambda^*_A > \lambda^*_B$.

2.5.10 The need for normalization for differences in initial outlays and projects' lives to make comparisons in terms of different criteria consistent is understandable. The suggestion for compounding the part of net benefit (of project in any period) which cannot be invested, at the social time preference rate (which is less than the opportunity cost rate), however, discriminates against projects which allow for relatively high rate of consumption. Moreover, inasmuch as the procedure involves discounting (rather compounding) at two different rates, it is difficult to understand which macro-objective is sought to be satisfied.

Static Efficiency in Allocation

2.5.11 Some economists have attempted at formal derivation of criterion consistent with the society's different macro-objectives. With the objective to ensure efficient allocation of resources in an economy in which the market is not perfect enough to ensure Pareto-optimal efficiency in resource allocation, the criterion of Social Marginal Productivity (SMP) is recommended [Cheneary (1953)]. SMP is equal to the increase in national income plus the incremental effect on balance of payments (measured in national income units) consequent upon an unit increase in investments. These incremental effects on national income and balance of payments are approximated by the ordinary calculation of profit subject to a set of adjustments necessary to eliminate tariffs, taxes and subsidies in the measurement of value of output, to take account of the external economies and diseconomies associated with any projects; and allow for the divergence between market

costs and social costs of using hitherto unemployed resources. Symbolically, the Social welfare function is assumed to by U = U (Y, B) where Y is the effect of investment on national income and B is the effect on balance of payments, U is the index of social welfare. Social Marginal Productivity of investment is measured by

$$dU = dY. \frac{\delta U}{\delta Y} + dB. \frac{\delta U}{\delta B} = dY + r. \quad dB \qquad \ldots (2.5)$$

assuming $\frac{\delta U}{\delta Y} = 1$ since welfare is measured in national income units and $\frac{\delta U}{\delta B} = \frac{\delta Y}{\delta B} = r$ = marginal rate of substitution between Y and B, estimated on the basis of average over-valuation of domestic currency at existing foreign exchange rates (or a premium attached to net earnings in foreign exchange). Adjusting for market imperfections referred to above,

$$SMP = dU = \frac{X+E-M_i}{K} - \frac{L+M_d+O}{K} + \frac{r}{K}(aB_1 + B_2) \qquad \ldots (2.6)$$

where X is value added, E is effect on external economies, M_i cost of imported materials; L labour costs, M_d cost of domestic materials, O overhead costs, K capital investment, B_1 effect of installation of the project on balance of payments and B_2 effect of the operation of the project on balance of payments, 'a' is the combined amortization and interest on current borrowing. Projects are to be ranked in terms of SMP and selected in order of rank until the available investment funds are fully allocated among the chosen set of projects. The SMP criterion of Chenery, however, should incorporate further adjustments to take account of the existence of underutilization of capacity and disguised unemployment.

infrastructural costs of the society; and the possibility of increasing returns to sale. Moreover, straightforward application of SMP criterion cannot be recommended in case of close interdependence among investment projects or where non-marketable outputs are produced. Besides, one of the basic problems to economic growth is the lack of purchasing power and inadequate effective demand. The SMP criterion assumes that effective demand is sufficient enough to ensure that whatever an investment project produces will be sold at the market prices. Since this is unlikely to be true in underdeveloped countries, SMP criterion cannot be applied straightway [Eckstein (1957)]. Moreover, static optimum criteria for choice of investment projects like the SMP criterion may fail to ensure maximization of the rate of economic (output) growth. Particularly, in underdeveloped countries where capital markets are imperfect and the actual levels of savings and investment fall far short of the optimum levels, investment project choice criterion should take account of the projects' direct contribution towards increasing the economy's capital stock which is regarded as one of the basic determinants of economy's growth rate.

Capital Accumulation and Aggregate Consumption

2.5.12 Eckstein (1957) derived a criterion that reflects the contribution of projects towards both static efficiency and capital accumulation. The problem is to maximize present value of the time stream of net benefits

$$H = \sum_{t=1}^{T} \sum_{1}^{n} \frac{(1 - \alpha_1)}{(1 + i)^t} Y_1 + \sum_{t=1}^{\infty} \frac{(1 - \alpha_R) Y_{Rt}}{(1 + i)^t}$$

subject to production relations : $Y_1 = Y_1(K_1)$, $1 = 1, \ldots, n$;

$$Y_{Rt} = Y_{Rt}(K_{Rt}), \quad t = 1, \ldots, ;$$

$$\frac{\delta Y_1}{\delta K_1} > 0, \quad \frac{\delta^2 Y_1}{\delta K_1^2} < 0, \quad \frac{\delta Y_{Rt}}{\delta K_{Rt}} = \beta ;$$

and capital constraint $\sum_{1=1}^{n} K_1 \leq \bar{K}$

where n is the number of projects to choose from;

$\bar{K}$ is the available capital stock to be allocated among the projec

Y_1 is the value added (increased national income) made possible by capital investment of K_1 in project 1;

α_1 is the part of Y_1 that is saved and goes into capital accumulation (re-investment coefficient);

Y_{Rt} is the value added possible by re-invested capital K_{Rt} in period t;

α_R is the re-investment coefficient is all future periods;

T is the period of life of the projects (assumed equal);

β is the marginal productivity of capital relevant to all re-investments in future periods; and

i is the rate of discount (time preference).

In terms of Lagrangean expression, the problem is to maximize

$$\phi = H - \sum_{l=1}^{n} \lambda_l \left[Y_l - Y_l(K_l) \right] + \mu \left[\sum_{l=1}^{n} K_l - \bar{K} \right]$$

$$+ \sum_{t=1}^{\infty} \lambda_R \left[Y_{Rt} - Y_{Rt}(K_{Rt}) \right] \qquad \ldots (2.7)$$

One of the optimal conditions, in its simplified form, is given by

$$\mu = \frac{\delta Y_l}{\delta K_l} \sum_{t=1}^{T} \frac{1 - \alpha_l}{(1 + i)^t} + \frac{\delta Y_l}{\delta K_l} \alpha_l (1 - \alpha_R) \times$$

$$\left[\frac{(1 + i)^T - 1}{i(1 + i)^T - 1} \right] \frac{\beta}{i - \alpha_R \beta} = \text{MGC} \qquad \ldots (2.8)$$

All projects are ranked in terms of their MGC (marginal growth contribution) and projects with MGC $> \mu$ are to selected. This is ensured by choosing the projects in order of the MGC till the available investment fund $\bar{K}$ is exhausted. The first part of (2.8)) is nothing but the SMP corrected for the part of net benefit re-invested and represents the direct contribution to consumption. The second part is the addition to consumption made possible by re-investment of unconsumed net benefits directly flowing from the project. MGC criterion, therefore, ranks projects in terms of the contribution towards the objective of aggregate consumption and in so far as initial conditions represent a situation of less than optimum rate of savings and investment and $i < \beta$, but $i > \alpha_R \beta$, projects which are associated with relatively high rate of saving (re-investment coefficient) out of net benefits tend to get higher ranking. The OECD (1969) and UNIDO (1972) approaches are, evidently, similar to the approach of MGC criterion.

Economic Growth

2.5.13 Treating economic growth (as measured by the rate of growth of national income) as the macro-objective, a priority formula for project ranking and selection was developed by the Netherlands Economics Institute on the basis of earlier works by Jan Tinbergen and Benjamin B. King [Higgins (1966) pp.654-56, 685. The formula involves a comparison of the annual growth rate of real national income for all future periods (using appropriate social time preference rate for discounting and shadow prices) with and without the project(s) in question. In the determination of these rates of income growth, the growth rate of capital stock (rate of capital accumulation) and the capital-output ratio constitute the strategic variables. However, the basic difficulty of using such a formula is the non-availability of data required to estimate the rates of income growth.

Redistributional Objectives

2.5.14 With greater income equality as the only national macro-objective the derivation of a criterion can only be made if an aggregate Social Welfare function is specified. The specification of the form of the Social Welfare function of necessity involves interpersonal utility comparisons and hence constitutes a set of valuejudgements. Assuming the Social Welfare function $W = W(Y_1, Y_2, \ldots, Y_{n+n'})$ such that the Social Marginal Welfare function reflect constant elasticity i.e., $\frac{\delta W}{\delta Y_i} = Y_i^{-a}$ where Y_i is the income of individual i, and identifying the potential gainers from any

project as i = 1, ..., n and the potential losers as j = 1, ..., m, the criterion for ranking projects would be

$$W = \sum_{i=1}^{n} \int_{Y_{i_1}}^{Y_{i_2}} Y_i^{-a}\, dY_i + \sum_{j=1}^{m} \int_{Y_{j_1}}^{Y_{j_2}} Y_j^{-a}\, dY_j \qquad \ldots (2.9)$$

with

It has been shown that a criterion function such as (2.9), it is quite possible that the optimum scale of a project may turn out to be beyond the point where marginal efficiency net benefits equal to zero, i.e., the total efficiency benefits are maximum [Freeman (1967)]. This indicates the possibility of conflict between the two objectives of efficient resource allocation and greater equality in income distribution.

2.5.15 Under the objective of greater equality, the acceptability or otherwise of a project depends on the benefit distribution, tax-distribution and the distribution of weights attached to individuals' incomes implied in the social welfare function. With efficient resource allocation or growth of output as objective, the rate of return criteria (PVC, IRORC, TRORC, etc.) implies that the net benefits divided by the initial investment outlay of a project must be greater than the critical or cut-off rate (the social discount rate) if the project is to be selected. When the redistributional objective is of primary importance, the cut-off rate would be different. If for a project yielding annutized net benefits amounting to B at an initial investment cost of K is associated with a benefit distribution scheme $\Sigma \lambda_i B = B(\lambda_i$ is the share of benefit of

the i-th individual) and a tax-distribution scheme $\Sigma t_i K = K$ (t_i is the share of tax burden on the i-th individual), the project in order to be acceptable must be such that the social value of net benefits $\sum_i w_i \frac{\lambda_i B}{\gamma_i}$ is greater than the social value of initial investment cost $\sum_i w_i t_i K$, where w_i is the weight attached to an unit benefit accruing to individual i and γ_i is the time-preference discount rate of individual i. In other words,

$$\sum_i w_i \left(\frac{\lambda_i}{\gamma_i} B - t_i K \right) > 0 \text{ or } \frac{B}{K} > \frac{\Sigma w_i t_i}{\Sigma w_i t_i \left(\frac{\lambda_i}{t_i \gamma_i} \right)} \quad \ldots (2.10)$$

i.e., the critical or cut-off rate for a project is the harmonic mean of $(t_i \gamma_i / \lambda_i)$ with weights $w_i t_i$. If, however, transfer adjustments could be made freely (i.e., if the objective of redistribution was not relevant), the cut-off rate would be $\frac{1}{\Sigma \frac{\lambda_i}{\gamma_i}}$ which is nothing but an average discount of xxx individual discount rates and hence the criterion corresponds to the usual PVC consistent with the objective of aggregate consumption [Bradford (1970)].

Multiplicity of Objectives

2.5.16 Project choice criterion consitent with multiple macro-objectives of a society has rarely been suggested. The formula suggested by the Philippines National Economic Council (1957) may be cited. The national objectives of economic policy identified by the Council were (i) national income, (ii) foreign exchange earnings, (iii) employment and (iv) other

social considerations including distribution of income. The scarce resources which were to be allocated among the projects were foreign exchange and labour. The formula suggested was the priority index

$$I = R_1 + R_2 + R_3 + R_4 \qquad \ldots \quad (2.11)$$

where R_1 is the social value added to national income (measured as the sum of wage and salaries, rent, interest and profit earned by people other than foreigners multiplied by relative essentiality multiplier of the commodity produced by a project; the value of the multiplier being determined on the basis of the relative social and economic importance of the commodity and other externalities associated with its production) by the project per unit of capital investment;

R_2 is the social value of the impact of the project on the balance of payment position per unit of capital investment;

R_3 is the social value of the additional economic benefits derived by the project from the use of domestic raw materials and supplies per unit of capital investment; and

R_4 is the social value derived from the employment of labour per unit of capital investment.

2.5.17 As far as the identification of macro-objectives and the translation of the objectives into relevant benefits are concerned the Council's attempt may be regarded as commendable. But the way the benefits are aggregated in the formula does not throw light on the relative importance or weights attached to different objectives, i.e., the resolution of plausible conflict among the objectives is not explicit. In particular, since the formula has not been derived on the basis of any explicit

macro-model, it is not clear whether the set of projects selected on the basis of the formula will lead to maximization of the society's welfare function. As referred to earlier, in Chapter V of this study, at attempt has been made to use explicit weights to twin macro-objectives of income/output growth and employment growth for the determination of an appropriate criterion of project selection at the micro-level in the light of macro-model developed in Chapter IV.

2.6 Some Special Problems

2.6.1 Apart from the problems discussed in the previous four sections, SCBA is confronted with some special problems related to the previously discussed ones. Three such problems, namely, those associated with linkages, externalities and uncertainties are discussed in this section.

Linkage and Sequence of Projects

2.6.2 The development of most of the project criteria above is generally based on the assumption that there is no significant interdependence among projects undertaken in different periods. Attempts have indeed been made through either the use of shadow prices and discount rates or adjustments in the definition of social benefits and costs to take account of possible linkages, externalities and interdependence among projects. Attempt has also been made to solve the problems of timing and sequence of projects under conditions of budgetary constraints and ensure maximization of present value of net social benefits [Marglin (1963c)]. But whether

a particular set of projects is the best that should be undertaken during the current period can not be determined without explicitly taking account of the possible interdependence among the choice of projects in different periods. Existence of backward and forward linkages may imply that a set of projects (A) in period (t) although optimum considered in isolation, may preclude the possibility of making another set of projects (B) which is optimum in period (t+1) if considered in isolation. While (A) in period (t) makes the set of projects (C) optimum in period (t+1), set of projects (D) makes the set of projects (B) optimum in period (t+1). This is because of linkages of the following nature : one set of projects undertaken in period (t) may affect the feasibility and viability and desirability (i.e., the time-stream of benefits and costs at shadow prices) of another set of projects depending on the period in which the latter set of projects are proposed to be undertaken. As a result, it is possible that the sequence (D) and (B) would give better results than the sequence (A) and (C). In view of this Hirschman (1958) suggested that, for developing countries, an optimal sequence would be the alternation of 'pressure creating' (bottleneck generating) and 'pressure-relieving' projects over the successive time periods. For these types of decisions concerning economic development, "it is not sufficient to supplement, qualify and otherwise refine the usual investment criteria. We must evolve entirely new aids to thought and action in this largely unchartered territory of efficient sequences and optimal development strategies" [Hrischman (1958), pp. 79]. It must be pointed out, however, that even if such decisions regarding optimal sequences are

made this will not in itself entirely solve all investment project choice decision problems. Problems relating to optimal capacity, choice of techniques and others will remain. Moreover, it is possible to supplement, qualify or refine the project criteria in a manner that the linkage effects are taken account of appropriately. In section 4.4 of Chapter IV and section 5.4 of Chapter V, the interrelation between linkage effects and the macro-objectives of output growth and employment growth has been discussed. It has been shown that linkages may give rise to conflict between the two objectives (para 4.4.7). Attempt has also been made to incorporate linkage effects in the project choice criterion (paras 5.4.4 - 5.4.7).

Externalities

2.6.3 'Linkages merge into externalities. Any distinction is somewhat arbitrary' [Stewart & Streeten (1971b)]. Externalities are also referred to as 'neighbourhood effects', 'side effects', 'spillover' effects or more generally as external economies and diseconomies. Standard instances of externalities are training of labour force by one firm which makes it possible for its competitors to employ skilled labour without incurring training costs, expansion of one automobile firm leading to internal economies of scale for a steel manufacturing firm which in turn makes it cheaper for other firms to obtain steel at cheaper prices, increased fishing activity by one group leading to depletion of the supply of fish and thereby making fishing more difficult for other groups, a barking dog

acquired by person A disturbing / sleep at night for another person B and making person C feel more safe against theft, forest resource depletion by a paper-pulp factory producing adverse effects on flora, fauna, rainfall and soil, artificial lakes leading to growth in mosquito population and causing health hazards, ruthless exploitation of exhaustible energy resources, increase in the number of high-speed vehicles on roads which raises the probability of loss of life in road accidents, etc. It is easily seen that these effects are generally unintentional and incidental; they arise out of such interdependence among welfare of different economic units as cannot be readily reflected through prices under market arrangement. The Pareto-optimality of the general equilibrium market solution of outputs and prices fails to hold with the existence of such externalities; market prices fail to allocate resources optimally under the circumstances. The number of such external effects in a real economy is virtually unlimited. However, one may ignore such externalities which arise due to personal envy, e.g., a girl feeling sad when she is unable to acquire a set of jwellery similar to the one recently procured by one of her relatives. Moreover, some of the external-effects can be internalized by imputing a shadow price for a scarce commodity which is not marketed and thereby ensure Pareto-optimality. For example, an external effect may be considered as a by-product of the main product and a shadow price of the by-product may be obtained on the basis of social opportunity cost. The congestion effect of additional buses on roads may be taken care of by imputing a price for the scarce factor road. If the road is correctly priced, the market economy, cet par, will yield

Pareto-optimal solution. Similarly, the pollution or noise costs may be estimated on the basis cost of anti-pollution or anti-noise devices, if they are technically feasible. In SCBA of projects such shadow pricing techniques help adjust the time-stream of benefits and costs in the light of externalities. However, the number of external effects which may be internalized in this manner are very limited. For example, some of the modern industrial activities are associated with noise-disturbance, air-pollution, water-pollution and discharge of radio-active wastes in respect of which foolproof remedial measures are not technologically feasible.

2.6.4 A method of compensating variation has been suggested for the valuation of external effects in SCBA [Mishan (1971)]. Compensating variation for the society as a whole is given by

$$V = \sum_i V_i + \sum_j V_j \qquad \ldots \quad (2.12)$$

where $V_i \geq 0$ is the maximum positive sum which the person i in the group of people who are better off as a result of a particular external effect [are prepared to pay] and $V_j \leq 0$ is the minimum positive sum which the person j in the group of people who are worse off would accept to put up with the adverse effect. If $V > 0$, the external effect on the society is regarded as positive, and the project associated with the external effect is worthy of being undertaken on grounds of Pareto-principle. In some cases, a part or all of these V_i or V_j may be determined directly by reference to market prices (e.g., increased laundry bill resulting from smoke nuisance).

In most cases, however, subjective evaluation with respect to compensation by individuals have to collected by arranging some sort of a negotiation between the potential gainers and potential losers from a given investment project and persuading them to reveal their willingness to pay/accept compensation for the likely increase/decrease in welfare and to arrive at a mutually profitable agreement.

2.6.5 The evaluation of these preferences in respect of certain psychic needs of life in terms of monetary compensation has been objected to (Section 1.3 footnote 7 of Chapter I). Moreover, the method of compensating variation assumes equal weightage of individual preferences irrespective of their income status. In the first place, the method only indicates whether there is a net gain or loss to the society from a project's external effects and, therefore, is consistent with the objective of Pareto-optimality; but, the distributional implications of these effects are not taken account of and, therefore, fails to indicate the contribution of a project towards redistributional objective of the society. Secondly, the relative bargaining power of affected individuals itself (and hence the outcome) depends on the existing distribution of income and wealth which may be far from the one that is socially ideal. Again, the method is also dependent on the existing laws concerning the liability for external effects (whether the liability rests on those who are adversely affected or those who are favourably affected). Also, there is the question of deducting costs of negotiation (as well as implementation of outcome) between gainers and losers; these costs have to be deducted from V to find

whether net social benefits are positive. Finally, the efficacy of the method is dependent on the dissemination of adequate information among the affected parties. It is extremely doubtful whether an appropriate questionaire technique could be evolved for eliciting necessary information from the potential gainers and losers in densely populated developing countries with high degree of illeteracy such as India. Because of these difficulties, a cost-benefit analysis may not like to incorporate external effects in the project choice criterion function until more reliable methods of bringing external effects appropriately into the economic calculus are developed. Nevertheless, the working out of the implications of externalities should form a part of SCBA of investment projects. This is particularly important when external effects may have different implications from the point of view of different macro-objectives of the society; it would not be advisable to treat them in a less serious manner (because of their immeasurability or insignificant impact from the point of view of one macro-objective) which Chapter 16 of Little & Mirrles (1969) apparently tends to suggest.

Uncertainties

2.6.6 Since projects yield benefits and costs over a span of time in future it is possible that the estimated benefits (and costs) need not turn out to be equal to actual benefits (and costs) resulting from the operation of the project. Uncertainties may be associated with the projects in regard to the magnitude of benefits (or costs) as well as the prices of

a unit of benefit or cost expected at a future date. Economists and Mathematicians have, therefore, made attempts at devising different techniques to get around this problem of uncertainty [Carter (1957); Hertz (1964); World Bank Staff Papers (1970)]. The simplest alternative is to find a certainty equivalence of the uncertain magnitude of the future benefits (and costs). Certainty equivalence is nothing but the lowest acceptable magnitude among the range of possible variation in actual outcome in future. Alternatively, it is assumed that people want to play safe and avoid risk. The risk premium for given quantum of benefit at a future date is nothing but the difference between the expected quantum and the actual provision made in calculations (or implicit in present transactions involving future goods). Evidently, the higher the degree of uncertainty about future magnitudes and price of benefits, the greater is the risk premium one would be willing to pay for playing safe. However, the concepts of certainty equivalent and risk premium are not meaningful when people differ in their estimates of the values for these.

2.6.7 Another line of approach towards the problem of uncertainty and risk is to use either a low cut-off period, or a rate of discount higher than the pure time preference rate (i.e., the riskless rate of interest) or the average opportunity cost rate of return. Yet another approach is to deflate the future ~~the~~ time-stream of benefits by a price index.

2.6.8 The use of principles in Game Theory has also been suggested. The principles of Maximin inasmuch as it concerns more with security may

be regarded as a highly conservative procedure and, correspondingly, the minimax procedure as highly optimistic one. And, the choice among the Game-theoretic procedures opens up yet another area where subjective valuejudgements of decision-makers may creep into SCBA. The Game theory approaches are based on the assumption that there exists no knowledge or past information that may indicate any likelihood of how future events will shape. It has been shown that no satisfactory basis for decision-making can be found which does not invoke judgements concerning the likelihood of various events [Dorfman (1962)]. One way of invoking such judgements is to assign probabilities to such events. Probability distribution of events may be estimated from past data and a weighted average of alternative possibilities are often used for purposes of cost benefit calculations [Hiller (1963)]. This indeed offers an attractive solution to the problem of uncertainty.

2.6.9 The problem of uncertainty and risks associated with the time-stream of benefits and costs of projects remains yet to be solved satisfactorily. This does not mean that this aspect is to be ignored altogether in SCBA. The role of SCBA, under the circumstances, lies in identifying all uncertainties and risks involved in project construction, operation and maintenance over time and working out the implications of uncertain benefits and costs on the realisation of various macro-objectives of the society. This will help ensure more informed project choice decisions.

2.7 Summing Up

2.7.1 In the brief review of the SCBA literature in the previous sections of this chapter, an attempt was made to identify and examine the various important theoretical and practical issues many of which still elude satisfactory solutions. Some of these problems appear to have given rise to doubts concerning the role and applicability SCBA in real economies. The discussions in this and the previous chapter also sought to locate the sources of such confusion and appreciate the role and applicability of SCBA in its proper perspective. The important conclusions emerging from these discussions in this regard are outlined in this concluding section.

2.7.2 Given the complex nature of interdependence among economic activities, the difficulties of obtaining relevant information and the state of knowledge at present, almost all applications of SCBA are likely to involve the use of some simplified or inexact rules and practical short-cut methods. This, it is true, gives rise to the objection that in view of the restrictive assumptions involved and limitations of rules and methods employed, SCBA may not ensure optimality in decision-making with respect to choice of investment projects. However, at the same time, it should be noted that the rules and methods of present day SCBA have been derived by making the best possible use of the knowledge gained so far and are expected to help ensure that society's decisions concerning project choices are taken on a more rational and informed basis. Moreover, to the extent these rules and methods can be applied in actual choice problems with some degree of

confidence, the decisions on the basis of SCBA are likely to be better than those based on rules of thumb. SCBA as a practical application of Welfare Economics is designed to help ensure improvements in decision-making concerned with social welfare. Given the present state of knowledge, SCBA may not ensure optimal situation; nevertheless, it can help achieve a second-best situation which PCBA or rules of thumb may fail to ensure /Little & Mirrles (1974), Chapter 19/.

2.7.3 It may be difficult to compare, rank and select investment projects of heterogeneous types on the basis of SCBA, For example, the comparison in terms of SCBA of investment projects in the area of family planning or mass education or environmental development with those in the area of multi-purpose river-valley development and industrial manufacturing may require such information regarding society's preferences and long-term developments in the economic and technological spheres as are difficult to obtain (or may be unreliable, even if available). But, then these decisions will have to be taken notwithstanding the fact that better alternatives to SCBA are not available to ensure optimality in decision-making. It appears, therefore, till satisfactory resolution of all the problems of SCBA are worked out, these decisions if taken after analysing all social costs and benefits (to the extent such analysis is feasible and operationally meaningful), would at least help make the society aware of the various implications of the decision taken and its alternatives.

2.7.4 Even for purposes of comparing investment projects quite similar in nature (a situation under which SCBA is confronted with fewer intricate problems), it is difficult to specify a single set of exact and precise rules which will suit all occasions; these rules (in respect of definitions, quantification, valuation and comparison of social benefits and costs) are expected to vary depending upon the organization of the economy, the nature and relative importance of different macro-objectives sought to be achieved by the society as well as the objective conditions (such as limitations on resources, nature of market imperfections, etc.) prevailing in the economy. But the basic approach to the problems of project choice remains the same : evaluation of benefits and costs in the light of the society's objectives and aspirations.

2.7.5 In a completely planned economy, the problem of micro-level project choice may be thought of as one of constructing a decentralization algorithm for the macro-planning model. The developments so far indicate that some success has been achieved in this respect in the framework of essentially static resource allocation planning models. But planning by nature is dynamic and the primary task is to solve problems of optimization over time. Generally applicable and operationally convenient decentralization algorithms for essentially dynamic multi-sectoral macro-planning models which explictly take account of the major macro-objectives of a society are yet to be determined. In the absence of such neat and workable algorithms, SCBA of investment projects on the basis of macro-objectives and projections contained in the long-term plan cannot be done away with in a planned economy.

2.7.6 In a free enterprise economy investment project decisions are taken by individuals from the point of view of their own interests and hence, their decisions will be generally linked to private cost benefit calculations at market prices. The State (Government), however, can introduce fiscal and monetary correctives on the basis of the principles of welfare economics, so as to make private costs and benefits approximate social costs and benefits. This naturally makes it necessary to undertake social cost benefit appraisal of different activities in the private sector. This apart, the State may undertake some investment projects to meet the demand for collective goods and merit wants. It is desirable that decision regarding these public utility projects are made on the basis of SCBA. Unfortunately, it is precisely in the case of public utility projects, the problems of applying SCBA are acute. For one thing, the value of benefits and costs associated with these projects should depend on the distribution of benefits and costs among various individuals/groups comprising the society. This obviously calls for determining the social valuations or weights reflecting the relative importance of various types of benefits/costs accruing to/inflicted on different individuals/sections of the society. Secondly, inasmuch as the public utility projects are likely to generate benefits (outputs) for which markets may not exist or for which beneficiaries (consumers) may not reveal their preferences (willingness to pay) for such benefit, the determination of appropriate shadow prices becomes difficult. But practical short-cut methods based on the present state of knowledge are

available to estimate best possible approximations to shadow prices[38]. As noted in para 2.7.2, the limitations of the methods notwithstanding, SCBA helps introduce an element of rationality in the decision-making process which itself is clearly a desirable thing. Moreover, since SCBA aims at making explict the valuejudgments implicit in any project choice decision, this help contain the degree of discretion otherwise enjoyed by those involved in social decision-making.

2.7.7 In a mixed economy in which the state undertakes not only public utility projects but also industrial, agricultural and transportation projects, SCBA can play an important role. The choice of public sector investment projects in such an economy should be made on the basis of net contribution of projects towards the achievement of macro-objectives of the society. The fact that the private sector may continue to make investment project choice decisions on the basis PCBA at market prices may cast a shadow on the utility of SCBA for public sector projects at shadow prices, particularly in view of the implications of the Second-best Theorem /vide para 2.3.15/. But, this does not imply that SCBA of public sector projects would be meaningless. In the first place, some guiding rules for shadow price determination are available which will ensure that the choice with regard to public sector projects will lead to Pareto-optimal improvements in the economy even if the exact second-best solutions could not be

---

38/ For some public utility projects (e.g., defence services) evaluation of benefits may not be necessary; social cost-effectiveness analysis of project variants generating the same measure of benefits only may be necessary — this reduces the problems of analysis usually faced by SCBA.

worked out. Secondly, Government decisions in respect of granting licenses and quotas for production and export/import activities may well be made on the basis of shadow prices reflecting the relative importance of various macro-objectives and the relative scarcity of resources. Moreover, it is also possible to influence the private sector investment project choice decisions if the Government assumes adequate powers (apart from fiscal and monetary instruments). If it was possible for a Government to ensure that all transactions are made at shadow prices determined and announced by it, private and social cost-benefit calculations will tend to converge. Finally, SCBA is not necessarily to be restricted to the objectives of static efficiency in resource allocation and aggregate consumption; macro-objectives of redistribution, employment generation, surplus generation, environment and quality of life etc., may well be very important macro-objectives of the society in their own rights in different stages of economic development in an economy. For the measurement of positive or negative contribution of projects towards some of these objectives may not require determination of shadow prices in the sense that is necessary under the objectives of static efficiency and aggregate consumption. For example, maximum re-investible surplus for the public sector may be more meaningful at market prices because the Government simply wants to have more of purchasing power for undertaking projects requiring larger investible funds at market prices. It is possible to think of computing such shadow prices as would take account of the need for higher investible surplus for the public sector,

but it is easier to work with market prices. Similarly, the contribution of projects towards the objective of employment generation may be measured in terms of labour units — the question of shadow prices just does not arise.

2.7.8 The use of market prices for measuring contribution of projects towards some of the objectives, however, does not mean the interdependence, linkages and externalities are to be ignored; these can be taken account of in SCBA even when market prices are used. For example, as a result of a new project A, employment and surplus generation in other existing or new projects may rise or fall. Also, new projects may come up because of incentives thrown off by a project A. Obviously, the net change in employment and surplus generation elsewhere in the economy as a result of undertaking project A are also to be taken into consideration in determining its worth, in addition to direct employment and surplus generation in project A itself. How these are to be incorporated in SCBA with twin macro-objectives of income and employment growth has been indicated in sections of Chapter V.

2.7.9 On the basis of an examination of the interrelations between possible macro-objectives of the society, the objectives which could be conflicting are to be identified. It is possible that the realization of one such objective may not ensure realization of another objective or may be at the cost of the latter objective; the conflict may arise in the short-run or in the long-run. Under situations of such conflict, it

seems appropriate to consider these two objectives as disparate ones. Once a society has a number of such desparate objectives, it is necessary that the society make explicit judgement as to the relative importance of the objectives. This judgement may not be easy to obtain unless the society (or those who take decisions on behalf of the society) is (are) made aware of the trade-off among the objectives. It would be advisable in such a case to work out the extent to which increase in satisfaction in terms of one objective will have to be foregone in order to realize a specified increase in satisfaction in terms of another objective. This may be done on the basis of a macro-model and requiring the society to indicate the weights or relative importance of the objectives. These weights may then be appropriately incorporated in SCBA at the micro-level. Alternatively, the results of SCBA may be worked out assuming different sets of weights and ask the society to choose projects in the light of the implications of choosing each project on the realization of the society's macro-objectives, which have been worked out by SCBA. But, it would not be advisable to adopt a still another alternative procedure which involves adjusting the projects' contributions (i.e. adjusting the concept of benefits and costs and their shadow prices) in terms of one objective in the light of other objectives. For, this procedure is unlikely to explicitly throw off the implications of alternative projects on the realization of different macro-objectives. In the present study, the former approaches have been adopted (Chapters IV and V) with output growth and employment growth as two macro-objectives of the society.

Chapter III

CRITERIA CONSISTENT WITH OUTPUT GROWTH OBJECTIVE

3.1 Introduction

3.1.1 In the previous Chapter, a number of alternative criteria which are consistent with the macro-objective of maximizing output growth have been discussed (section 2.5 , paras 2.5.2 - 2.5.7). The important criteria suggested in the literature to evaluate the contributions of projects towards the objective of output growth include the Payback Period Criterion (PPC), Present Value Criterion (PVC), Internal Rate of Return Criterion (IRORC), True Rate of Return Criterion (TRORC) and Limiting Recoupment Period Criterion (LRPC). In this Chapter a further discussion of these criteria is made with a view to

(a) comparing these criteria under a number of different situations concerning project choice; and

(b) establishing conditions for formal equivalence of these criteria when the problem is one of choosing the best alternative among a set of incompatible projects.

3.2 PPC and PVC

3.2.1 The Payback Period is the number of years within which the aggregate net returns from an investment will be equal to the initial investment outlay in a project. The investment project associated with the least value of payback period is selected. In other words, given

two projects A : (b_t^A, K) and B : (b_t^B, K), where b_t are the net benefits in year t associated with the relevant project and K is the initial investment, one is to choose the project for which the payback period is the least, i.e.,

Minimum (T_a, T_B) where

$$\left.\begin{aligned} \sum_{t=0}^{T_A} b_t^A - K &= 0 \\ \sum_{t=0}^{T_B} b_t^B - K &= 0 \end{aligned}\right\} \quad \ldots \quad (3.1)$$

i.e., project A is preferred to project B if $T_A < T_B$.

3.2.2 The Present Value of an investment project is the excess of present value (discounted for time differences in the flow of benefits) of the net returns over the initial investment cost. According to PVC, projects are ranked according to

$$\underset{A,\,B}{\text{maximum}} \left(\sum_{t=0}^{T} d(t)\, b_t^A - K, \quad \sum_{t=0}^{T} d(t)\, b_t^B - K \right) \quad \ldots \quad (3.2)$$

i.e. $$\underset{A,\,B}{\text{maximum}} \left(\sum_{t=0}^{T} d(t)\, b_t^A, \quad \sum_{t=0}^{T} d(t)\, b_t^B \right) \quad \ldots \quad (3.3)$$

Moreover, projects A and B are said to be viable if

$$\sum_{t=0}^{T} d(t)\, b_t^A \geq K \quad \text{and} \quad \sum_{t=0}^{T} d(t)\, b_t^B \geq K \quad \ldots \quad (3.4)$$

where d(t) is the discount factor for costs and benefits arising in time period t and T is the period of life of the project which lives longer.

In other words, Project A is preferred to B if

$$\sum_{t=0}^{T} d(t) \quad (b_t^A - b_t^B) > 0 \qquad \ldots \quad (3.5)$$

where (3.4) holds.

From (3.1), if follows, Project A is preferred to B if

$$\sum_{t=0}^{T_A} (b_t^A - b_t^B) > 0 \qquad \ldots \quad (3.6)$$

It is easily seen that PPC is a special case of PVC where

$$d(t) = 1 \quad \text{for} \quad t = 0, \ldots, T_A \quad \text{and} \quad d(t) = 0 \quad \text{for} \quad t \geq T_{A+1} \qquad \ldots \quad (3.7)$$

Quick-yielding and Late-yielding Projects

3.2.3 So long as PPC is given by (3.1) or (3.6), it may be compared with PVC as represented by (3.3) and (3.5) formally in the above manner. The comparison indicates that PPC involves a particular type of weight distribution for aggregating inter-temporal net benefits; while net benefit accruing upto the minimum payback period (T_A) are counted at their face value (unity weight), those accruing in periods $t > T_A$ are neglected (assigned zero weights). Inasmuch as costs and benefits at future points of time are of less value compared to present costs and benefits of same magnitude, a discount factor may well be introduced in the Payback Period concept. Thus, for a better comparison between PPC and PVC the following definition may be adopted.

Generalised Payback Period Criterion I (GPPC-I)

A is preferable to B if $T_o^A < T_o^B$

where $\sum_{t=0}^{T_o^A} d(t).b_t^A - K = 0$ and $\sum_{t=0}^{T_o^B} d(t).\ b_t^B - K = 0$

or assuming $d(t) = \lambda^t$ for all t,

A is preferrable to B if $T_o^A < T_o^B$

where $\sum_{t=0}^{T_o^A} \lambda^t\ (b_t^A - b_t^B) > 0$ ... (3.8)

Similarly, from (3.5), A is preferrable to B if

$$\sum_{t=0}^{T} \lambda^t\ (b_t^A - b_t^B) > 0 \qquad \ldots \quad (3.9)$$

From (3.8) and (3.9), if $T = T_o^A$, then B is not acceptable since it is unable to recoup it costs at all. In this case, both GPPC-I and PVC have the same conclusion : prefer A to B. If $T < T_o^B$ both criteria prefer A to B. But for $T > T_o^B$, these criteria need not give the same result.

3.2.4 This may be illustrated diagramatically as follows :

Let $\alpha_T = \sum_{0}^{T} \lambda^t\ b_t^A$, $\beta_T = \sum_{0}^{T} \lambda^t\ b_t^B$ ... (3.10)

Assuming $b_t^A \geq 0$, $b_t^B \geq 0$, α_T and β_T may be represented as follows :

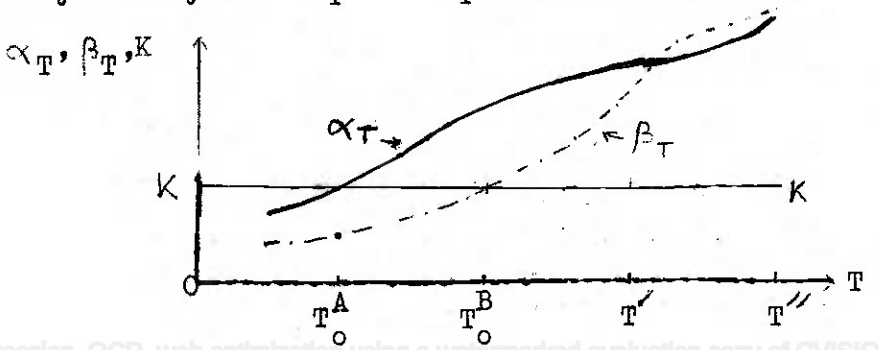


Diagram 1

α_T is the heavily drawn curve and β_T is the broken curve. Both GPPC-I and PVC agree so long as $T < T'$. But for $T' \leq T \leq T''$, PVC might well prefer B to A while GPPC-I always prefers A to B for in this range T is the such that $\beta_T > \alpha_T$.

Now, $\alpha_T - \beta_T = \alpha_{T_o^B}^B + \sum_{T_o^B+1}^{T} \lambda^t (b_t^A - b_t^B) - K$

$$(\because \quad \alpha_{T_o^A}^A = K = \beta_{T_o^B}^B)$$

$$= \sum_{T_o^B+1}^{T} \lambda^t (b_t^A - b_t^B) - (K - \alpha_{T_o^B}^B) \qquad \ldots (3.11)$$

Therefore, $\beta_T > \alpha_T$ if

$$\sum_{T_o^B+1}^{T} \lambda^t (b_t^A - b_t^B) < K - \alpha_{T_o^B}^B \qquad \ldots (3.12)$$

If $b_t^A \geq 0$ for all t and $b_t^B \geq 0$ for all t, $\alpha_{T_o^B}^B \geq \alpha_{T_o^A}^A = K$

Therefore, $\beta_T > \alpha_T$ if $\sum_{T_o^B+1}^{T} \lambda^t (b_t^A - b_t^B) < 0 \qquad \ldots (3.13)$

Evidently, GPPC-I discriminates against projects having relatively long payback period and associated with flow of net benefits of relatively greater magnitude around or soon after their payback periods. In other words, GPPC-I is likely to discriminate against late-yeilding projects.

Phased Investment Outlays

3.2.5 Capital investment in a project need not be confined at the initial period of time but may well be spread over different periods. Example of such phased investment outlays may be flood control-cum-power generation-cum-irrigation projects, urban water supply projects and metropolitan tube railways. In the case of these projects contruction work is phased over different periods while benefits start flowing after the first phase of construction works are over. Under situations where investment outlays are phased at selected periods over time, the following generalization of the PPC may be adopted for purposes of comparison with PVC.

Generalized Payback Period Criterion-II (GPPC-II)

A is preferable to B if, given

$$\left.\begin{array}{l} \sum_{t=0}^{T_i^A} \lambda^t b_t^A - \sum_{t=0}^{i} \lambda^t K_t = 0 \quad \text{for } i=1,2,\ldots,T \\ \text{and} \\ \sum_{t=0}^{T_i^B} \lambda^t b_t^B - \sum_{t=0}^{i} \lambda^t K_t = 0 \quad \text{for } i=1,2,\ldots,T \\ \left[T_i^A;\ i=1,\ldots,T\right] \leq \left[T_i^B;\ i=1,2,\ldots,T\right] \end{array}\right\} \quad \ldots(3.14)$$

i.e., there exists at least one i for which $T_i^A < T_i^B$ where $T_i^A = T_i^B$ for all other i.[39] Here T_i^A is the Payback period of all investment outlay in project A upto time period i. By definition, therefore, in the absence of pointwise dominance among the payback period vectors T_i^A and T_i^B, the

39/ Since for many t, $K_t = 0$ (i.e., no fresh investment outlay in period t), for successive values of i, T_i^x may be the same for any project x.

criterion GPPC-II is unable to rank the projects (unless additional considerations are introduced). Thus, with projects involving investment outlays over time, PPC in its generalised version (i.e., GPPC-II) is applicable only in a very restricted field.

3.2.6 An extension of GPPC-II, retaining the concept of Payback Period, to take account of differences among projects with respect to investment-cost time-configurations ($K_t^A \neq K_t^B$ for some t), would be the following :

Generalized Payback Period Criterion-III (GPPC-III)

A is preferable to B if

$$\left[T_i^A \right] \leq \left[T_i^B \right]$$ (strict inequality holding for at least one i)

where $$\sum_{t=0}^{T_i^A} \lambda^t b_t^A - \sum_{t=0}^{i} \lambda^t K_t^A = 0;$$

$$\sum_{t=0}^{T_i^B} \lambda^t b_t^B - \sum_{t=0}^{i} \lambda^t K_t^B = 0;$$

and $$\sum_{t=0}^{i} \lambda^t K_t^A \geq \sum_{t=0}^{i} \lambda^t K_t^B, \quad i = 1, 2, \ldots, T$$

(strict inequality holding for at least one i) ... (3.15)

This once again reflects the restricted applicability of the Payback Period concept; if for any i $T_i^A > T_i^B$ with $T_i^A \leq T_i^B$ for other values of i or $\sum_t^i \lambda^t K_t^A < \sum_t^i \lambda^t K_t^B$ even when other conditions are satisfied, the criterion is not workable. As against this, PVC is of wider applicability

than the Generalized Payback Period Criteria. For project A to be preferable to project B, PVC requires

$$\frac{\sum_{t=0}^{T} \lambda^t (b_t^A - K_t^A)}{\sum_{t=0}^{T} \lambda^t (b_t^B - K_t^B)} > 1 \qquad \ldots (3.16)$$

Unlike GPPC-III, PVC does not involve comparison of investment outlays in each period with net benefit; instead a single comparison of costs and benefits is involved in PVC. The problem of vector comparison, therefore, does not arise in the case of PVC.

Rate of Discount

3.2.7 It is possible to compare the criteria, PPC and PVC in terms of the rate of discount used in PPC. From (3.1), according to PPC A is preferable to B

$$\text{if} \quad \sum_{t=0}^{T_A} (b_t^A - b_t^B) > 0 \quad (\text{where } T_A < T_B)$$

$$\text{i.e. if} \quad \sum_{t=0}^{T_A} h_t > 0, \quad (\text{where } h_t = b_t^A - b_t^B) \qquad \ldots (3.17)$$

From (3.3), according to PVC, A is preferable to B

$$\text{if} \quad \sum_{t=0}^{T} \lambda^t h_t > 0 \qquad \ldots (3.18)$$

While (3.17) is independent of the value of λ, the result from (3.18) depends on λ; $H(\lambda) = \sum_{t=0}^{T} \lambda^t h_t$ is a polynomial in λ. Given

$\sum_{t=0}^{T_A} h_t > 0$, it may well happen that for some value of λ, $\sum_{t=0}^{T} \lambda^t h_t < 0$. In other words, if A is preferable to B according to PPC criterion this will also be true according to PVC only for certain values of λ. This may be shown in terms of the diagram below. $H(\lambda) = 0$ might have multiple solutions among which more than one root may be non-complex, non-negative and less than or equal to the maximum positive value that can be assigned to λ in a real economy. $H(\lambda)$ is represented by the curve H. Easily seen that according to PPC A is preferable to B for $\sum_{t=0}^{T_A} h_t > 0$, $T_A < T_B$. But the same preference ordering holds true according to PVC only if the value of λ falls strictly inside the regions OA or BC or DE and so on.

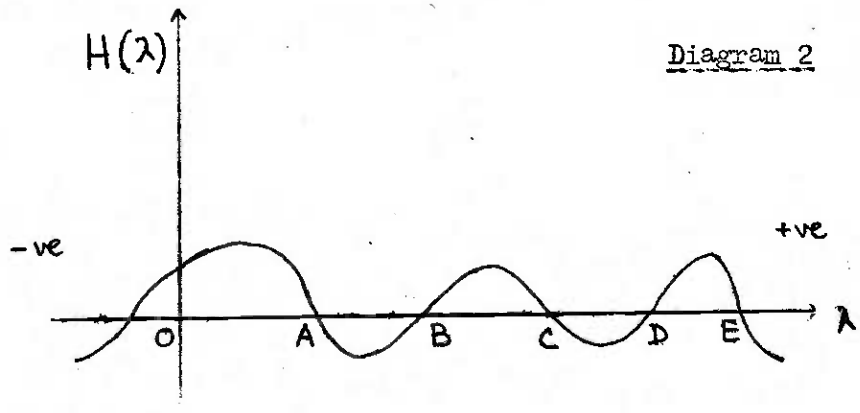


Diagram 2

3.3 PVC and IRORC

3.3.1 In this section, results following from the application of PVC and IRORC in problems of project ranking and selection are compared. Let there be two projects A : (b_t^A, K_A) and B : (b_t^B, K_B) where K represents fixed capital costs and b_t^* denotes net benefits at time t for the respective projects.

PVC requires for A to be preferable to B,

$$PV_A > PV_B$$

i.e. $$\left[\sum_{t=0}^{T} \left(\frac{1}{1+r}\right)^t b_t^A - K_A\right] > \left[\sum_{t=0}^{T} \left(\frac{1}{1+r}\right)^t b_t^B - K_B\right] \quad \ldots (3.19)$$

i.e. $$\sum_{t=0}^{T} \left(\frac{1}{1+r}\right)^t (b_t^A - b_t^B) > 0$$

if $$K_A = K_B \quad \ldots (3.20)$$

From the point of view of IRORC for the same result to hold

$$\rho_A > \rho_B > 0$$

where $$K_A = \sum_{t=0}^{T} \left(\frac{1}{1+\rho_A}\right)^t b_A^t \quad \ldots (3.21)$$

$$K_B = \sum_{t=0}^{T} \left(\frac{1}{1+\rho_B}\right)^t b_B^t$$

Comparing (3.20) and (3.21), it is apparent that internal rate of return (ρ) gives the upper limits for r (assuring $b_t^* \geq 0$ for simplicity) for which A or B will be eligible for selection according to PVC (i.e., $PV_A = 0$ for $r = \rho = \rho_A$). For $r > \rho_B$, B has non-positive present value and hence B is not admissible for selection according to PVC. From (3.19) it also follows that $(PV_A - PV_B)$ is a function of r and whether $PV_A \gtrless PV_B$ depends on the value of r. The diagrams below are for illustrative purposes. In diagrams 3A, 3B and 3C while according to IRORC A is preferable to B, according to PVC the same conclusion holds if the discount rate r

lies in the interval Or′ or ρ_A r″ (for r > r^2_B, B is inadmissible). In diagrams 3D and 3E, according to IRORC, projects A and B are equally desirable. According to PVC this conclusion holds true if r = r′ and r = ρ_A = ρ_B.

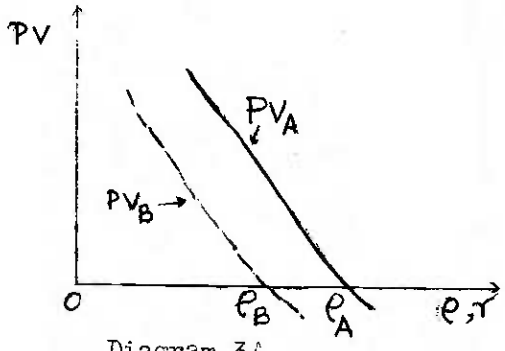


Diagram 3A

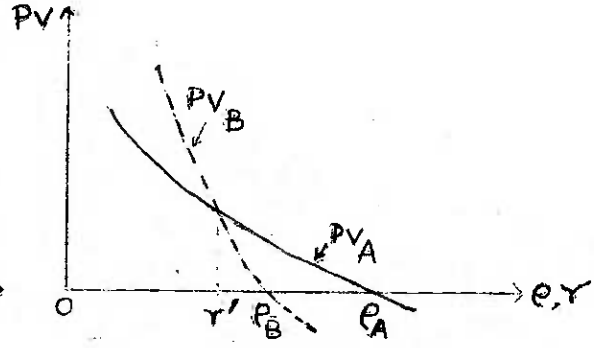


Diagram 3B

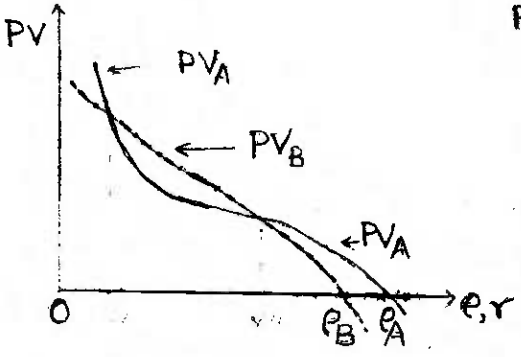


Diagram 3C

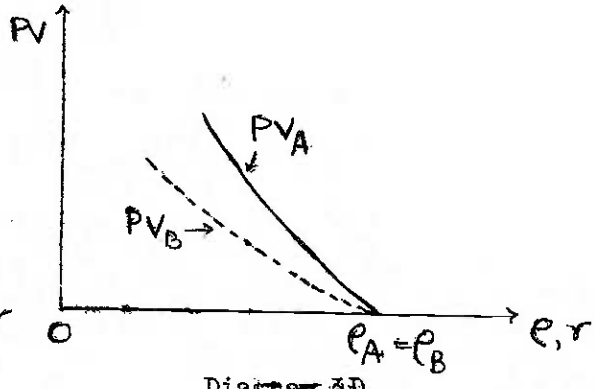


Diagram 3D

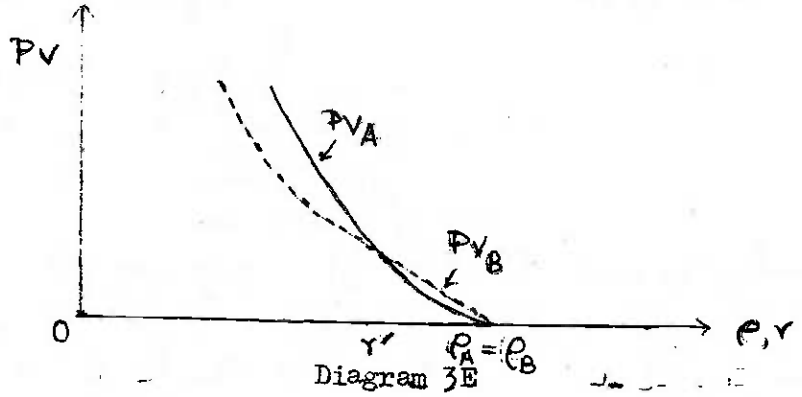


Diagram 3E

3.3.2 Evidently, results from PVC depend on the value of the discount rate chosen, while IRORC is independent of it. But IRORC may be faced with the following two difficulties.

(i) ρ_A and/or ρ_B satisfying (3.21) may not exist; and

(ii) multiple values of ρ_A and/or ρ_B may satisfy (3.21) if the restriction $b_t^* \geq 0$ is removed.[40]

3.3.3 With budgetary constraint (limitation of investment to be allocated among projects), one of the methods often suggested is to choose that rate of discount for which demand and supply of capital are equal[41]. In other words, for the last project choosen PV must be equal to zero. In this case existence of unique solution for IRORC means, project selection by PVC and by IRORC amount to the same thing.

3.4 IRORC and TRORC

3.4.1 The True (Effective) Rate of Return ($\bar{r}_A$) of project A is defined by the relation

$$K_A = \sum_{t=1}^{T} (b_t^A - \bar{r}_A \cdot K_A)(1+i)^{T-t} \qquad \ldots (3.22)$$

40/ As per the Descarte's Rule of signs, only one change in sign in the the co-efficients in the polynomial $\sum_t \frac{1}{(1+\rho)^t} b_t^* = K$ implies that there is only one or no solution for ρ. With $b_t^* \gtrless 0$, the possibility of multiple changes in signs arises and, hence, that of multiple solutions for ρ arises.

41/ For example, the use of Accounting Rate of Interest suggested in [Little and Mirrles (1969)].

where i is the rate of return on re-investments for the entire life period (T) of the project. Expanding (3.22),

$$K_A + \bar{r}_A \cdot K_A \sum_{t=1}^{T} (1+i)^{T-t} = \sum_{t=1}^{T} b_t^A (1+i)^{T-t}$$

or, $$K_A \left[1 + \bar{r}_A (1+i)^T \sum_{t=1}^{T} (1+i)^{-t} \right] = (1+i)^T \sum_{t=1}^{T} b_t^A (1+i)^{-t} \quad \ldots (3.23)$$

If $$1 + \bar{r}_A (1+i)^T \sum_{t=1}^{T} (1+i)^{-t} = (1+i)^T \quad \ldots (3.24)$$

(3.23) reduces to the IRORC equation in (3.21). Now, from (3.24)

$$\bar{r}_A \frac{(1+i)^T - 1}{i} = (1+i)^T - 1$$

or, $$\bar{r}_A = i (= \rho_A) \quad \ldots \quad (3.25)$$

In other words, if the rate of return on re-investment, i, is equal to the true rate of return, IRORC and TRORC are equivalent.

3.4.2 For any given project A, it is expected that higher the rate of return on re-investment (i), higher is the true rate of return ($\bar{r}_A$) i.e. $\frac{\delta \bar{r}_A}{\delta i} > 0$ 42/. In order to compare the results of the application of

---

42/ $$\frac{\delta \bar{r}_A}{\delta i} = \frac{\sum_{t=1}^{T} (b_t^A - \bar{r}_A \cdot K_A)(T-t)(1+i)^{T-t-1}}{K_A \sum_{t=1}^{T} (1+i)^{T-t}} \rightarrow 0$$ if it is assumed that $b_t^A - \bar{r}_A \cdot K_A > 0$.

TRORC and IRORC, the following diagrams may be useful

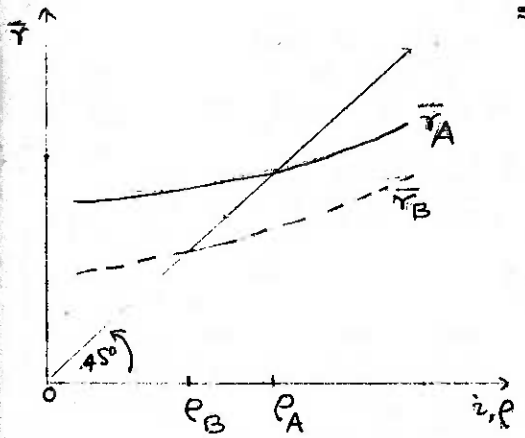


Diagram 4A

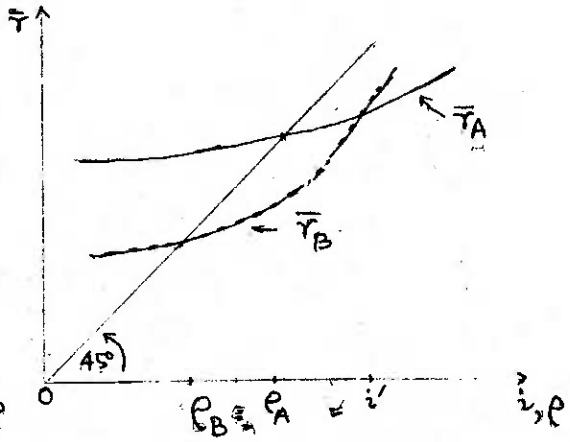


Diagram 4B

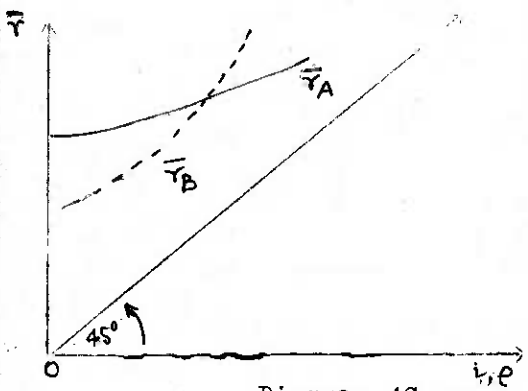


Diagram 4C

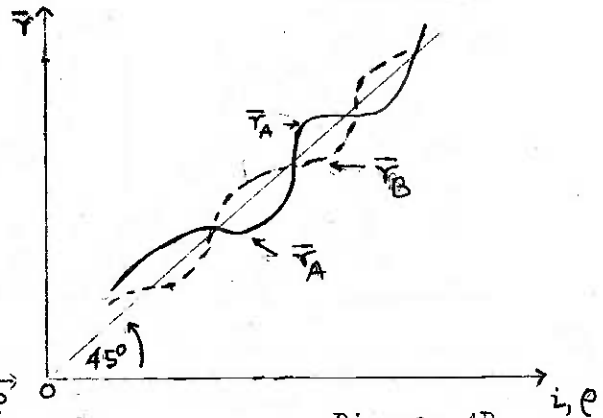


Diagram 4D

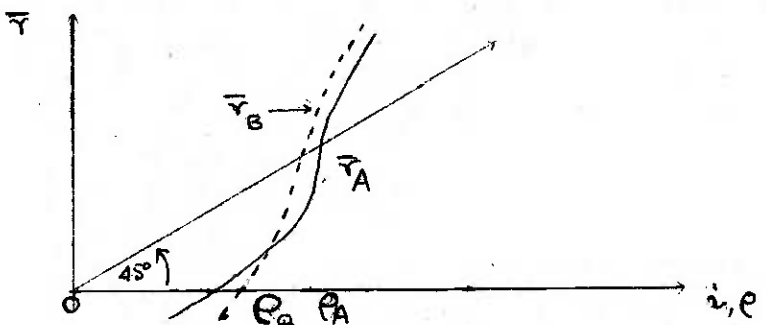


Diagram 4E

In Diagram 4A, both TRORC and IRORC prefers project A to project B. In Diagram 4B, A is preferable to B for $i < i'$ and B preferable A for $i > i'$ according to TRORC. But, according to IRORC A is preferable to B. Diagrams

4D and 4E represent two situations under which IRORC fails for either non-existence of a non-negative finite value for internal rate of return (Diagram 4C) or existence of multiple solutions for internal rate of return (Diagram 4D). But TRORC does not fail in this case because, for any given value of i, there exist unique value for $\bar{r}_A$ and $\bar{r}_B$. However, there may be case of switching and re-switching as to the choice of projects by TRORC depending upon the actual value of i and the distribution of benefits b_t over time. In Diagram 4E, while TRORC rejects both projects for $i < \rho_B$ and prefers B to A for $i \geq \rho_B$, according to IRORC project A is preferable to project B.

3.5 PVC and TRORC

3.5.1 To compare the results from the application of PVC and TRORC, it is necessary to reformulate the PVC criterion to take account of re-investment of that portion of benefits associated with a given project at different points of time so that the initial capital stock is fully recouped by the end of the project life. Net benefits at any point of time, after deductions for depreciation, is given by $\bar{r}.K$ where K is the initial cost of capital. Besides $\bar{r}K$ in every period, at the end of the project's life benefits equal to the initial capital stock K is also available (due to provision of depreciation). Thus, the discounted sum of net benefits or present value of net benefit is equal to

$$\bar{r}.K\left[\frac{1}{(1+r)}+\frac{1}{(1+r)^2}+\ldots+\frac{1}{(1+r)^T}\right]+\left[\frac{K}{(1+r)^T}-K\right],$$

where r is the discount factor which makes benefits in different points of time additive. Therefore, the present value of the project is given by

$$K\left[\bar{r}\,\frac{\frac{1}{(1+r)}\left(1-\frac{1}{(1+r)^T}\right)}{1-\frac{1}{(1+r)}}+\frac{1}{(1+r)^T}-1\right]$$

$$=K\left[\bar{r}\,\frac{(1+r)^T-1}{r\,(1+r)^T}+\frac{1-(1+r)^T}{(1+r)^T}\right]$$

$$=K\,\frac{(1+r)^T-1}{r\,(1+r)^T}\,(\bar{r}-r) \qquad \ldots \quad (3.26)$$

For a project to be acceptable, PVC requires (3.26) to be positive, i.e., $\bar{r}$ must be greater than r. But TRORC requires $\bar{r} > i$ for a project to be admissible. Thus, both PVC and TRORC lead to the same result if i = r (rate of return on re-investments or the opportunity cost rate of return on investment is equal to the time-preference rate of discount that determines the present values). Conflict between the two criteria will arise if either $r > \bar{r} > i$ or $i > \bar{r} > r$.

3.5.2 Between two projects A and B, according to PVC, A will be preferable to B, if

$$(\bar{r}_A - r) > (\bar{r}_B - r).\frac{K_B}{K_A} \qquad \ldots (3.27)\ \underline{43/}$$

43/ If r = 0, (3.27) reduces to $\bar{r}_A > \bar{r}_B > \frac{K_B}{K_A}$. If PVC is presented in terms of ratio of present value of net benefits to initial investment cost, (3.27) reduces to $\bar{r}_A - r > \bar{r}_B - r$ i.e., $\bar{r}_A > \bar{r}_B$ if $r = 0$.

while TRORC will require

$$\bar{r}_A > \bar{r}_B > i \qquad \ldots \quad (3.28)$$

It is easily seen that from the point of view of TRORC, the value of K at the beginning of the period and that of K at the end of the project life are equal, while from the point of view PVC the latter is less than the former. This is because PVC considers all benefits in terms of the objective of consumption only and hence applies a time preference discount rate.

3.5.3 As is evident from (3.28) TRORC depends on the rate of return on re-investments (i). For one thing, for the determination of $\bar{r}$, a value for i has to assumed. For another, a project is admissible if $\bar{r} > i$. But PVC (adjusted to take account of replacement investments) is dependent both on i and r. xxxxxxxxx Apparent that PVC evaluates projects in terms of their contribution to the objective of aggregate consumption, if r is equal to the social consumption time preference rate[44], while TRORC does so in terms of the contribution towards the objective of aggregate consumption if net benefits $\bar{r}.K$ are assumed to be consumed subject to the constraint that initial capital investment is recouped at face value.

3.6 Formal Similarity of Criteria

3.6.1 In this section, it will be shown that in situations involving choice among incompatible projects (i.e., where choice of one project precludes the choice of others), the socialist criterion of Limiting Recoupment Period Criterion (LRPC) is formally a variant of PPC, PVC,

---

44/ Corresponds to the use of PVC in [UNIDO (1972) and [Little and Mirrlees (1969)].

IRORC, TRORC and NTVC. Let there be two projects A : (b_t^A, K_A); B :(b_t^B, K_B). According to LRPC, A is preferred to B

if, for $K_A > K_B$ and $C_A < C_B$,

$$\frac{1}{T^*} K_A + C_A < \frac{1}{T^*} K_B + C_B \qquad \ldots (3.29)$$

where C represents the annual production costs and assumed constant over time, outputs of projects A and B are assumed to be same (i.e., $Q_A = Q_B = Q$), $b_t^A = Q_A - C_A$, $b_t^B = Q_B - C_B$, (i.e., $b_t^A - b_t^B = C_B - C_A$), and T^* is equal to the maximum allowable recoupment period for any project[45/]. According to the Payback Period Criterion (PPC), A is preferred to project B if $T < \bar{T}$, where T is given by

$$\sum_{t=1}^{T} (b_t^A - b_t^B) = K^A - K^B \qquad \ldots (3.30)$$

and $\bar{T}$ is exogenously given. Easily seen that LRPC is equivalent to PPC if $\bar{T} = T$. For, from (3.30)

$$\sum_{t=1}^{T} (b_t^A - b_t^B) = K_B - K_B$$

or, $$\sum_{t=1}^{T} (Q_A - C_A - Q_B + C_B) = K^A - K^B$$

or, $$T.(C^B - C^A) = K^A - K^B \quad (\because Q_A = Q_B = Q \text{ as assumed}).$$

or, $$T = \frac{K^A - K^B}{C^B - C^A}$$. Now, according to PPC, A is chosen if $T < \bar{T}$,

---

45/ It has been shown earlier that LRPC is formally equivalent to MDCC or MIEC — two other criteria used in socialist planning (vide Chapter I, paras 1.6.5 & 1.6.6). These criteria may be generalized so as to allow for variation in b, Q, C, K over time for a given project and variation in the output over projects (i.e., $Q_A \neq Q_B$); annual production costs may also be extended to include, besides direct labour costs, the costs of raw materials inputs valued at their respective norms of feedback costs, and the costs of normal repairs and maintenance [Fiszel (1966); Nowozilov (1968-9)].

i.e., if $K^A - K^B < \bar{T} \ (C^B - C^A)$ or $\frac{1}{\bar{T}} \ K^A + C^A < \frac{1}{\bar{T}} \ K^B + C^B$.

Thus, LRPC is nothing but PPC as applied to choice problems concerning incompatible projects with norm $\bar{T}$ taking the value T^*.

3.6.2 Similarly, LRPC as described in (3.29) may be shown to be a special case of IRORC. According to IRORC

A is chosen if $\rho > \rho^*$ where ρ^* is and exogenously given norm and

$$\sum_{t=1}^{T} (b_t^A - b_t^B) \ (1 + \rho)^{-t} = K^A - K^B \qquad \ldots (3.31)$$

Now, $\sum_{t=1}^{T} (b_t^A - b_t^B) \ (1 + \rho)^{-t} = K_A - K_B$,

or, $\sum_{t=1}^{T} (C^B - C^A) \ (1 + \rho)^{-t} = K_A - K_B \ (\because Q_A = Q_B)$,

or, $\frac{\Delta K}{\Delta C} = \sum_{t=1}^{T} (1 + \rho)^{-t}$, where Δ stand for absolute difference between projects A and B.

Since ρ must be greater than ρ^* for A to be chosen, IRORC requires

$$\sum_{t=1}^{T} (1 + \rho^*)^{-t} > \sum_{t=1}^{T} (1 + \rho)^{-t}$$

or, $\frac{\Delta K}{\Delta C} < \sum_{t=1}^{T} (1 + \rho^*)^{-t}$

If $T^* = \sum_{t=1}^{T} (1 + \rho^*)^{-t}$ LRPC and IRORC yield identical results.

It may be noted that $T^* \longrightarrow \frac{1}{\rho^*}$ as $T \longrightarrow \infty$ .46/

3.6.3 According to PVC, A is chosen if

$$\sum_{t=1}^{T} (b_t^A - b_t^B)\ (1 + r)^{-t} \quad > \quad K_A - K_B \qquad \ldots (3.32)$$

where time discount rate r is exogenously given. From (3.32),

$$\sum_{t=1}^{T} (C_t^B - C_t^A)\ (1+r)^{-t} \quad > \quad K^A - K^B$$

or, $$\frac{\Delta K}{\Delta C} < \sum_{t=1}^{T} (1+r)^{-t}$$

If $\sum_{t=1}^{T} (1+r)^{-t} = T^*$, LRPC and PVC give same results. Once again,

if $T \longrightarrow \infty$, $T^* \longrightarrow \frac{1}{r}$ or $r = \frac{1}{T^*}$.

3.6.4 According TRORC, A is chosen if $\bar{r} > i$ where $\bar{r}$ is given by

$$\sum_{t=1}^{T} (\Delta b_t - \bar{r}\ \Delta K)\ (1 + i)^{T-t} = \Delta K \qquad \ldots (3.33)$$

and i is an exogenously given rate of return on re-investments. From (3.33),

---

46/ $T^* = \sum_{t=1}^{T} (1+\rho^*)^{-t} = \frac{1}{1+\rho^*} + \frac{1}{(1+\rho^*)^2} + \ldots + \frac{1}{(1+\rho^*)^T}$

$$= \frac{1}{\rho^*} \left\{ 1 - \frac{1}{(1+\rho^*)^T} \right\}$$

$$= \frac{1}{\rho^*} \text{ as } T \longrightarrow \infty, \text{ i.e., } \rho^* = \frac{1}{T^*};$$

both ρ^* and $\frac{1}{T^*}$ represent opportunity cost rate of return on investments.

$$\sum_{t=1}^{T}(1+i)^{T-t}\,(\Delta C - \bar{r}\,\Delta K) = \Delta K \qquad (\because \Delta b_t = \Delta C),$$

or, $$\Delta C = \left[\frac{1}{\sum_{t=1}^{T}(1+i)^{T-t}} + \bar{r}\right]\Delta K$$

or, $$\frac{\Delta K}{\Delta C} = \frac{\sum_{t=1}^{T}(1+i)^{T-t}}{1+\bar{r}\sum_{t=1}^{T}(1+i)^{T-t}} = \frac{\sum_{t=1}^{T}(1+i)^{-t}}{(1+i)^{-T} + \bar{r}\sum_{t=1}^{T}(1+i)^{-t}} < \frac{\sum_{t=1}^{T}(1+i)^{-t}}{(1+i)^{-T}+i\sum_{t=1}^{T}(1+i)^{-t}}$$

$(\because \bar{r} > i).$

If $R = \dfrac{\sum_{t=1}^{T}(1+i)^{-t}}{(1+i)^{-T} + i\sum_{t=1}^{T}(1+i)^{-t}} = \dfrac{1}{i}\left\{1 - \dfrac{1}{(1+i)^{T}}\right\} = T^{*}$, $\dfrac{\Delta K}{\Delta C} < T^{*}$,

and, therefore, LRPC and TRORC yield identical results in this case. Once again, as $T \longrightarrow \infty$, $\dfrac{1}{T^{*}} \longrightarrow i$.

3.6.5 It is also possible to show that LRPC is a special case of the Normalized Terminal Value Criterion (NTVC). Let two projects A and B be as follows :

$$A : (K_A\ ,\ Q - C_A) \qquad \text{and} \qquad B : (K_B\ ,\ Q - C_B)$$

$$\text{where } K_A > K_B \quad \text{and} \quad C_A < C_B$$

For relating the projects to common outlay, normalization gives

$$A : (K_A,\ Q - C_A) \qquad \text{and} \qquad B : \left[K_A,\ (Q - C_B) + (K_A - K_B)\right]$$

Assuming, that all benefits are consumed and the time-preference discount rate is r, the difference between the normalized terminal values (V^{T}) of the

projects is given by $V^T(b_t^A) - V^T(b_t^B)$

$$= \left[(Q-C_A)\sum_{t=1}^{T}(1+r)^{T-t}\right] - \left[\sum_{t=1}^{T}(Q-C_B)(1+r)^{T-t} + (K_A-K_B)(1+r)^T\right]$$

$$= \sum_{t=1}^{T}(C_B - C_A)(1+r)^{T-t} - (K_A - K_B)(1+r)^T$$

For project A to be preferable to project B, NTVC requires

$$V^T(b_t^A) - V^T(b_t^B) > 0 \quad \text{i.e.,} \quad \frac{K_A-K_B}{C_B-C_A} > \frac{\sum_{t=1}^{T}(1+r)^{T-t}}{(1+r)^T}$$

or, $\frac{\Delta K}{\Delta C} < \sum_{t=1}^{T}(1+r)^{-t}$. Therefore, if $T^* = \sum_{t=1}^{T}(1+r)^{-t}$ both NVTC and LRPC yield identical results. Again, as $T \longrightarrow \infty$, $\frac{1}{T^*} \longrightarrow r$.

3.6.6 The results above indicate that if the values of the parameters T^*, $\bar{T}$, ρ^*, r and i are so determined as to ensure that the choice among projects which are incompatible leads to the maximum net social benefits, the values should satisfy the following relations :

$$T^* = \bar{T} = \sum_{t=1}^{T}(1+\rho^*)^{-t} = \sum_{t=1}^{T}(1+r)^{-t} = \frac{1}{i}\left[1 - \frac{1}{(1+i)^T}\right] \quad \ldots(3.34)$$

3.7 Choice of criteria

3.7.1 Under conditions of choice among mutually exclusive or incompatible projects, there is apparently nothing to choose among different criteria or decision formula discussed in the previous sections if the macro-level objective is given and the optimal value of opportunity cost rate relevant from the point of view of the objective could be found out,

the application of any one of the previous criteria should yield identical results (since the values of the opportunity cost rate under different definitions, i.e., T^*, $\bar{T}$, ρ^*, r and i would satisfy 3.54). However, the macro-objectives may differ from economy to economy and errors in estimating the optimal values of the opportunity cost parameters may also occur. It is possible that in a market economy, the observed or estimated values may not be equal to the optimal values of i, ρ^* or r ; the same also may be true for estimated values of T^* or $\bar{T}$ in a socialist economy. Consequently, the results would be sentitive to the choice of criterion. It is felt, therefore, that when the macro-objective is specified, the choice among alternative criteria should be made on the basis of (a) consistency between macro-objective and micro-level project criterion and (b) the relative accuracy with respect to the estimation of the values of the parameters.

3.7.2 So far as the macro-objective of output growth (increasing the rate of growth of national output) is concerned, the contribution of a project towards this objective may be measured in terms of the reinvestible surplus in a project. The sources of this reinvestible surplus are (a) the rate of return on capital investment, (b) the rate of depreciation, and (c) the savings of the wage earners employed in the project [vide Chapter I para 1. 3. 6 and Chapter IV paras 4.2.1 & 4.2.6]. None of the criteria LRPC, MDCC, MEIC, PPC take account of the savings of the wage earners. Although PVC, IRORC and TRORC may be generalized to take account of savings of the wage earners, it has been shown earlier that TRORC is more general compared to IRORC (paras 3.4.1 and 3.4.2) and that PVC and TRORC yield identical results if $r = i = \bar{r}$

(para 3.5.1). However, TRORC makes it possible to distinguish between the sources (a) and (b) referred to above, more clearly than does PVC, PPC, LRPC, MDCC and MEIC. Again, the form in which PPC, LRPC, MDCC and MEIC have been developed in the present and the previous Chapters are characterized by restricted applicability (paras 3.2.1 – 3.2.6). Also, TRORC cannot be applied when a positive value of internal rate of return does not exist. Even though it is true that under certain conditions, any other criterion may yield the same results as TRORC, it is felt that, in view of the considerations mentioned in the preceeding lines, the use of the formula of the true rate of return ($\bar{r}$) is advisable for evaluating the contribution of a project towards the output growth objective. However, the formula for $\bar{r}$ given by equation (3.22) help measure the contribution of projects towards the output growth objective (i.e., towards the generation of investible surplus) only partially since it does not take into account the savings of the wage and salary earners of the project. An index which reflects the total contribution of projects towards the output growth objective is discussed in the next Chapter.

Chapter IV

GORWTH OF OUTPUT AND EMPLOYMENT

4.1 Introduction

4.1.1 In SCBA literature it is often assumed that there does not exist any conflict between growth of output and growth of employment; a faster increase in output is almost always expected to be associated with a faster expansion in employment. In this Chapter, two models have been developed to examine the relationship between growth of output and employment. Attempt has been made to explore the conditions when these two goals of a society are not conflicting and when they are inversely related. The factors which explain the existence of a conflict between them are also sought to be identified.

4.2 A Project Model (Model A)

4.2.1 Let X_o denote Net National Output or Product (value added less depreciation) in the initial period; X_t Net National Output in period t; I_t total investment in t; I_o total investment in the initial period; L_t total employment in t; L_o total employment in the initial period; e_{it} employment per unit of initial investment in project i in t-th year of operation; x_{it} output (value added) in t per unit of initial investment in project i; π_{it} profit in t per unit of initial investment in project i; δ_{it} depreciation in t per unit of initial investment in project i; w_{it} wage per unit of employment in t for project i; ε_{it} average savings per unit of wage

income in t for project i; θ_i is the productive life period of project i. Since value added in a project is equal to profit plus depreciation plus wage and salary,

$$x_{it} = \pi_{it} + \delta_{it} + \Psi_{it} e_{it} \qquad \ldots (4A.1)$$

4.2.2 Model-A assumes that all projects in the economy are associated with same values of $e_{it} = e_t$, $x_{it} = x_t$, $\pi_{it} = \pi$, $\Psi_{it} = \Psi$, $\varepsilon_{it} = \varepsilon_t$, $\delta_{it} = \delta$. It is also assumed that the projects have equal productive lives i.e., $\theta_i = \theta$. Assuming that entire profit income is saved, the surplus generation in period t per unit of initial investment in any project is given by

$$\beta_t = \left\{ x_t - (1 - \varepsilon_t) \Psi_t e_t \right\} \qquad \ldots (4A.2)$$

or, alternatively by,

$$\beta_t = \pi_t + \delta_t + \varepsilon_t \Psi_t e_t \qquad \ldots (4A.3)$$

Further assuming that all surplus (profit + depreciation) and savings associated with the projects are invested (savings include savings out of factor shares — profits and wages; profits are assumed to be entirely ploughed back), the following relations may be derived[47]:

$$X_{t+\theta} = X_o + \sum_{l=t+\theta-1}^{t} (x_l - \delta_l) I_l = X_o + \sum_{l=t+\theta-1}^{t} \beta'_l \cdot I_l \qquad \ldots (4A.4)$$

where $\beta'_l = x_l - \delta_l$[48]

47/ A simplified model similar to the one represented by (4A.4) and (4A.5) was developed by Max Bershad [cited in Solomon, M.J. (1966)]; the model here is much more general than that of Mershad.

48/ Because of (4A.2) and (4A.3) $\beta'_l > \beta_l = \pi_l + \varepsilon_l \Psi_l e_l$ if $\delta_l \neq 0$.

$$I_{t+\theta} = I_o + \sum_{l=t+\theta-1}^{t} x_l - (1-\varepsilon_l)\psi_l \cdot e_l \qquad I_l = I_o + \sum_{l=t+\theta-1}^{t} \beta_l \cdot I_l \quad \ldots(4A.5)$$

$$L_{t+\theta} = L_o + \sum_{l=t+\theta-1}^{t} e_l \cdot I_l \quad \ldots(4A.6)$$

From (4A.4) and (4A.5), using operator E[49], the following is obtained :

$$\begin{bmatrix} E^{\theta} & - \sum_{l=1}^{\theta} \beta'_{t+\theta-l} E^{\theta-1} \\ 0 & E^{\theta} - \sum_{l=1}^{\theta} \beta_{t+\theta-l} E^{\theta-l} \end{bmatrix} \begin{bmatrix} X_t \\ I_t \end{bmatrix} = \begin{bmatrix} X_o \\ I_o \end{bmatrix} \quad \ldots(4A.7)$$

or, $$P(E)\, z_t = z_o \quad \ldots(4A.8)$$

where $z_t = \begin{bmatrix} X_t \\ I_t \end{bmatrix}$, $P(E) = \begin{bmatrix} E^{\theta} - \sum_{l=1}^{\theta} \beta'_{t+\theta-l} E^{\theta-l} \\ 0 \quad E^{\theta} - \sum_{l=1}^{\theta} \beta_{t+\theta-l} E^{\theta-l} \end{bmatrix}$

and $z_o = \begin{bmatrix} X_o \\ I_o \end{bmatrix}$

Solution of (4A.8) is given by (assuming no two roots are equal),

$$z_t = \sum_{j=1}^{\infty} V_j \lambda_j^t P_i^*(\lambda_j) + \bar{z} \quad \ldots(4A.9)$$

where V_j are arbitrary constants determined by initial conditions; $P_j^*(\lambda_j)$ is any column of the adjoint matrix of matrix $P(E)$ with λ_j substituted for E; $\bar{z}$ is the particular solution of (4A.8); and λ_j (j=1,2,..., w) are the roots of the determinantal equation

$$|P(\lambda)| = 0 \quad \ldots(4A.10)$$

49/ The mathematics involving use of operators in simultaneous difference equation systems employed in the text is based on Baumol (1951; Chapters 15 and 16).

In other words, λ_j are the roots of the equation

$$\begin{vmatrix} \lambda^{\theta} - \sum_{l=1}^{\theta} \beta'_{t+\theta-l} \lambda^{\theta-l} & \\ 0 \quad \lambda^{\theta} - \sum_{l=1}^{\theta} \beta_{t+\theta-l} \lambda^{\theta-l} \end{vmatrix} = 0$$

or,

$$\lambda^{\theta} \left[\lambda^{\theta} - \sum_{l=1}^{\theta} \beta_{t+\theta-l} \lambda^{\theta-l} \right] = 0$$

or, provided $\lambda \neq 0$,

$$\sum_{l=1}^{\theta} \beta_{t+\theta-l} \lambda^{-l} = 1 \qquad \ldots\ (4A.11)$$

4.2.3 Now, if $\bar{r}$ is defined to be the true rate of return (TROR) of the time-stream of surplus generation (re-investments) per unit of initial investments, β_1, $\bar{r}$ is given by

$$\sum_{l=t-\theta}^{t-\theta} (\beta_l - \bar{r})(1 + i_o)^{\theta-l} = 1 \qquad \ldots\ (4A.12)$$ 50/

Since all projects are similar, the rate of return on re-investments (i_o) is equal to $\bar{r}$. Therefore, (4A.12) reduces to

$$\sum_{l=t-\theta}^{t-\theta} \beta_l (1 + \bar{r})^{-l} = 1 \qquad \ldots\ (4A.13)$$

Comparing (4A.11) and (4A.13),

$$\lambda = (1 + \bar{r}) \qquad \ldots\ (4A.14)$$

If TROR is positive ($\bar{r} > 0$), $\lambda > 1$ (since the stream $\beta_{t+\theta-1}$, $\beta_{t+\theta-2}$, ..., β_t is the same as the stream β_{t-1}, β_{t-2}, ..., $\beta_{t-\theta}$). Now, from (4A.9) if (4A.11) has a dominant positive root λ^*, the long-term

50/ True Rate of Return formula earlier given in Chapter III [relation (3.22)].

growth rate of net national output X_t and investment I_t will be given by $(\lambda^* - 1)$. Since (4A.11) and (4A.13) show that $\lambda - 1 = \bar{r}$, it is seen that the long-run growth rate of (net national) output is equal to the true rate of return $(\bar{r})$ for surplus generation. The higher is $\bar{r}$, higher is the long-run output growth rate $(\lambda^* - 1)$. In a similar manner, it may be shown that the long-run rate of growth of employment will also be given $\lambda^* - 1 = \bar{r}$. If there exist differences among projects in respect of x_t, e_t, π_t, ψ_t, ε_t and δ_t and, therefore, in respect of β_t, the TROR $\bar{r}$ will be the weighted average of the true rates of return for surplus generation of different projects; weights being the share of investment and re-investments in different projects. The long-run growth rate of output and employment will be determined by the weighted true rate of return for surplus generation in different projects. The higher is the share of investment and re-investments in projects with higher $\bar{r}$, higher will be the weighted true rate of return and hence higher the long-run growth rates of output and employment.

A Simpler Version

4.2.4 For the sake of simplicity, if it is assumed that all projects are characterized by same $x_t = x$, $\delta_t = \delta$, $\pi_t = \pi$, $\psi_t = \psi$, $\varepsilon_t = \varepsilon$, $e_t = e$, and therefore, by $\beta_t = \beta$ and $\beta'_t = \beta'$ for all values of t, the system of equations (4A.4) - (4A.6) will be reduced to, respectively,

$$X_t = X_o + \beta' \sum_{t-1}^{t-\theta} I_j \qquad \ldots (4A.15)$$

$$I_t = I_o + \beta \sum_{t-1}^{t-\theta} I_j \qquad \ldots (4A.16)$$

and

$$E_t = E_o + e \sum_{t-1}^{t-\theta} I_j \qquad \ldots (4A.17)$$

From (4A.15) and (4A.16),

$$I_t = I_o + \beta \frac{X_t - Y_o}{\beta'} = \beta \frac{X_t}{\beta'} + \left(I_o - \frac{\beta X_o}{\beta'}\right)$$

Therefore,

$$\sum_{t-1}^{t-\theta} I_j = \frac{\beta}{\beta'} \sum_{t-1}^{t-\theta} X_j + \theta \left(I_o - \frac{\beta X_o}{\beta'}\right)$$

From (4A.15) again,

$$X_t = X_o + \beta \sum_{t-1}^{t-\theta} X_j + \theta \left(\beta' I_o - \beta X_o\right)$$

or,

$$X_t = W + \beta \sum_{t-1}^{t-\theta} X_j \qquad \text{where } W = X_o + \theta \left(\beta' I_o - \beta X_o\right)$$

i.e., $$X_t = \beta X_{t-1} + \beta X_{t-2} + \ldots + \beta X_{t-\theta} + W \qquad \ldots (4A.18)$$

The particular solution of the difference equation (4A.18) is given by

$$\bar{z} = \beta (\bar{z} + \bar{z} + \ldots + \bar{z}) + W \qquad \ldots$$

or, $$\bar{z} = \frac{W}{(1 - \beta\theta)}$$

The general solution of (4A.18) is given by

$$X_t = A_o \sum_i \lambda_{i\,\text{pos.}}^t + B_o \sum_i \lambda_{i\,\text{neg.}}^t + M_o \gamma_i^t \cos\left(\frac{2\lambda}{M_o} t + N_o\right) + \frac{W}{(1 - \beta\theta)} \qquad \ldots (4A.19)$$

where $\lambda_{i\,\text{pos.}}$, $\lambda_{i\,\text{neg.}}$ and γ_i are the positive, negative and complex roots of the auxiliary equation

$$\lambda^{\theta} - \beta(\lambda^{\theta-1} + \lambda^{\theta-2} + \ldots, + 1) = 0; \text{ and}$$

A_o, B_o, M_o and N_o are constants determined by the initial conditions.

Now, for X_t to show positive growth over time, it is essential that $\beta.\theta > 1$. But for $\beta.\theta$ to be greater than unity there will exist only one positive root $\lambda_{pos} > 1$ and the complex roots γ_i will have modulus less than unity implying dampned osscillations (if θ is even there will also be a negative root λ_{neg} with $|\lambda_{neg}| < 1$ which implies dampened osscillations). Thus λ_{pos} will be the dominant root and the long-run trend rate of growth rate will be given by $\lambda_{pos} - 1$.

4.2.5 It can be shown that $\lambda_{pos} - 1 = \beta$.

From (4A.18)

$$X_t = \beta X_{t-1} + \beta X_{t-2} + \ldots + \beta X_{t-\theta} + W$$

and $$X_{t+1} = \beta X_t + \beta X_{t-1} + \ldots + \beta X_{t-\theta-1} + W$$

On subtraction,

$$X_{t+1} = (1 + \beta) X_t + \beta X_{t-\theta}$$

or,

$$\frac{X_{t+1}}{X_t} = (1 + \beta) + \beta \frac{X_{t-\theta}}{X_t}$$

or,

$$\frac{X_{t+1}}{X_t} = (1+\beta) + \beta \frac{X_{t-\theta}}{X_{t-\theta-1}} \frac{X_{t-\theta-1}}{X_{t-\theta-2}} \cdots \frac{X_{t-1}}{X_t}$$

i.e., $\lambda_{pos} = (1 + \beta) + \beta (\lambda_{pos})^{\theta}$

i.e., $\beta (\lambda_{pos})^{\theta} - \lambda_{pos} + (1 + \beta) = 0$ (assuming $\beta > 0$)

By Descarte's Rule of Signs the above equation has a single positive

root. The relation between roots and co-efficients of the equation gives

$$\lambda_{pos} = - \frac{-(1+\beta)}{1} = (1+\beta) \text{ i.e., } \lambda_{pos} - 1 = \beta \quad \ldots(4A.20)$$

The true rate of return in this case is given by $\bar{r}_o$ where

$$\beta \sum_{t=1}^{\theta} (1+\bar{r}_o)^{-t} = 1 \text{ or } \beta = \frac{\bar{r}_o (1+\bar{r}_o)^{\theta}}{(1+\bar{r}_o)^{\theta} - 1} \quad \ldots (4A.21)$$

4.2.6 It is apparent, therefore, that higher is the value of β higher is the long-term rate of growth output. Thus, among investment projects those with higher value of β should be preferred if growth of output is the national macro-objective. However, projects selected must satisfy that $\beta . \theta > 1$. β is equal to $\pi + \delta + \varepsilon^{\eta}/_{e}$ i.e., rate of profit on initial investment plus rate of depreciation on initial investment plus the ratio of savings out of wage and salary income to initial investment[51]. In other words β is the surplus generated per unit of initial investment in each period over a project's life span. Therefore, $\beta . \theta$ represents the total output generated by the project over its life period less the total consumption by the project over its life period divided by initial investment. In other words $\beta . \theta > 1$ implies that the net benefits in terms of surplus generated for re-investment over the life of a project must be greater than its initial investment cost. Evidently, with growth of (net national) output as the macro-objective in this model, benefit of a project is measured in terms of contribution to surplus generation for re-investment and cost of a project is given by its initial investment cost. Given

51/ Since all savings(and surplus) are assumed to be invested, β in the model represents the society's annual rate of capital accumulation.

$\beta . \theta > 1$, higher the value of β higher is the value of net benefit-cost ratio of a project and more is its net contribution to the objective of growth of output (net value added)[52], [53].

4.2.7 Under the assumptions of the model, choice among investment projects on the basis of the value of β (given $\beta . \theta > 1$) will not only satisfy the output growth objective but also the employment growth objective. From (4A.15) and (4A.17)

$$L_t = L_o + \beta \sum_{t-1}^{t-\theta} L_j + e.\theta \left(I_o - \frac{\beta}{e} L_o\right)$$

or, $$L_t = \beta L_{t-1} + \beta L_{t-2} + \ldots + \beta L_{t-\theta} + W' \qquad \ldots (4A.22)$$

where $W' = L_o + \theta (e.I_o - \beta . L_o)$

Now, by comparing (4A.22) with (4A.18), it is evident that the long-term growth rate of employment also is given by β and L_t has a positive growth

---

52/ Usually, maximisation of the rate of profit on investment π or a similar index of rate of return is regarded as the appropriate criterion under the macro-objective of output growth. As is apparent from the model this need not be true unless it is assumed that savings out of wage income is zero or negligible. For high values of $(\pi + \delta)$ or π or similar index of profit may be associated with lower value of $\varepsilon \downarrow e$ which may imply lower value of β.

53/ If the rate of depreciation $(\delta = \bar{\delta})$ is determined by the straightline method,

$$\bar{\delta} + \bar{\delta} + \bar{\delta} \ldots\ldots = 1 \quad \text{or} \quad \bar{\delta}\theta = 1 \quad \text{i.e.,} \quad \bar{\delta} = \frac{1}{\theta}$$

Thus, the condition for X_t to show positive growth given by $\beta . \theta > 1$ reduces to $\beta > \bar{\delta}$, or, $\pi + \varepsilon \downarrow e > 0$ (since $\beta = \pi + \delta + \varepsilon \downarrow e$), or, $\pi > 0$ if $\varepsilon \downarrow e$ is zero or negligible. If, however, the rate of depreciation $(\delta = \hat{\delta})$ is determined by TROR formula in Chapter II and III,

$$\sum_{t=1}^{t=\theta} \hat{\delta} (1+i)^{\theta - t} = 1$$

where i is the rate of return on depreciation fund. In other words,

$$\hat{\delta} = \frac{i}{(1+i)^{\theta} - 1}$$

which is less than $1/\theta$ $(\hat{\delta} < \bar{\delta})$.

rate if $\beta . \theta > 1$. In other words, under the assumptions of Model-A, long-term growth of output and long-term growth of employment are non-conflicting objectives and the choice criterion which satisfies one objective satisfies the other also. Higher is β, higher are the long-run growth rates of both output and employment.

Short-run Employment and Long-run Output

4.2.8 However, if short-run employment is treated as a macro-objective, it is possible that this may not be satisfied by the β-criterion. Value added in a project is distributed among profit, wages and salaries, and depreciation allowance i.e., $x = \pi + v + \delta$ where $v = \psi e$. Taking differentials, $dx = d\pi + dv + d\delta$. Again, $\beta = \pi + \delta + \varepsilon v$. Therefore, $d\beta = d\pi + \varepsilon dv + d\delta$ (assuming ε coefficient to be constant). On substitution,

$$d\beta = dx - (1 - \varepsilon) dv.$$

or,
$$\frac{d\beta}{dv} = \frac{dx}{dv} - (1 - \varepsilon) \qquad \ldots (4A.23)$$

The contribution towards short-run employment objective may be measured in terms of labour input (wages and salaries paid). It is easily seen that the employment objective is satisfied by the β-criterion if $\frac{d\beta}{dv} > 0$. But a conflict between long-term output growth objective and short-run employment objective arises if $\frac{d\beta}{dv} < 0$,

i.e., if $\frac{dx}{dv} < (1 - \varepsilon)$ or $\frac{dx}{dv} < 1$ with $\varepsilon = 0$ $\ldots (4A.24)$

The latter ($\frac{dx}{dv} < 1$) implies that a marginal change in wage and salary payments to investment ratio is associated with less than proportionate

change in output-investment ratio. In other words, when increase in employment as indicated in a rise in wages and salaries per unit of initial investment is associated with a less than proportionate rise in value added per unit of initial investment, the rate of surplus generation falls. Thus, employment objective is satisfied but output growth in the long-run is adversely affected.

4.2.9 The contribution of a project towards the short-run employment objective may also be measured in terms of labour units employed. The β-criterion is consistent with short-run employment objective provided $\frac{d\beta}{de} > 0$. A conflict between short-run employment and long-run output growth arises if $\frac{d\beta}{de} < 0$,

i.e., if $$\frac{dx}{de} < (1 - \varepsilon)\left(\psi + e.\ \frac{d\psi}{de}\right) \qquad \ldots (4A.25)$$ 54/

4.2.10 A conflict between short-run employment and long-run output growth may also arise in investment project choice concerning allocation of limited investment fund among different projects. This may be shown as follows. Let there be two projects with rate of surplus per unit of initial investment β_A and β_B and employment per unit of initial investment e_A and e_B. It follows

$$\beta = n\beta_A + (1-n)\beta_B = \beta_B + n(\beta_A - \beta_B) \qquad \ldots (4A.26)$$

and $$e = ne_A + (1-n)e_B = e_B + n(e_A - e_B) \qquad \ldots (4A.27)$$

54/ With $\frac{d\psi}{de} = 0$ (i.e., if wage rate does not change with changes in labour per unit of initial investment) and $\varepsilon = 0$ (i.e., nothing is saved from salary and wage), the condition reduces to $\frac{dx}{de} < \psi$ i.e., the change in output investment ratio due to a marginal change in employment investment ratio is less than the wage rate.

where n is the share of investment fund allocated to project A. If the life of projects are equal and the savings co-efficient (ε) and the wage rate (Ψ) is same for all projects, from (4A.26)

$$\beta = \beta_B - n(\beta_A - \beta_B) = \beta_B + n\{(x_A - x_B) - (1 - \varepsilon)\Psi(e_A - e_B)\} \quad \ldots(4A.28)$$

If $e_A > e_B$, as value of n is increased, value of e increases, but value of β decreases if $x_A < x_B$. Therefore, a conflict between the two objectives arises if among two projects the one with higher labour investment ratio is also the one with lower output investment ratio. Even if $x_A > x_B$, conflict arises unless $(x_A - x_B)/(e_A - e_B) < (1 - \varepsilon)\Psi$.

4.3 A Macro-model (Model B)

4.3.1 The Project Model (Model A) outlined in section 4.2 above assumed that the technical co-efficients associated with investments in the economy are given; in any period the choice with regard to investment allocation is restricted to the same set of projects available. However, over time new investment projects which differ in terms of technical co-efficients with those that were undertaken previously come up and investments are allocated to such new projects. As a result, the output-capital and employment-capital ratios for the economy as a whole vary depending on the nature of new projects that are undertaken. In the model in this section, the undertaking of the new investment projects with technological co-efficients different from those undertaken previously are assumed to cause a specific nature of change in the technological production coefficients for the

economy as a whole in each period. On that basis the relation between growth of output and employment are sought to be studied.

4.3.2 Let L denote employment (in labour units); K denote capital employed in the economy; X national output; C total consumption in the economy; N available labour force in the economy; k employment-capital ratio for the economy as a whole; q output-employment ratio for the economy as a whole; s_1 (< 1) factor of decline in k over time; s_2 factor of change in kq (output-capital ratio) over time; n (≥ 1) factor of increase in labour supply over time; c consumption per unit of labour in the economy; and t is the time subscript. The Model involves the following relations :

$$L_t = k_t \cdot K_t \qquad \ldots (4B.1)$$

$$K_t - K_{t-1} = X_{t-1} - C_{t-1} \qquad \ldots (4B.2)$$

$$X_t = q_t \cdot L_t \qquad \ldots (4B.3)$$

$$C_t = c_t \cdot L_t \qquad \ldots (4B.4)$$

$$L_t \leq N_t = n \cdot N_{t-1} \qquad \ldots (4B.5)$$

$$k_t = s_1 \cdot k_{t-1} \qquad \ldots (4B.6)$$

$$q_t k_t = s_2 \, q_{t-1} \, k_{t-1} \qquad \ldots (4B.7)$$

It follows, therefore, that

$$L_t = s_1 \left[1 + k_{t-1} (q_{t-1} - c_{t-1}) \right] L_{t-1} \qquad \ldots (4B.8)$$

Putting $b_t = k_t(q_t - c_t)$ = surplus per unit of capital in period t, $b_t = b_o \, \mu^t$, where μ is the factor of change in surplus-capital ratio over time, it follows that

$$L_t = s_1(1 + b_o \, \mu^{t-1}) \, L_{t-1} \qquad \ldots (4B.9)$$

From (4B.9) and (4B.5) the time path of employment rate (or labour participation rate) $p_t = L_t/N_t$, is given by

$$p_t = \frac{s_1}{n}(1 + b_o \mu'^{t-1}) p_{t-1} \qquad \ldots (4B.10)$$

From (4B.3), (4B.6), (4B.7) and (4B.9) the factor of change in national output (an index of output growth) is given by

$$g_t = \frac{X_t}{X_{t-1}} = \frac{q_t \cdot L_t}{q_{t-1} \cdot L_{t-1}} = \frac{s_2}{s_1} \cdot s_1(1 + b_o \mu'^{t-1})$$

or, $$g_t = s_2 (1 + b_o \mu'^{t-1}) \qquad \ldots (4B.11)$$

4.3.3 From (4B.10) if follows that $f_t = \frac{p_t}{p_{t-1}} > 1$ (i.e., the employment rate increases over time), if

$$\frac{s_1}{n}(1 + b_o \mu'^{t-1}) > 1 \qquad \ldots (4B.12)$$

In other words, for p_t to be rising, the availability of capital stock per unit of available labour must rise at a rate higher than $n\left(\frac{1}{s_1 - 1}\right)$.[55/]

Similarly, from (4B.11), for positive growth rate of output, it is required that

$$s_2 (1 + b_o \mu'^{t-1}) > 1 \qquad \ldots (4B.13)$$

55/ From (4B.2)

$$K_t - K_{t-1} = K_{t-1} - C_{t-1} = b_o \mu'^{t-1} \cdot K_{t-1}$$

i.e. $K_t = (1 + b_o \mu'^{t-1}) K_{t-1}$

Therefore, the rate of change in capital stock per unit of available labour supply is given by

$$\frac{K_t/N_t}{K_{t-1}/N_{t-1}} - 1 = \frac{(1 + b_o \mu'^{t-1})}{n} - 1.$$ Now, from (4B.12)

$p_t > p_{t-1}$ if $\frac{s_1}{n}(1 + b_o \mu'^{t-1}) > 1$ i.e., if $\left\{\frac{1 + b_o \mu'^{t-1}}{n} - 1\right\} > \left(\frac{1}{s_1} - 1\right)$

In other words, capital stock must grow at a rate higher than $\left(\frac{1}{s_2} - 1\right)$, if the economy is to experience a positive expansion of output. It may also be noted that a positive growth of employment rate implies a positive growth rate in output, but increasing levels of output need not necessarily imply a rising employment rate. Given $n \geq 1$ and $s_1 < 1$, $s_2 > s_1$, $g_t > 1$ may not ensure that $f_t > 1$. Thus, under these situation output growth and employment growth may be conflicting in nature depending upon the values of s_1 and s_2[56/]. Given the values of s_1 and s_2, even if the growth rate of output is positive, it is possible that the employment rate may experience a decline.

4.3.4 With constant employment-capital ratio and output-capital ratio and assuming constant labour force availability ($n=1$), the growth rates of output and employment are positively related, i.e., a conflict between output growth and employment growth objectives cannot arise. From (4B.10), if $k_t = k$, $q_t = q$ for all values of t (i.e., $s_1 = 1 = s_2$), $c_t = c$ for all t and $n = 1$,

$$p_t = (1 + b_o)\, p_{t-1} \quad \text{or} \quad p_t = p_o\, (1 + b_o)^t \qquad \ldots (4B.14)$$

where $b_o = k\,(q - c)$. Also from (4B.11) under the above assumptions,

$$g_t = (1 + b_o) \qquad \ldots (4B.15)$$

In other words, both employment (employment rate since $n = 1$) and output grow at the same rate $(1 + b_o)$; the maximization of the growth rates of both employment rate and output requires maximization of $k(q - c)$ which

---

56/ For a situation in which $g_t > 1$ and $f_t < 1$ to arise, it is sufficient though not necessary that $s_1 = s_2 = n = 1$. But $g_t > 1$ and $f_t < 1$ if $\frac{n}{s_1} > (1 + b_o M) > \frac{1}{s_2}$

is nothing but the surplus per unit of capital (or the rate of surplus generation per unit of capital).[57]

4.3.5 Under conditions of constant k and q, the relation between output and employment growth in the long-run and in the short-run may be understood in terms of the following :

From (4B.14),

$$L_t = L_o(1 + b_o)^t = L_o\,(1 + k_o \cdot q_o \cdot u_o)^t = L_o(1+ kqu)^t \quad \ldots(4B.16)$$

where $u = \frac{q-c}{q}$ = surplus per unit of output.

Also, from (4B.15),

$$X_t = X_o\,(1 + kqu)^t \quad \ldots (4B.17)$$

From (4B.16), L_o depends on the investible surplus available and the choice of k in the initial period t=0. Choice of labour-intensive technology (high value of k) in period 0 implies higher initial employment generation L_o. But an increase in the value of k, if associated with a decline in the value of $b_o = kqu$ (surplus per unit of capital), will imply that the values of L_t will be lower for sufficiently high values of t. Conversely, the choice of a capital-intensive technology (lower value of k) in the initial period, if associated with a higher value of b_o (i.e., with a proportionately higher value of qu, the surplus per unit of employment), will imply higher employment in the long-run (i.e., for large value of t) — although in the short-run (small value of t) L_t may be lower than what L_t would have been if a less capital intensive (a more labour intensive) technique were

57/ This situation is the one presented by equations (4A.15), (4A.16) and (4A.18) of Model A.

chosen. Therefore, if a given change in k is associated with a proportionately larger change in qu in the opposite direction, an increase (decrease) in short-run employment will lead to a decline (rise) in long-run employment and vice versa (once the capital stock in the initial period is given). From (4B.17) it can be shown that a similar relation between short-run employment and long-run output holds true if an increase in the employment capital ratio (k) is associated with a proportionately greater fall in the surplus per unit of employment (qu). It is, therefore, clear that a conflict between short-run employment and long-run output (or long-run employment) may arise depending on the exact relation between changes in k and qu (or b).

Relative Strength of Capital Accumulation and Decline in Employment Capital Ratio

4.3.6 Referring back to the case of non-constant k and q (i.e. $s_1 \neq 1$, $s_2 \neq 1$), it is easily seen that the growth rates of output and employment (assuming n = 1) consists of two parts, namely, the autonomous part given by s_1 or s_2 and the savings induced part given by $(1 + b_o \mu^{t-1})$. If the relations are expressed in terms of continuous variables, since L = k.K and p = L/ N, the following relations hold :

$$r_L = f - 1 = \frac{\dot{p}}{p} = \frac{\dot{k}}{k} + \frac{\dot{K}}{K} - \frac{\dot{N}}{N} = (s_1 - 1) + k(q - c) - (n - 1)$$

or, $$f - 1 = (s_1 - n) + k(q - c) \qquad \ldots (4B.18)$$

where k(q - c) is the surplus per unit of capital.

['.' on top of a variable represents derivative of the variable with respect to time].

In (4B.18), $(s_1 - n)$ represents the autonomous part of the rate of change in employment rate p and with $n \geq 1 > s_1$, $(s_1 - n) < 0$. The savings (or investment) induced part of $\dot{p}/p$ is $k(q - c)$ which might be expected to be positive. Clearly, it is the relative pull of these parts which determines the sign of $\dot{p}/p$ (the rate of change over time in the employment rate). Easily seen that the autonomous part represents the downward pull of falling employment intensity of technology on the growth rate of employment and the savings induced part reflects the upward pull of capital accumulation on employment growth. Again, since $X = q.\ L = kq.K$

$$g-1 = \frac{\dot{X}}{X} = \frac{\dot{k}}{k} + \frac{\dot{q}}{q} + \frac{\dot{K}}{K} = (s_1-1) + (s_2-s_1) + k(q - c)$$

or, $$r_X = g - 1 = (s_2 - 1) + k(q - c) \qquad \ldots (4B.19)$$

In (4B.19), the autonomous part of the rate of change in output growth, given by (s_2-1), is positive or negative according as $s_2 > 1$ or $s_2 < 1$. The savings induced part $k(q - c)$ is expected to be positive (assuming that the reinvestible surplus per unit of capital is positive and the entire surplus is reinvested; $k(q - c)$ clearly gives the rate of growth of capital). Therefore, if $s_2 > 1$ output growth rate will be positive. If $s_2 < 1$, output growth rate will be positive if $k(q - c)$ is greater, in absolute value, than the $(s_2 - 1)$. In other words, with $s_2 < 1$, the sign of $\dot{X}/X$ will depend on the relative pulls of the two parts.

4.3.7 As has already been noted that $k(q - c)$ is the rate of change is capital over time $(h - 1)$, or

$$r_K = (h - 1) = k(q - c) \qquad \ldots (4B.20)$$

It follows, $(h-1) > 0$ (i.e., rate of growth of capital is positive), if $q > c$ (output per unit of labour is greater than consumption per unit of labour). Also, from (4B.18) and (4B.19),

$$(g - 1) = (f - 1) + (s_2 - s_1) + (n - 1) \qquad \ldots (4B.21)$$

or, $g = f + (s_2 - s_1)$ if $n = 1$.

Thus, with $n \geq 1$, $g \gtrless f$ according as $s_2 \gtrless s_1$.

In other words, if the factor of change in employment-capital ratio is lower than the factor of change in output-capital ratio over time, output growth rate will always be higher than the growth rate of employment rate. If $n = 1 = s_1 = s_2$, i.e., if employment-capital ratio, output-capital ratio and labour supply remains constant, $g = f = h$. This, once again, shows that with constant employment capital and output capital ratios, the rates of growth of both output and employment are (determined by and) equal to the rate of growth of capital stock (which under the assumptions of the model is equal to the rate of reinvestible surplus generation per unit of capital).

4.3.8 Examining equations (4B.19), (4B.20) and (4B.21), it is seen, once again, that a positive rate of growth of employment implies a positive growth rate of output and that the reverse need not necessarily be true. Assuming $k(q - c) > 0$ and $s_2 > 1 > s_1$, $g > 1$; but $s_2 > 1$ does not ensure

that $|s_1 - n| < k(q - c)$ which is necessary for f to be greater than unity. With $n \geq 1 > s_2 > s_1$ also, $g > 1$ may not imply $f > 1$. But $f > 1$ implies $|s_1 - n| < k(q - c)$. Since $n \geq 1 > s_2 > s_1$, $|s_1 - n| > |s_2 - 1|$ and, therefore, $|(s_2 - 1)| < k(q - c)$ which implies $g > 1$. Clearly, therefore, if the rate at which the employment-capital ratio declines is less than the rate at which capital stock grows (i.e., the reinvestible surplus generation per unit of capital), employment will experience a decline over time although output may continue to rise. In this situation, there is a conflict between output growth and employment growth in the long-run.

4.3.9 Differentiating with respect to time t, the equation (4B.18), (4B.19) and (4B.20) yield (assuming n is constant),

$$\dot{r}_K = \left[\frac{\dot{q} - \dot{c}}{q - c} + \frac{\dot{k}}{k} \right] r_K;$$

$$\dot{r}_Q = \dot{s}_2 + \dot{r}_K$$

$$\dot{r}_L = \dot{s}_1 + \dot{r}_K$$

Clearly seen, if r_K is constant (i.e., $\dot{r}_K = 0$), $\dot{r}_Q = \dot{s}_2$ and $\dot{r}_L = \dot{s}_1$. Thus, if r_K is constant over time, the rate of growth of output and employment will move in the same direction according as $\dot{s}_1$ and $\dot{s}_2$ have the same or opposite signs. If, however, s_1 and s_2 are also constant, the assumption of constant r_K implies that the rates of growth of output, employment and will be equal ($r_K = r_X = r_L$).

4.3.10 The implications of constant r_K may be studied as follows. Constant r_K implies $\dot{r}_K = 0$, i.e.,

$$\frac{\dot{q}}{q}\ \frac{q}{q-c} - \frac{\dot{c}}{c}\ \frac{c}{q-c} + \frac{\dot{k}}{k} = 0$$

or, $[(s_2-s_1).kq - \sigma kc]\ /\ k(q-c) = (1 - s_1)$

where, $\frac{\dot{q}}{q} = (s_2 - s_1)$, $\frac{\dot{k}}{k} = (s_1 - 1)$ and $\frac{\dot{c}}{c} = \sigma$

or, $r_K = \frac{k}{(1-s_1)}\ [(s_2 - s_1)\ q - \sigma c] = r_K^*$ (say)

It follows that if r_K is constant $r_K = r_K^*$. Also $\dot{r}_K \gtrless 0$ according as $r_K \lessgtr r_K^*$. Therefore, if r_K^* is constant, $r_K \longrightarrow r_K^*$ (i.e., over time, r_K will tend to the value r_K^* so long $r_K \neq r_K^*$; however, r_K might oscillate around r_K^* and may never be equal to r_K^*). It must be noted, however, the above conclusions are meaningful only if the value of $\frac{k}{(1-s_1)}[(s_2-s_1)\ q - \sigma c]$ is roughly stable over time. Also, with $\dot{s}_2 = \dot{s}_1 = 0$, r_K constant implies $r_X = (s_2 - 1) + r_K^*$ and $r_L = (s_1 - 1) + r_K^*$.

4.3.11 Now, examining the equation

$$r_K = \frac{k}{(1-s_1)}\ [(s_2 - s_1)\ q - \sigma c]$$

it is seen that (i) if $(s_2-s_1) = \sigma$, $(1 - s_1) = (s_2-s_1) = \sigma$; (ii) if $(s_2-s_1) > 0$ and $(1 - s_1) = 0$, $(s_2-s_1) < q$ since $q > c$; and (iii) if $(1 - s_1) > 0$ and $(s_2 - s_1) = 0$, $r_K \gtrless 0$ according as $\sigma \lessgtr 0$.

The above results may be interpreted as follows : Given that the rate of growth of capital is constant, (i) same rate of change in output-employment and surplus-employment ratios in the same direction implies that rates of change in output-employment, surplus-employment, employment-capital ratios are equal; (ii) positive growth in labour productivity (output-employment

ratio) and constant employment-capital ratio (as if labour productivity increases as a result of experience over time), implies that the rate of growth of labour productivity must be lower than the rate of growth of consumption per unit of labour; and (iii) with falling labour-capital ratio and no gains in labour productivity, the rate of growth of capital will be positive or negative according as the consumption per unit of labour employed declines or rises over time.

Impact of a Change in the Rate of Decline of Employment Capital Ratio on the Autonomous and Savings Induced Parts

4.3.12 It may now be examined whether as a result of a change in the value of s_1 (a change in the rate at which the employment capital ratio declines over time) leads to changes in g and f in the same direction or not. It is assumed that s_1, s_2 and $\hat{\Phi} = k(q - c)$ are interdependent[58/], i.e., a change in the value of any one of these variable causes changes

---

58/ The following indicates how a macro-level planning problem may be formulated on the basis of interrelations among s_1, s_2 and $\hat{\Phi}$. The technological possibilities frontier open to an economy may be expressed by the relation $s_2 = F_1(s_1)$ which associates different rates of change in labour capital ratio (capital intensity) with different rates of change in output capital ratio (capital productivity). Let the society specify the policy function $\sigma = F_2(s_2 - s_1)$ which links socially acceptable/permissible increase in consumption per unit of employment to increases in output-employment ratio or labour productivity (where $\sigma = \dot{c}/c$). Subject to F_1 and F_2 and also conditions such as $0 < \delta F_1/\delta s_1 \leq 1, \delta^2 F_1/\delta s_1^2 < 0, \quad 0 < \delta F_2/\delta(s_2 - s_1)$, etc., the society might plan to maximize expansion of output or employment or a weighted combination of increases in output and employment over a given planning period. The objective function, as will be apparent from relation (4B.19) and (4B.20), will be dependent on s_1, s_2 and σ.

in the values of the other two variables. If a change in s_1 is associated with changes in s_2 and $\hat{\phi}$ in the same direction, from (4B.18) and (4B.19) both g and f will move in the same direction as a result of a change in s_1. If, however, a change in s_1 is associated with a change in $\hat{\phi}$ in the opposite direction, g and f may not move in the same direction. For, in that case, the savings induced parts in both (4B.18) and (4B.19) will show a fall (rise) as a result of a rise (fall) in s_1, but the autonomous parts will show a rise (fall). While the changes in savings induced parts in both (4B.18) and (4B.19) will be of the same magnitude, the corresponding change in the autonomous parts may differ in magnitude unless s_1 and s_2 change proportionately. It is, therefore, possible that as a result of an increase (a decline) in s_1, the decline (rise) in the savings induced part may be outweighted by the rise (decline) in the autonomous part so far as equation (4B.18) is concerned, while the reverse obtains with regard to equation (4B.19). In other words, the growth rate of output and the growth rate of employment may or may not move in the same direction as a result of a change in s_1; the actual outcome will depend on the relative strengths of the changes in s_1, s_2 and $\hat{\phi}$. The conditions under which g and f move in the same or the opposite directions may be deduced from (4B.18) and (4B.19) which on differentiation yield,

$$\frac{df}{ds_1} = 1 + \frac{d\hat{\phi}}{ds_1} \qquad \ldots (4B.21)$$

and

$$\frac{dg}{ds_1} = \frac{ds_2}{ds_1} + \frac{d\hat{\phi}}{ds_1} \qquad \ldots (4B.22)$$

where $\hat{\phi} = b_o \mu^{t-1}$ = surplus per unit of capital = $k(q-c)$.

Easily seen, $\frac{dg}{ds_1} \gtrless \frac{df}{ds_1}$ according as $\frac{ds_2}{ds_1} \gtrless 1$. Now, if surplus per unit of capital rises (falls) as the employment-capital ratio rises (falls), i.e., $\frac{d\hat{\phi}}{ds_1} > 0$, it follows that $\frac{df}{ds_1} > 0$. If, in addition, $\frac{ds_2}{ds_1} > 0$, it is also true that $\frac{dg}{ds_1} > 0$. Thus, with $\frac{d\hat{\phi}}{ds_1} > 0$ and $\frac{ds_2}{ds_1} > 0$, g and f are positively related (they move in the same direction). If, however, $\frac{d\hat{\phi}}{ds_1} < 0$ and $\frac{ds_2}{ds_1} < 0$, g and f will move in the same direction if $\left|\frac{d\hat{\phi}}{ds_1}\right| > 1$ and in the opposite directions if $\left|\frac{d\hat{\phi}}{ds_1}\right| < 1$. If $\frac{d\hat{\phi}}{ds_1}$ and $\frac{ds_2}{ds_1}$ have opposite signs, the relations between the movements of g and f may be studied as follows. From (4B.21) and (4B.22), $\frac{df}{ds_1} \gtrless 0$ according as $\left|\frac{d\hat{\phi}}{ds_1}\right| \lesseqgtr 1$ if $\frac{d\hat{\phi}}{ds_1} < 0$, while $\frac{dg}{ds_1} \gtrless 0$ according as $\left|\frac{d\hat{\phi}}{ds_1}\right| \gtrless \left|\frac{ds_2}{ds_1}\right|$ if $\frac{d\hat{\phi}}{ds_1} < 0$ and according as $\left|\frac{d\hat{\phi}}{ds_1}\right| \gtrless \left|\frac{ds_2}{ds_1}\right|$ if $\frac{d\hat{\phi}}{ds_1} > 0$.

4.3.13 Similar conditions may also be derived from (4B.10) and (4B.11). Putting $(1 + b_o \mu^{t-1})$=1+ surplus per unit of capital in period t = ϕ_t, for any period t,

$$\frac{dg}{ds_1} = \frac{ds_2}{ds_1} \phi_t + s_2 \frac{d\phi_t}{ds_1} \qquad \ldots (4B.23)$$

and $$n \frac{df}{ds_1} = \phi_t + s_1 \frac{d\phi_t}{ds_1} \qquad \ldots (4B.24)$$

As in <u>para</u> 4.3.12, it is easily seen that if $\frac{ds_2}{ds_1} > 0$ and $\frac{d\phi_t}{ds_1} > 0$, then both g and f move in the same direction ($\frac{dg}{df} > 0$ as a result of a change in s_1). With $\frac{ds_2}{ds_1} < 0$ and $\frac{d\phi_t}{ds_1} < 0$, $\frac{dg}{df} \gtrless 0$ according as $\left|\frac{d\phi_t}{ds_1} \cdot \frac{s_1}{\phi_t}\right| \gtrless 1$. In other words, when a change in the rate of decline in employment-capital ratio is associated with changes in the opposite direction in the rate of change in the output-capital ratio and in the surplus-capital ratio, output

growth rate and employment growth rate move in the same or opposite directions according as the absolute value of the elasticity of surplus-capital ratio with respect to the rate of decline of employment-capital ratio is greater than or less than unity. With $\frac{ds_2}{ds_1} < 0$ and $\frac{d\phi}{ds_1} > 0$, $\frac{dg}{df} \gtrless 0$ according as $\left|\frac{ds_2}{d\phi}\ \frac{\phi}{s_2}\right| \gtrless 1$. If $\frac{ds_2}{ds_1} > 0$ and $\frac{d\phi}{ds_1} < 0$, $\frac{dg}{df} \gtrless 0$ according as $\left|\frac{ds_2}{d\phi}\ \frac{\phi}{s_2}\right| > 1 > \left|\frac{d\phi}{ds_1}\ \frac{s_1}{\phi}\right|$ or $\left|\frac{ds_2}{d\phi}\ \frac{\phi}{s_2}\right| < 1 < \left|\frac{d\phi}{ds_1}\ \frac{s_1}{\phi}\right|$.

4.3.14 Conditions similar to those in paras 4.3.12 and 4.3.13 may also be derived in terms of μ (which is the factor of change in the surplus per unit of capital). Recalling equation (4B.10) and (4B.11) and differentiating with respect to s_1,

$$\frac{dg_t}{ds_1} = \frac{ds_2}{ds_1}(1+b_o\mu^{t-1}) + (t-1)\,b_o\,\mu^{t-2}\,\frac{d\mu}{ds_1}\,s_2 \qquad \ldots (4B.25)$$

$$\frac{df_t}{ds_1} = (1+b_o\,\mu^{t-1}) + (t-1)b_o\,\mu^{t-1}\,\frac{d\mu}{ds_1}\,s_1 \qquad \ldots (4B.26)$$

Clearly, $\frac{dg_t}{ds_1} \gtrless 0$ according as

$$Z_t \gtrless -\frac{d\mu}{ds_2}\,\frac{s_2}{\mu} \qquad \ldots (4B.27)$$

and $\frac{df_t}{ds_1} \gtrless 0$ according as

$$Z_t \gtrless -\frac{d\mu}{ds_1}\,\frac{s_1}{\mu} \qquad \ldots (4B.28)$$

where

$$Z_t = \frac{1 + b_o\,\mu^{t-1}}{(t-1)\,b_o\mu^{t-1}} \qquad \ldots (4B.29)$$

Easily seen that the left hand sides of the inequalities in (4B.27) and (4B.28) are independent of time, while the right hand sides given by Z_t are dependent on time.

Now, $Z_t = \frac{1}{(t-1)} + \frac{1}{(t-1)\ b_o\ \mu^{t-1}}$

$= Z_{At} + Z_{Bt}$

As, t tends to infinity Z_{At} tends to zero. Also,

$$\frac{Z_{Bt+1}}{Z_{Bt}} = \frac{(t-1)\ b_o\ \mu^{t-1}}{(t+1-1)\ b_o\ \mu^{(t+1-1}} = \frac{1}{\mu}\left(1 - \frac{1}{t}\right).$$

Therefore, $\frac{Z_{Bt+1}}{Z_{Bt}}$ tends to $\frac{1}{\mu}$ as t tends to infinity. If follows Z_{Bt} tends to zero or infinity (positive) according as $\mu > 1$ or $\mu < 1$. Therefore, Z_t is non-negative (if $b_o > 0$, $\mu > 0$) and Z_t converges to zero or explodes to infinity as t increases to infinity according as $\mu > 1$ or $\mu < 1$.

Case 1: Now, examining (4B.27) and (4B.28), if $\frac{ds_2}{ds_1} > 0$ and $\frac{d\mu}{ds_1} > 0$ (and therefore $\frac{d\mu}{ds_2} > 0$), $Z_t > -\frac{d\mu}{ds_2}\frac{s_2}{\mu}$ and $Z_t > -\frac{d\mu}{ds_1}\frac{s_1}{\mu}$ (since $Z_t \geq 0$). Therefore, with $\frac{ds_2}{ds_1} > 0$ and $\frac{d\mu}{ds_1} > 0$, g_t and f_t move in the same direction as a result of a change in s_1.

Case 2: If, however, both $\frac{ds_2}{ds_1}$ and $\frac{d\mu}{ds_1}$ are negative (therefore $\frac{d\mu}{ds_2} < 0$), $Z_t > \left(-\frac{d\mu}{ds_2}\frac{s_2}{\mu}\right)$ and, hence, from (4B.27), $\frac{dg_t}{ds_1} > 0$. But Z_t may be greater than equal to or less than $\left(-\frac{d\mu}{ds_1}\frac{s_1}{\mu}\right)$. Accordingly $\frac{df_t}{ds_1} \gtrless 0$ and hence $\frac{dg_t}{df_t} \gtrless 0$ according as $Z_t \gtrless -\frac{d\mu}{ds_1}\frac{s_1}{\mu}$. Now, if $\mu > 1$, Z_t tend to zero

as t increases. Therefore, even if Z_t is greater than $-\frac{d\mu}{ds_1}\frac{s_1}{\mu}$ for small values of t, for large values of t, however, Z_t may be smaller than $-\frac{d\mu}{ds_1}\frac{s_1}{\mu}$. Again, if $\mu < 1$, Z_t tends to infinity as t increases. Therefore, even if Z_t is smaller than $-\frac{d\mu}{ds_1}\frac{s_1}{\mu}$ for small values of t, Z_t may become greater than $-\frac{d\mu}{ds_1}\frac{s_1}{\mu}$ for large values of t. On the otherhand, if Z_t is smaller than $-\frac{d\mu}{ds_1}\cdot\frac{s_1}{\mu}$ for small values of t, Z_t will ever remain so if $\mu > 1$ which implies Z_t tends to zero as t increases. It is evident, therefore, that, under certain circumstances, the values of g and f for the initial periods/long-run may change in the same direction while their values for the long-run/initial short-run period may change in the opposite direction consequent upon a change in s_1. Similar situation may also arise if $\frac{ds_2}{ds_1} > 0$ and $\frac{d\mu}{ds_1} < 0$ (Case 4) or if $\frac{ds_2}{ds_1} < 0$ and $\frac{d\mu}{ds_1} > 0$ (Case 3)

Case 3: Since $\frac{d\mu}{ds_1} > 0$, $Z_t > -\frac{d\mu}{ds_1}\cdot\frac{s_1}{\mu}$ and, therefore, from (4B.28) $\frac{df_t}{ds_1}$ is always positive. But since $\frac{d\mu}{ds_2} < 0$, Z_t may be greater or less than $-\frac{d\mu}{ds_2}\frac{s_2}{\mu}$. Thus, in Case 3 $\frac{dg_t}{ds_1}$ and, therefore, $\frac{dg_t}{df_t} \gtrless 0$ according as $Z_t \gtrless -\frac{d\mu}{ds_2}\frac{s_2}{\mu}$.

Case 4: With $\frac{ds_2}{ds_1} > 0$ and $\frac{d\mu}{ds_1} < 0$, $\frac{d\mu}{ds_2} < 0$. Therefore, right hand sides in the inequalities of (4B.27) and (4B.28) are positive. But Z_t is also non-negative. Therefore, $\frac{dg_t}{df_t} > 0$ if either $\gtrless$

(a) $Z_t > -\frac{d\mu}{ds_2} \cdot \frac{s_2}{\mu}$ and $Z_t > -\frac{d\mu}{ds_1} \cdot \frac{s_1}{\mu}$, or,

(b) $Z_t < -\frac{d\mu}{ds_2} \cdot \frac{s_2}{\mu}$ and $Z_t < -\frac{d\mu}{ds_1} \cdot \frac{s_1}{\mu}$ holds good.

Also, $\frac{dg_t}{df_t} < 0$, if either

(c) $-\frac{d\mu}{ds_2} \cdot \frac{s_2}{\mu} > Z_t > -\frac{d\mu}{ds_1} \frac{s_1}{\mu}$

or (d) $-\frac{d\mu}{ds_2} \cdot \frac{s_2}{\mu} < Z_t < -\frac{d\mu}{ds_1} \cdot \frac{s_1}{\mu}$ holds good.

Now, it is theoretically possible for the values of g and f for some time periods to shift in the same direction as a result of a variation in s_1 while the values of g and f for some other time periods may change in the opposite directions. In other words, it possible that for some values of t, conditions for $\frac{dg_t}{df_t} > 0$ are satisfied, while for some other values of t conditions for $\frac{dg_t}{df_t} < 0$ may be satisfied. For example, let

$$Z_t > -\frac{d\mu}{ds_2} \cdot \frac{s_2}{\mu} > -\frac{d\mu}{ds_1} \frac{s_1}{\mu}$$

for small values of t, i.e., the condition (a) above is satisfied in the initial period. Therefore, in the initial period $\frac{dg_t}{df_t} > 0$. But, if $\mu > 1$, Z_t monotonically decreases over time. Therefore, after some time (i.e., for a large value of t), Z_t may become less than $-\frac{d\mu}{ds_2} \cdot \frac{s_2}{\mu}$ but yet remains greater than $-\frac{d\mu}{ds_1} \cdot \frac{s_1}{\mu}$. In this situation $\frac{dg_t}{df_t} < 0$ since condition (c) is satisfied. However, as t increase further, Z_t may become less than $-\frac{d\mu}{ds_1} \cdot \frac{s_1}{\mu}$ also i.e. condition (b) may be satisfied. Therefore, for

sufficiently large values of t, $\frac{dg_t}{df_t} > 0$ may once again obtain. It may be noted that the conditions derived above for $\frac{dg_t}{df_t} > 0$ and $\frac{dg_t}{df_t} < 0$ may be expressed in terms of elasticities as defined below :

$$\text{elasticity } (\mu, s_2) = -\frac{d\mu}{ds_2} \cdot \frac{s_2}{\mu}, \quad \text{elasticity } (\mu, s_1) = -\frac{d\mu}{ds_1} \cdot \frac{s_1}{\mu}.$$

For example, in case 4, the condition (a) for $\frac{dg_t}{df_t} > 0$ would reduce to $Z_t >$ elasticity (μ, s_2) and $Z_t >$ elasticity (μ, s_1) and the condition (c) for $\frac{dg_t}{df_t} < 0$ would reduce to elasticity $(\mu, s_2) > Z_t >$ elasticity (μ, s_1).

4.3.15. The exercises in para 4.3.14 shows that if a change in s_1 is associated with changes in s_2 and μ in the same direction, the growth rates of output and employment (or, employment rate) are affected in the same manner [i.e., if $\frac{ds_2}{ds_1} > 0$ and $\frac{d\mu}{ds_1} > 0$, values of g_t and f_t for each t and all t shifts in the same direction as a result of a change in s_1]. It seems unlikely, however, that $\frac{d\mu}{ds_1}$ will be positive in reality. For, a decrease in s_1 means that the capital-intensity (capital-employment ratio) of production is rising at a faster rate than before the decrease in s_1. A faster rate of increase in capital-intensity in a developing (underdeveloped) economy is expected to be associated with the adoption, at a quicker pace, of increasingly modern capital-intensive technology (perhaps, through foreign assistance) which are capable of generating progressively higher re-investible surplus per unit of capital. In other words, $\frac{d\mu}{ds_1}$ is likely to be negative (i.e., situation described by case 4 obtains). In this situation, as has been shown in para 4.3.14, the changes in the time profiles g_t and f_t as a

result of a change in s_1 will not be in the same direction for all values of t; while for some values of t, $\left(\frac{dg_t}{df_t}\right)$ will be positive, for some other values of t this will be negative. Clearly, this is another situation where a conflict between output and employment growth objectives arises - two different values of s_1 are associated with two sets of time profiles (g_t, f_t) such that no one time profile of (g_t, f_t) dominates pointwise over another time profile of (g_t, f_t).

4.4 Factors Responsible for Inverse Nature of Relation between Output and Employment

4.4.1 The results derived in Model A and Model B in the previous sections suggest that maximization of output or the growth rate of output need not necessarily imply maximization of employment or the rate of growth of employment (or the growth rate of employment rate which is more important in developing labour-surplus economies with large-scale unemployment). It has been shown that (i) under conditions of constant employment-capital and capital-output ratios, while the long-run growth rates of output and employment will be positively related (i.e., an increase in one rate implies an increase in the other rate), the short-run employment may be negatively related with long-run output growth. The crucial variables are the employment-capital, output-capital and surplus-capital ratios of the projects in which investments may be made as well as the corresponding ratios for the economy as a whole (paras 4.2.3, 4.2.7-4.2.10 and paras 4.3.4, 4.3.5 and 4.3.7).
(ii) Under conditions when employment-capital ratio and output-capital ratio

changes over time in particular manner, the growth rates of output and employment — both in the short-run and in the long-run — may be positively or inversely related depending upon the values of and the interrelations among the rates of change in the employment-capital, output-capital and surplus-capital ratios (in particular, the elasticities involving these rates of change) for the economy as a whole (paras 4.3.3, 4.3.6 – 4.3.14).

4.4.2 The major sources or factors which may explain (or, are responsible for) the existence of a conflict between output and employment include (a) the technique (or labour-intensity) of production of any period; (b) the inter-industry and intra-industry product composition; (c) the rate of capital accumulation and (d) the change over time in the technique of production. Choice of relatively labour-intensive technique of production in any period will increase the employment opportunities in the short-run but at the same time lower the rate of surplus generation which means lower output and employment growth in the long-run. In other words, the output and employment that will be generated in the economy over the future time periods depend, among other things, on the rate of growth of capital stock. The higher is this rate, the greater is the potential for creation of output and employment in future. The rate of capital accumulation, again, is influenced by the techniques chosen in the earlier periods (and the wages policy adopted by the country). More labour-intensive projects are likely to generate lower output and lower savings than the capital-intensive projects and the cost of increasing employment in the

short-run may be a reduction in the range of opportunities for increasing employment and output in the long-run.[59/]

4.4.3 Although capital stock may grow at a fast rate, but technological progress of a far reaching character and leading to sharp decline in labour-intensity may result in fast increasing output without any appreciable expansionary impact on the growth of employment. Increasingly higher levels of production may be achieved through better inputs, improved plant lay out, increasing sophistication in machinery and implements as well as more efficient management of men, materials and things involved in the production process. But this need not necessarily lead to a larger volume of employment in future (rather may cause a decline in employment). On the basis of the experience of the less developed economies, it has been observed, a rapid succession of technological changes leading to sudden large-scale redundancy

---

59/ The relation between choice of techniques, capital accumulation, and short-run and long-run growth of both output and employment has been investigated by a number of economists. The possibility of conflict between output and employment (in particular, between long.run output/employment and short-run employment) has been demonstrated, among others, by Sen (1968a), Streeten (1972), Stewart and Streeten (1971a). Blitzer and Manne (1974) have shown, in terms of a model analysing the impact of choice of techniques in the public sector on the growth of output and employment in the economy in different years of a given planning period, that a conflict between output growth maximization and employment growth maximization may arise. A numerical solution of the model shows that the output growth maximizing choice of techniques (i.e., the choice offering the highest rate of return of 15 per cent per annum) in the public sector leads to a rise in the unemployment rate from the initial level of 12 per cent to 28 per cent within the first nine years but a consistent decline in the unemployment rate from the 10th year to around 10.5 per cent by the 30th year (planning horizon 30 years). With the most labour intensive techniques which offer zero rate of return, the level of unemployment initially falls below 10 per cent and gradually rises throughout to 16 per cent in the 30th year. With an intermediate rate of return (8 per cent), unemployment rate does not drop below its initial level of 12 per cent until the 15th year; by the 30th year it falls below 6 per cent.

in fairly limited areas causes serious problems of surplus manpower, especially if the rate of growth of the economy is limited and the mobility of labour force happens to be limited [Das (1972)].

4.4.4 . Even if there were no such problems as labour immobility, conflict between output and employment may arise. Choice of capital-intensive projects may be preferred because even though these lead to smaller employment opportunities initially, in the long-run the high rate of surplus generation associated with capital-intensive projects will create higher output and employment potential in future. But, if the surplus generated by capital-intensive projects are in turn ploughed back into more capital-intensive projects, 'the promise of much future employment may never materialize' [Little & Mirrlees (1974), p.56]. As has been shown in Model B earlier (paras 4.3.3, 4.3.6 and 4.3.12—4.3.14), with decline over time in output-capital and employment-capital ratios, it is possible that the decline in output-capital ratio may be outweighed by the rise in the capita stock (because of high surplus generation) and consequently output will grow over time. But the decline in employment-capital ratio may itself outweigh the rise in the capital stock and therefore employment may experience a decline over time. Whether the decline in employment-capital ratio could outweigh the rise in the capital stock (or, the rise in surplus generation), however, will depend on the values of and interrelationship (e.g., elasticities) among employment-capital, output-capital and surplus-capital ratios and their rates of changes. Evidently, therefore, maximization of the rate of

surplus generation per unit of investment in projects even though it maximizes the rate of growth output, may not maximize the long-run rate of growth of employment (or, short-run employment generation, as has been pointed out earlier).

4.4.5 It has been shown in para 4.2.10, the allocation of given investible funds among different types of projects may give rise to a conflict between short-run employment and long-run output growth. The particular product-mix selected at both inter-industry and the intra-industry level is a critical determinant of the employment implication of any industrialization strategy [Morawetz (1974)]. At the industry level allocation of greater investment to construction activity or machine building rather than to consumption goods like beverages, tobacco and processed foods may result in more employment [Moratwetz (1974); Pack & Todaro (1969); Tockman (1972)]. Similarly, some labour-intensive exportable goods if given preferential treatment in investment allocation compared to capital intensive import substitutes may help generate more employment in developing economies. Some empirical results show that consumption basket of the poor is to some extent more labour-intensive than the that of the rich [Morawetz (1974)]. Such possibilities may give rise to a conflict between output growth and employment growth. Within a given industry, alternative product lines may offer different employment and surplus generation implications. Thus, the allocation of investment among projects producing different outputs at the inter-industry or intra-industry level may be a source of inverse relation between long-run output growth and short-run employment.

Gestation Lags and Linkages

4.4.6 Apart from the factors discussed above, two other important sources of conflict between employment and output are gestation lags of and linkages among investment projects. Often, the projects are characterized by a time-lag between construction and installation of capital equipments and flow of output. Sometimes, projects which are characterized by such time-lag of shorter duration are found to be more labour-intensive compared to those with larger gestation lags. Moreover, quite often, long-gestating projects (higher time-lags) employ more labour during the construction and installation phase but relatively few men when the production starts flowing. On the other hand, quick yielding projects (short-gestation period) might involve a more or less uniform employment. This may give rise to a conflict between employment generation and output growth.

4.4.7 Linkages between investment projects are thought to exist when one (investment) decision has some influence on another investment decision : one type of investment may add to the net returns of another, or may prevent a reduction, while another type of investment may detract them. One might define 'linkages' as opportunities or incentives, generated because of the creation of one particular investment project, which are expected to attract or detract investment in new projects or lead to increased/reduced activity in the existing projects. Thus, one type of investment projects which have high growth potential offers very little linkage and thereby contribute less towards overall economic growth when compared with investment projects which produce very high linkage effects. The difference in 'linkage' effects of investment projects may sometimes explain the conflict between employment output growth. It may happen that compared with a labour-intensive project , a capital-intensive project is associated with greater 'linkage' effects in terms of attracting large number of labour-intensive projects in its wake.

CHAPTER V

OUTPUT, EMPLOYMENT AND CHOICE OF INVESTMENT PROJECTS

5.1 Employment Objective

5.1.1 Choice criteria for evaluating and ranking projects in terms of social costs and social benefits have been evolved and applied primarily with a view to achieving the society's objective of output growth or aggregate consumption maximization. Often, implicitly or explicitly, it is assumed that maximization of output growth will automatically ensure maximization of employment growth. In the previous chapter it was shown that this may not always be true; under certain conditions increase in output growth may be associated with fall in employment growth. The sources of such conflict between output growth and employment growth have been referred to in economic literature since the mid-fifties (Galenson and Leibenstein (1955); ILO (1961); Baer and Herve (1966); Carter, N.G. (1969)[60].

5.1.2 Empirical evidence also tends to suggest that higher output growth rates need not be associated with higher employment growth rates. For example, in U.K. during 1970-71, output in all industries increased by 2 per cent, while employment declined by 5 per cent. In manufacturing

---

60/ Stoleru (1965) developed a model for an underdeveloped economy characterized by large unemployment and low per capita income in which it was shown that the objective of full employment balanced growth within minimum time and the welfare objective of aggregate consumption maximization could be achieved by adopting the same policy of allocating investment between the consumption goods sector and capital goods sector. Nanchane (1972) demonstrated that this is not valid except for a limited range of values of the parameters in the model.

industries, an increase of output by 1.5 per cent was associated with a decline in employment by 5 per cent. In the case of service industries (e.g., electricity and water supply), there was an 3 per cent increase in output while employment registered a fall of about 5.5 per cent. The statistics on employment and industrial production over a longer period also bear the lack of any positive relation between output expansion and employment growth [Das (1972)]. During 1963-1969, the growth rates of production and employment in selected countries were as follows :

country	percentage increase in production	percentage increase in employment
(1)	(2)	(3)
U.S.A.	46	19
Canada	47	18
West Germany	47	3
U.K.	26	-
Japan	127	14
India	15	9

5.1.3 In India during the Inter-Census decade 1961-71, the employment in the organized manufacturing industry increased by 43.6 per cent as against 75 per cent increase in production. This large divergence in expansion rates may be attributed [Dandekar (1972)] to the following : (i) a change in the composition of industrial production (the 1971 industry-mix being relatively less employment intensive than the 1961 industry-mix) and (ii) a change in technology (production techniques with

much less employment potential being more common in 1971 compared to 1961). Cross-sectional and time-series evidence on the relationship between industrial growth and employment generation in less developed countries in general provides a uniformly consistent picture of a significant employment lag; in three East African countries this employment lag is significant [Das (1972)]. For quite a prolonged period (the late 1950's and the early 1960's), there was in fact a negative relationship, i.e., employment declined absolutely while output expanded.

5.1.4 The inverse nature of relation between output growth and employment growth has, of late, assumed great significance in a number of the developing economies. With population growing fast, these economies find it difficult to rely solely on policies for output expansion for generation of adequate growth of employment opportunities. The problem of unemployment in most of these countries has assumed such serious proportions as to give rise to great social and political tensions, threatening the very possibility of economic progress.

5.1.5 Theoretically, it could be argued that, if the rate of expansion of output is high enough to ensure adequate standard of living to both employed and unemployed (through unemployment benefits or doles), employment per se need not be of any concern for a nation. It is difficult, however, to design a mechanism by which such unemployment benefits or doles could be distributed without affecting the morale of the employed and distributional justice. Moreover, such a high rate of output expansion is, perhaps, beyond the means of the developed economies, not to speak of the capital -

scarce over-populated developing economies constrained by institutional and structural bottlenecks to economic expansion. Secondly, employment of each individual is desirable for its own sake, as perhaps, a Puritan may argue. Thirdly, the sense of frustation and lack of dignity which are generally associated with large-scale unemployment may be regarded as an environmental cost to the society. To put it differently, employment creation may be regarded as an environmental objective having some weightage in the society's welfare function. Fourthly, more employment, even at the cost of a fall in output growth rate may imply better income distribution. This distributional aspect of economic development under current socio-political thinking, cannot be by passed[61/,62/]. Finally, the abundance of unemployed (unskilled) labour from the point of view of an underdeveloped economy represents under-utilization of a basic factor of production. For purposes of output expansion such countries should make maximum possible use of this relatively cheap factor input. In particular, the recent global oil crisis which has severely affected the development programmes of the developing economies shows that human energy is considerably more abundant and cheaper than other forms of energy which are

---

61/ Upto the mid-1960s most development economists regarded the growth of output as the single dominant macro-economic objective in developing economies. It was expected that with the growth in national output even the poorer people would be better off. Subsequent experience have in many cases belied this expectation. The increasing assymetry in income distribution with the growth of national output has been observed in a number of countries such as Brazil and Pakistan. This has led to a policy shift in favour of income distribution /Morawetz, (1974)/.

62/ Similar line of reasoning preferring employment to output under conditions of conflict between output maximization and employment maximization has been put forward in / Streeten (1972)/.

exhaustible or the exploitation of costs of which are expected to show continuous rise over the years. The reduction of unemployment of labour thus constitutes an important development strategy based on economic considerations of relative scarcities of factor endowments and energy resources 63/, 64/.

5.1.6 Given the objective conditions in the developing economies — the socio-political tensions associated with fast growing population and increasing unemployment, and the possible existence of conflict between output growth rate and employment growth, employment has, in recent years, established itself as an independent and important macro-objective [ILO (1975)]. Formulation and implementation of various economic policies to reduce unemployment while maintaining a reasonable rate of output expansion are being made in these countries. Choice of investment projects is also considered an instrument for not only growth of output but also increasing employment opportunities.

63/ Even in advanced countries economists have pointed out that the natural recources are not unlimited but exhaustible whereas labour supply is abundant. Galbraith (1958) questioned why the US economy appeared to be well supplied with hair-oil, tail-finned cars, etc., while cities decayed, air and water became polluted and land was despoiled. Boulding (1968) attributed this despoiling nature of man primarily to his inadequate frame of perception which leads him to regard the natural resource base as limitlessly exploitable. As a result of this 'cowboy economics' capital is being increasingly subsituted for labour even at the cost of an alarmingly increasing rates of resource depletion. Pearl (1971) observed that, since economies are characterized by a surplus of human beings and a shortage of non-renewable resources, it is necessary to establish a human-services society characterized by high labour intensity of economic activities; the earth's resources could be best conserved and the human resources best exploited for the benefit of the human beings only in such a society.

64/ Theoretical formulation of the economics of exhaustible resources has been made, among others, by Hotelling (1931), Solow (1974) and Smith (1974).

5.1.7 With growing backlog of unemployment through the Five Year Plans, considerable shift in emphasis in regard to employment creation has been noticed in the planned programmes in India. In the earlier Plans, growth of employment was treated as a by-product of growth of output. With the rate of unemployment mounting, the Government appears to have felt the need for considering employment expansion as an objective independent of the objective of output growth. Apart from the normal developmental programmes under the Fourth Five Year Plan, various schemes and programmes were undertaken primarily with a view to boosting the expansion of employment opportunities. Assistance in the form of free technical consultancy services, financial support, supply of plant and machinery at subsidised prices, provision of land and building for factory sheds arrangements for ensuring adequate and equitable procurement of scarce materials and foreign xchange and arrangements for marketing of products have been made available for both existing and prospective entrepreneurs in the small-scale industries (SSI) sector. These incentives for the growth of SSI units have been introduced primarily because considerable employment may be generated be diverting a portion of the limited stock of investible resources to the SSI units which are generally characterized by relatively low capital-labour ratios. Besides these, since 1971-72 a number of special employment programmes such as Crash Scheme for Rural Employment, Drought Prone Area Programme, etc., had been undertaken by the Central and State Governments in India.

5.1.8 In the Fifth Plan Approach paper, a massive programme of rural works has been proposed as a spring board to employment generation. Since it is the rural areas of the backward districts in the country where the unemployment problem is most accutely felt, implementation of rural works programmes of (i) minor irrigation, social conservation, area development, dairying, animal husbandry, forestry, fishery, warehousing, small-scale industries, roads, etc.; and (ii) elementary education, public health, rural water supply, home sites for landless labour, rural roads, rural electrification and slum improvement have been considered as suitable strategy for providing short-term relief to the unemployed and under-employed persons in the countryside. The bulk of the investment outlays under the rural works programmes would be undertaken during January to June so as to ensure steady flow of employment opportunities throughout the year to rural agricultural labourers and others who generally find employment between July and December. While such programmes were implemented in the previous plans also, a substantially larger amount of investment outlay is likely to be directed to these programmes during the Fifth Plan. All this indicates that the rural works programmes have been relied upon as a major instrument for the realization of the objective of larger employment. But employment generated through these programmes may be temporary in nature. On long-term considerations, this type of employment may prove highly capital-intensive because fresh capital outlays have to be made periodically to maintain the employment of labour, although such outlays are not recouped in view of low or zero rate of surplus generation

in these projects. And, these projects may be required to be ultimately replaced by employment of more durable nature in manufacturing and service sectors through appropriate selection of investment projects.

5.2 Weighted Sum of Contributions: Suggested Criterion

5.2.1 It is possible to take into account the weightage assigned to the objective of employment generation by a society in the choice of investment projects. Under conditions of conflict between the twin growth objectives of output and employment, the society may be assumed to have a weighted preference function involving output and employment (i.e., the society may be said to have a valuation of costs of not having a higher output/employment growth and the associated benefit of having a higher employment/output growth). A criterion of weighted sum of the projects' contributions towards the twin objectives which would be consistent with the society's preference function may be derived and used in solving investment project choice problems.

5.2.2 Let the contribution of project i to the objective of output growth be measured in terms of $\bar{r}_i$ and the contribution to the employed growth objective be e_i, where $\bar{r}_i$ is the rate of surplus generation per unit of initial investment (as defined in para 4.2.3 equation 4A.12) and $\bar{e}_i = \sum_{t=1}^{\theta_i} e_{it} \cdot h_t$. e_{it} is the direct employment generated by any project i at time t per unit of initial capital investment; $0 \leq h_t \leq 1$ for all t; h_t are the weights on the employment

contribution of projects over different points of time and θ_i is the life-span of project i 65/, 66/. Now, in the event of pointwise dominance, i.e., $\bar{r}_i \geq \bar{r}_j$ and $\bar{e}_i \geq \bar{e}_j$ with at least one inequality holding good, project i is preferable to project j since it contributes more towards at least one of the objectives without contributing less towards any other objective compared to the project j. Such pointwise dominance cannot be assumed in general and for a set of m projects it may be that

$$\bar{r}_1 > \bar{r}_2 > \cdots\cdots \bar{r}_i > \bar{r}_j > \cdots\cdots > \bar{r}_m \qquad \ldots (5.1)$$

$$\bar{e}_1 < \bar{e}_2 < \cdots\cdots \bar{e}_i < \bar{e}_j < \cdots\cdots < \bar{e}_m \qquad \ldots (5.2)$$

65/ The greater is the urgency with which the unemployment problem is treated in the immediate period, the larger is the values of h_t for small values of t compared to those for higher values of t. However, the values of e_{it} ($t = 1, 2, \ldots, \theta_i$) are given for the i-th project and does not depend on calendar period in which the project is considered for implementation or is implemented. But the values of h_t ($t = 1, 2, \ldots, \theta_i$) will depend on the calendar period during which project i is in operation.

66/ The discount rate between employment in period t and (t+1) may be defined as

$$d_e(t) = \frac{h_t - h_{t+1}}{h_t} \quad \text{i.e.,} \quad h_{t+1} = (1 - d_e(t))\, h_t$$

If $\frac{h_{t+1} - h_t}{h_t}$, i.e., the rate at which h_t falls is constant, $d_e(t)$ is constant. If it is assumed that h_t falls over time (i.e., employment later is less valuable than employment now), $d_{e(t)} = d_e$ is positive. Unlike in the case of output or consumption, in case of employment value of employment may not fall with rise in the level of employment [Streeten (1972), p.335]; rather the value of employment should rise or fall according as degree of unemployment rises or falls. If it is expected that in future degree of unemployment will decline, employment in future will be less valuable than employment now i.e., d_e will be positive. It has also been argued [Streeten (1972), p.335-36] that the discount rate to be applied to employment should be less than the discount rate to be applied to output or consumption. With the rise in income (consumption) per head marginal utility of income (consumption) falls; but with fall

contd..... /-

The ranking of projects given by (5.1) is in accordance with the objective of output growth, while ranking represented by (5.2) is consistent with the employment growth objective[67]. Let the social weight assigned to output growth and employment growth objectives be π and $(1 - \pi)$,

---

footnote [66] contd.

in the degree of unemployment (ratio of number of actually employed to total number of persons in need of employment in the country) although the intensity of unemployment problem and, therefore, the need for (value of) one unit of extra employment as such declines, the intensity of dissatisfaction of the unfortunate few who remain unemployed rises. 'Poverty in the midst of affluence is worse than plain poverty widely shared'.

[67] If output growth is the only objective, then a project j may be said to be inefficient if there exists a project i such that project i requires less of both investment and employment to generate a unit of reinvestible surplus compared to project j, i.e.,

$$\left(\frac{1}{\bar{r}_i} < \frac{1}{\bar{r}_j} , \quad \frac{\bar{e}_i}{\bar{r}_i} < \frac{\bar{e}_j}{\bar{r}_j} \right)$$

Therefore, from the point of view of output growth objective project j will never be chosen because project i is better than project j. Accordingly, given output growth as the objective, the efficient set of projects (to which the choice will be restricted) may be arranged as follows:

$$\left.\begin{array}{l} (\bar{r}_1 > \bar{r}_2 > \cdots > \bar{r}_m) \\ (\bar{e}_1 > \bar{e}_2 > \cdots > \bar{e}_m) \end{array}\right\} \quad \text{and} \quad \ldots \text{(S-A)}$$

If, however, both output/employment are objectives, then project j is inefficient if there exists a project i which generates more of reinvestible surplus and employment with a unit of investment, i.e.,

$$(\bar{r}_i > \bar{r}_j , \quad \bar{e}_i > \bar{e}_j)$$

Evidently, the efficient set of projects with both output and employment may be arranged as follows :

$$\left.\begin{array}{l} (\bar{r}_1 > \bar{r}_2 > \cdots > \bar{r}_m) \\ (\bar{e}_1 < \bar{e}_2 < \cdots < \bar{e}_m) \end{array}\right\} \quad \ldots \text{(S-B)}$$

It may be noted that for adjacent projects (k, k+1)

$$\frac{\bar{r}_k - \bar{r}_{k+1}}{\bar{e}_k - \bar{e}_{k+1}} \gtrless 0$$

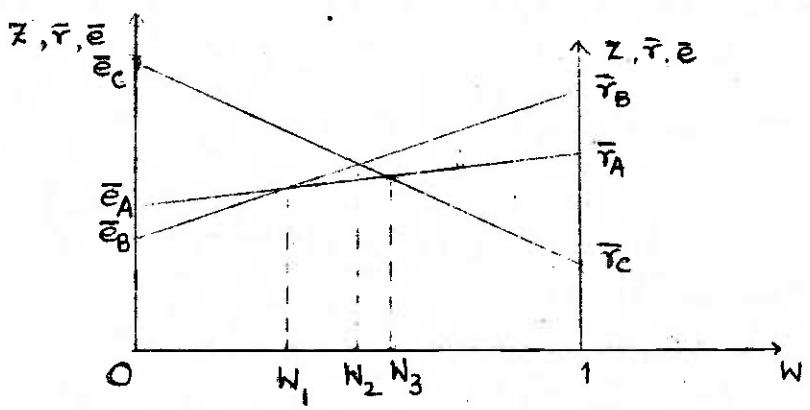
according as the projects are chosen from set (S-A) or set (S-B).

respectively, where $0 \leq W \leq 1$. The projects may be ranked in terms of the values of the index

$$Z_i = W \bar{r}_i + (1 - W) \bar{e}_i \quad \ldots (5.3)$$

subject to $\bar{r}_i \geq 0 \quad \ldots (5.31)$ [68]

5.2.3 It is easily seen that the ranking entirely depends on the value of W chosen and the ranking changes in an interesting manner with changes in the value of W. This is evident from the diagram and the Table below.



Diagram

Table : Ranking of projects A, B and C

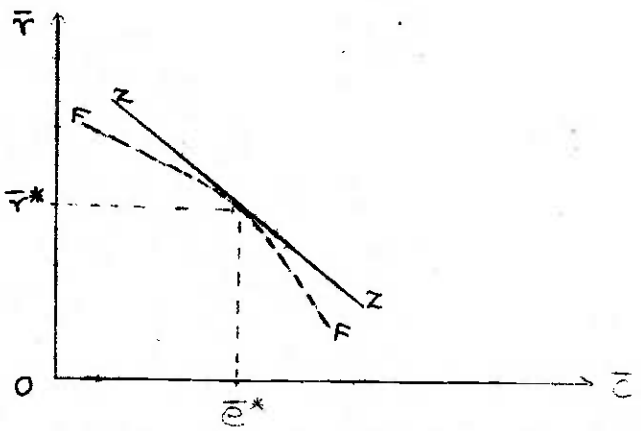
Rank	Alternative value of weights (W)						
	$0 \leq W < W_1$	$W = W_1$	$W_1 < W < W_2$	$W = W_2$	$W_2 < W < W_3$	$W = W_3$	$W_3 < W$
I	C	C	C	C,B	B	B	B
II	A	A,B	B	A	C	A,C	A
III	B	-	A	-	A	-	C

68/ The significance of the condition $\bar{r}_i \geq 0 \quad \ldots (5.31)$ is discussed in para 5.2.4 below. $\bar{r}_i \geq 0$ ensures that the re-investible surplus generated by the project is not less than the investment outlay made in project i. In other words, the project does not take away from the pool of capital accumulation more investment than what it contributes to the pool by way of re-investible surplus generated by it.

If each of these three projects require investment outlay of K/2 and the total available investible outlay is K, the combination of projects would be (C, A), (C, A or C, B), (C, B), (C, B or A, B) and (A, B) according as $0 \leq W < W_1$, $W = W_1$, $W_1 < W < W_3$, $W = W_3$ and $W_3 < W$. This dependence of ranking on the value of W may be shown as follows. If (5.1) and (5.2) be such that the the transformation relation $F(\bar{r}, \bar{e}) = 0$ is continuous with $\frac{\delta \bar{r}}{\delta \bar{e}} < 0$ and $\frac{\delta^2 \bar{r}}{\delta \bar{e}^2} > 0$ maximum value of $Z_i = W \bar{r}_i + (1 - W) \bar{e}_i$ is attained for $\bar{r} = \bar{r}^*$ and $\bar{e} = \bar{e}^*$ where $\bar{r}^*$ and $\bar{e}^*$ are given by the condition

$$- \frac{\delta \bar{r}}{\delta \bar{e}} = \frac{W}{1-W} \qquad \ldots \quad (5.4)$$

Diagramatically,



Consistency between Macro-level and Micro-level :

5.2.4 The use of a preference function as above involves estimation of weights for employment benefit generated at different points of time, for employment index $\bar{e}$ and for output growth index $\bar{r}$. It is difficult, however, to determine these social weights. This difficulty notwithstanding, the need for using weighted preference function in project choice problems under

situations of conflict between employment and output growth objectives cannot be underrated. For the sake of simplicity, it is assumed that (i) there are no external effects or linkage effects[69]; (ii) $e_{it} = e_i$ for all t (i.e., same employment-capital ratios throughout for any project); and (iii) the surplus generated per unit of investment $\beta_{it} = \beta_i$ for all t (i.e., same surplus generation per unit of investment throughout for any project). Since $\sum_{t=1}^{\theta_i} h_t \cdot e_{it} = e_i \sum_{t=1}^{\theta_i} h_t$ and since given the values of h_t, $\sum_{t=1}^{\theta_i} h_t$ is constant for all projects having same life period $\theta_i = \theta$, the contribution of project i towards the objective of employment may be measured by e_i[70]. Again, as has been shown in paras 4.2.5 and 4.2.6 of Chapter IV, the contribution of project i towards the objective of output growth may be measured by the constant rate of surplus generation β_i. In this simplified situation, the following criterion of weighted sum of contributions towards the objectives of employment and output growth may be suggested for ranking and selection of projects :

$$\text{Maximize } Z_i = [W_1 \beta_i + W_2 e_i] \quad \text{where } W_2 = 1 - W_1 \quad \ldots \quad (5.5)$$

$$\text{subject to } \beta_i \cdot \theta_i \geq 1 \quad \ldots \quad (5.51)$$[71]

69/ The problems associated with linkage effects and the procedure of incorporating linkage effects in the project choice criterion function are discussed in section 5.4 of this Chapter.

70/ Even when projects have different life period (i.e. $\theta_i \neq \theta$ for all i), the contribution of projects towards employment growth may be measured in terms of e_i (see footnote 72 below).

71/ The significance of $\beta_i \cdot \theta_i \geq 1$ for choice among projects with different life span is discussed in footnote 72 below.

The condition (5.51) which may be regarded as a viability restriction, is necessary to rule out the possibility of those projects being chosen which make negative contribution towards output growth objective. It is possible that such projects as make negative contribution towards output growth to have relatively high ranking in terms of criterion (5.5) if they are associated with substantially greater employment generation potentialities compared to other projects which make positive (or, non-negative) contribution towards the output growth objective. A project may be said to make negative contribution towards output growth if $\beta_i \theta_i < 1$ and non-negative contribution $\beta_i \cdot \theta_i \geq 1$. If a project is characterized by $\beta_i \cdot \theta_i < 1$, the capital stock is not recouped through surplus generation in project i (vide paras 4.2.4 and 4.2.6 of Chapter IV). Sometimes because of biased considerations for the necessity of generating large-scale employment opportunities, such projects are designed and implemented in labour-surplus economies as involve very low or zero rates of surplus generation ($\beta_i \theta_i < 1$ or $\beta_i = 0$) but generate considerably high employment. The implication of choosing such projects (e.g., some rural works programmes referred to in para 5.18) is that the capital stock is eaten into to provide employment. Thus, at the end of the projects' life output and employment associated with the project cannot be maintained unless fresh capital allocations are made from the resources generated elsewhere. In other words, such projects draw more from the society's pool of accumulation than what they contribute towards the pool. On benefit-cost considerations, therefore, these projects are not viable and, hence, cannot be selected. Even in a labour-surplus

developing economy society is unlikely to accept such a situation where more of employment means negative output growth. In particular, projects characterized by $\beta_i \cdot \theta_i < 1$ will ultimately have to be replaced by viable projects to maintain the order of employment offered earlier in non-viable projects. Therefore, it is more likely that the society will prefer to have at least a minimum surplus generation rate for each project so that there is no depletion of capital stock in the economy just for the sake of employment creation. In other words, the society is assumed to maximize weighted sum of contributions towards output and employment growth objectives (maximize $W_1 \beta_i + W_2 e_i$) subject to the condition that there is no decline in the stock of capital in the economy and, therefore, national output does not experience decline over time. Thus, the choice is restricted to the projects which satisfy the viability restriction $\beta_i \theta_i \geq 1$[72]. The condition (5.31) in para 5.2.2 is essentially a similar viability restriction when β_{it} are different for different values of t for any project i (vide footnote 68 above).

72/ With the imposition of condition (5.51) for applying criterion (5.5), even if θ_i is different for different projects, the contribution of projects towards employment objective may be measured by e_i. For with $\beta_i \theta_i \geq 1$, it is possible to assume that each project is operated for indefinite period of time by re-investing the surplus in the same project at the end of every θ_i periods. In other words, $\sum_{t=1}^{\infty} h_t$ is constant for projects even with unequal life-span.

5.2.5 The criterion (5.5) is consistent with the maximization of $W_1' g + W_2' f$ where g and f are the growth factors[73] of output and employment for the economy as whole; W_1' and W_2' describe the social weight distribution between output growth and employment growth at the macro-level, In period t, choice of projects in accordance with the criterion

$$\text{maximize} \quad W_1 \beta_i + W_2 e_i \qquad \ldots\ (5.5)$$

is equivalent to maximizing $\sum_{j=1} \{ W_1 \beta_j + W_2 e_j \} K_j$ where j denotes the projects selected under the capital funds constraint, $\sum_{j=1} K_j = K_t$, for the economy as a whole in period t; K_j denotes the requirement of capital in project j (since in real situation the entire capital stock cannot be allocated afresh in every period, the projects already allocated capital in earlier periods may be regarded as chosen in period t with allocation of original capital less all depreciation). It follows that (5.5) implies

$$\text{maximize} \quad W_1 \sum_{j=1} \beta_j K_j + W_2 \sum_j e_j K_j$$

or,

$$\text{maximize} \quad W_1 \sum_{j=1} (1 + \beta_j) K_j + W_2 \sum_j e_j K_j \qquad \ldots\ (5.6)$$

(since W_1 and $\sum_j K_j = K_t$ are given)

Now, relating the above to the Model B of chapter IV it follows that maximizing (5.5) implies

$$\text{maximize} \quad W_1 (1 + b_o \mu^t) K_t + W_2 k_t \cdot K_t$$

or,

$$\text{maximize} \quad \left(W_1 \cdot \frac{1}{s_2}\right) s_2 (1 + b_o \cdot \mu^t) + \left(W_2 \cdot n \cdot L_{t-1} \cdot \frac{1}{K_t}\right) f_t \qquad \ldots\ (5.7)$$

which is equivalent to maximize

$$W_1' g_{t+1} + W_2' f_t \qquad \ldots\ (5.8)$$

where $W_1' = W_1/s_2$ and $W_2' = W_2 \cdot n \cdot L_{t-1}/K_t$.

73/ Growth rate of output = g-1; Growth rate of employment = f-1.

5.2.6 Evidently, given the values of the macro-level weights W_1' and W_2', it is possible to work out a set of micro-level weights W_1 and W_2, consistent with W_1' and W_2', for use in the project choice criterion. Here, the the values of L_{t-1}, $\bar{K}_t$ and n are known. Although the value of s_2 depends on the projects actually chosen in different periods and is expected to vary over periods, for purposes of maximizing a weighted sum of the growth factors of output and employment, the value of s_2 may be estimated. With changes in the level of national output and the rate of employment, the values of W_1' and W_2' are likely to be changed. Consistent with these changes as also the changes in n, L_{t-1}, K_t and s_2, the values of the weights W_1 and W_2 at the micro-level will also have to be revised.

Formula for Shadow Wage Rates

5.2.7 This criterion of weighted sum of contributions to the objectives of output growth and employment may be shown to be equivalent to maximizing β_i' where β_i' is the rate of surplus per unit of capital computed on the basis of a shadow wage rate $\psi_i' = \psi_i - \frac{W_2}{W_1} \frac{1}{(1 - \varepsilon_i)}$ where ψ_i' is the actual wage and ε_i is the saving rate for wage and salary income in project i. For, maximizing $W_1 \beta_i + W_2 e_i$ implies

$$\underset{i}{\text{maximize}} \quad \beta_i + \frac{W_2}{W_1} e_i \quad (W_1 \neq 0) \qquad \text{which implies}$$

$$\underset{i}{\text{maximize}} \quad \pi_i + \delta_i + \varepsilon_i \psi_i' e_i + \frac{W_2}{W_1} e_i$$

i.e., $$\underset{i}{\text{maximize}} \quad \pi_i' + \delta_i' + (\psi_i' - \psi_i) e_i + \varepsilon_i \psi_i' e_i + \frac{W_2}{W_1} e_i$$

$\because$ x_i the output-capital ratio is independent of the wage rate in any project i.e., $\pi_i + \delta_i + \psi_i e_i = x_i = \pi'_i + \delta'_i + \psi'_i e_i$

i.e., $\underset{i}{\text{maximize}} \; \pi'_i + \delta'_i + \varepsilon_i \psi'_i e_i + (1 - \varepsilon_i)(\psi'_i - \psi_i) + \frac{W_2}{W_1} e_i$

i.e., $\underset{i}{\text{maximize}} \; \beta'_i$ where $(1 - \varepsilon_i)(\psi'_i - \psi_i) + \frac{W_2}{W_1} e_i = 0$ i.e.,

$$\psi'_i = \psi_i - \frac{W_2}{W_1} \frac{1}{(1 - \varepsilon_i)} \qquad \ldots \quad (5.9)$$

It may be noted that when output growth is the sole objective of the society ($W'_2 = 0 = W_2$), $\psi'_i = \psi_i$. It may also be noted from above that $\underset{i}{\text{maximize}} \; W_1 \beta_i + W_2 e_i$ is equivalent to $\underset{i}{\text{maximizing}} \; (\bar{\pi}_i + \bar{\delta}_i)$ where $(\bar{\pi}_i + \bar{\delta}_i)$ is computed on the basis of a shadow wage rate

$$\bar{\psi}_i = (1 - \varepsilon_i)\psi_i - \frac{W_2}{W_1} \qquad \ldots \quad (5.10)^{74/}$$

Interpretation of Shadow Wage Rates

5.2.8 The shadow wage rate of labour has been frequently used in the literature on cost-benefit analysis of investment projects [Sen (1968a, 1972); Stern (1972)] as the value of labour which if equated to the marginal product of labour results in optimal allocation of labour. The shadow wage rate has also been interpreted as that value of the marginal product of labour for which the change in social welfare (due to unit increase in labour employment) is zero [Sen (1972)]. The formula for shadow wage rate $\bar{\psi}_i$ given by (5.10) in para 5.2.7 above is consistent with this

---

74/ Max $W_1 \beta_i + W_2 e_i$ implies max $\bar{\pi}_i + \bar{\delta}_i$ where

$$\varepsilon_i \bar{\psi}_i e_i + (1 - \varepsilon_i)(\bar{\psi}_i - \psi_i) + \frac{W_2}{W_1} e_i = 0$$

definition. As a result of a unit increase in labour employment in a project, the contribution of the project towards the growth objective increases by $[\hat{q}_i - (1 - \varepsilon_i)\Psi_i]$ and the contribution towards the employment objective increase by unity, where $\hat{q}_i$ is the marginal product of labour in the project i, Ψ_i is the wage rate in project i and ε_i is the savings per unit of wage income. Therefore, the increase in social welfare is given by $W_1[\hat{q}_i - (1 - \varepsilon_i)\Psi_i] + W_2$ because W_1 and W_2 are the weights signifying the relative social valuation of a unit increase in contributions towards the objective of, respectively, output and employment. Social welfare is maximized if employment is carried upto the point at which $W_1[\hat{q}_i - (1 - \varepsilon_i)\Psi_i] + W_2 = 0$. The value of marginal product of labour at this point is, evidently, given by $\hat{q}_i^* = (1 - \varepsilon_i)\Psi_i - \frac{W_2}{W_1}$. Therefore, $\bar{\Psi}_i = (1 - \varepsilon_i)\Psi_i - \frac{W_2}{W_1}$ [75]. Alternatively, this formula for shadow wage rate $\bar{\Psi}_i$ may be interpreted as follows. The social cost of employing a unit of labour is the loss in the contribution to the growth objective as measured by the loss in savings and is given by $(1 - \varepsilon_i)\Psi_i$. The social benefit of employing a unit of labour expressed in units of the contribution towards the growth objective is $\frac{W_2}{W_1}$. Therefore, the net social cost of employing unit of labour is $(1 - \varepsilon_i)\Psi_i - \frac{W_2}{W_1}$. Since the shadow wage rate should equal the net social cost of employing a unit of labour, $\bar{\Psi}_i = (1 - \varepsilon_i)\Psi_i - \frac{W_2}{W_1}$. It may be noted that in the derivation of the formula (5.9) of the shadow wage rate ($\bar{\Psi}_i$), it was

---

[75] If W_1 expresses the social welfare per rupee of savings and W_2 the social welfare per unit of labour employed, W_2/W_1 is expressed in terms of rupees per unit of labour employed.

assumed that the net social cost of employing a unit labour should equal the consumption due to unit labour at the shadow wate rate (since it is β_i' which is maximized at the shadow wage rate Ψ_i' and not $(\bar{r}_i + \bar{\delta}_i)$ which is maximized at the shadow wage rate $\bar{\Psi}_i$). Therefore,

$$(1 - \varepsilon_i)\,\Psi_i' = (1 - \varepsilon_i)\,\Psi_i - \frac{W_2}{W_1}$$

$$\text{or,} \quad \Psi_i' = \Psi_i - \frac{W_2}{W_1} \cdot \frac{1}{(1 - \varepsilon_i)}$$

Alternatively, Ψ_i' may be interpreted as the wage rate at which consumption due to marginal unit of labour is equal to <u>that</u> value of the marginal product of labour at which net increase in social welfare due to marginal unit of labour is zero. As shown already net incrase in social welfare due to marginal labour is given by $W_1 \left[\hat{q}_i - (1 - \varepsilon_i)\,\Psi_i'\right] + W_2$; the value of the marginal product of labour at which net social welfare is zero, therefore, will be given by $\hat{q}_i^* = (1 - \varepsilon_i)\,\Psi_i - \frac{W_2}{W_1}$. Now, consumption at shadow wage rate must equal $\hat{q}_i^*$. Therefore,

$$(1 - \varepsilon_i)\,\Psi_i' = (1 - \varepsilon_i)\,\Psi_i - \frac{W_2}{W_1}$$

$$\text{or,} \quad \Psi_i' = \Psi_i - \frac{W_2}{W_1} \cdot \frac{1}{(1 - \varepsilon_i)}.$$

Notwithstanding the apparent difference in the formula for the shadow wage rates Ψ_i' and $\bar{\Psi}_i$, they will lead to the same results. For, $\bar{\Psi}_i$ is used for computing $(\bar{r}_i + \bar{\delta}_i)$ which is equivalent to computing β_i at the wage rate Ψ_i, Ψ_i' is used for computing β_i' which is equivalent to computing β_i at the wage rate Ψ_i.

5.2.9 From the formula for shadow wage rates Ψ_i' and $\bar{\Psi}_i$, it is easily seen that shadow wage rates may be negative; $\Psi_i' \gtrless 0$ (also $\bar{\Psi}_i \gtrless 0$) according as $(1 - \varepsilon_i)\,\Psi_i \gtrless \frac{W_2}{W_1}$. Thus, shadow wage rate (Ψ_i' or $\bar{\Psi}_i$) is negative if the relative weight on employment objective in terms of the weight on output growth objective is greater than the consumption out of wage income per unit of labour. Alternatively, $\Psi_i' < 0$ if $W_1(1 - \varepsilon_i)\,\Psi_i < W_2$, i.e., if the social value of the loss in savings due to a unit increase in employment is less than the social value of a unit increase in employment. In other words, if the social cost of employment reflected in the value of associated fall in savings (increase in consumption) is less than the social benefit from employing a unit of labour, shadow wage is negative; here employment means a net gain (net social benefit is positive). It may be noted, however, that the formula for shadow wage rates Ψ_i' and $\bar{\Psi}_i$ are relevant for only those projects which satisfy the condition $\beta_i \theta_i > 1$ ... (5.51). Now since $\beta_i = x_i - (1 - \varepsilon_i)\Psi_i e_i$ condition (5.51) reduces to $(1 - \varepsilon_i)\,\Psi_i < (x_i - \frac{1}{\theta_i})\,\frac{1}{e_i}$.

Extension of Shadow Wage Rate Formula

5.2.10 So far it has been assumed that as a result of employing unit of labour, surplus in the form of savings from wage and salary income is generated by the project in addition to profit and depreciation. If, however, the additional unit of labour employed in the project is assumed to have been shifted from elsewhere in the economy, where its marginal productivity was m, its consumption was $\bar{C}$, the net surplus generation of the project will not be

given by $\pi_i + \delta_i + \varepsilon_i \Psi_i e_i$. When a labour is shifted from elsewhere in the economy to project i, the following effects are produced. His consumption increases not by $(1 - \varepsilon_i) \Psi_i$ but by $[(1 - \varepsilon_i) \Psi_i - \bar{c}]$. The people remaining behind in the sector from where he was shifted increase consumption by $\sigma (\bar{c} - m)$, $\sigma \leq 1$ is the propensity of those remaining behind to consume out of additional income availability. Thus the surplus generation in the economy is given by $\beta_i = \pi_i + \delta_i + \varepsilon_i \Psi_i e_i + \sigma (\bar{c}-m) e_i$ Clearly in this case, the shadow wage rate formula corresponding to (5.10) would be given by

$$\bar{\Psi}_i^{\circ} = (1 - \varepsilon_i) \Psi_i - (1 - \sigma) \bar{c} - m - \frac{W_2}{W_1} \quad \ldots\ldots (5.11)$$

This may be interpreted as follows : the social benefit of employing a labour is given by $\frac{W_2}{W_1}$; the social cost of employing a labour is the loss in savings (or increase in consumption) and is given by $[(1 - \varepsilon_i) \Psi_i - \bar{c} + \sigma (\bar{c} - m)]$. Therefore, the shadow wage rate or the net social cost of employing a unit of labour is

$$[(1 - \varepsilon_i) \Psi_i - (1 - \sigma) \bar{c} - m] - \frac{W_2}{W_1},$$

Comparison with other Shadow Wage Rate Formula

5.2.11 The formula for shadow wage rate $\bar{\Psi}_i = (1 - \varepsilon_i) \Psi_i - \frac{W_2}{W_1}$ ...(5.10) may be compared with the usual formula derived in terms of the society's objective of maximizing aggregate consumption [Little & Mirrless (1969); Sen (1972), UNIDO(1972)]. The usual shadow wage rate formula is derived as follows. The social cost of employing a unit of labour is the decline

in savings (potential for future consumption) and is given by $(1 - \varepsilon_i)\Psi_i$. The social benefit of employing a labour is the increase in current consumption given by $(1 - \varepsilon_i)\Psi_i$. Since sub-optimality of savings is assumed, savings are regarded as more valuable to current consumption. Let s_o be the premium on savings relative to current consumption. Therefore, the social benefit in terms of savings is given by $\frac{1}{s_o}(1 - \varepsilon_i)\Psi_i$. The net social cost of employing a labour or the shadow wage rate is given by

$$\hat{\Psi}_i = (1 - \varepsilon_i)\Psi_i - \frac{1}{s_o}(1 - \varepsilon_i)\Psi_i = \frac{(s_o - 1)\Psi_i(1 - \varepsilon_i)}{s_o} \quad \ldots (5.12)$$

Comparing $\hat{\Psi}_i$ in (5.12) with $\bar{\Psi}_i$ in (5.10), it is easily seen that $\hat{\Psi}_i = \bar{\Psi}_i$ if

$$W_1 = \frac{s_o}{s_o + \Psi_i(1 - \varepsilon_i)} \quad \text{and} \quad W_2 = \frac{\Psi_i(1 - \varepsilon_i)}{s_o + \Psi_i(1 - \varepsilon_i)} \quad \ldots (5.13)$$

Alternatively, this may be shown as follows. The weighted criterion function (5.5) suggested in <u>para</u> 5.2.4 is equivalent to

$$\underset{i}{\text{maximize}} \; W_1 x_i - \left[\bar{W}_1 (1 - \varepsilon_i)\Psi_i - W_2\right] e_i$$

or $$\underset{i}{\text{maximize}} \; x_i - \left[(1 - \varepsilon_i)\Psi_i - \frac{W_2}{W_1}\right] e_i, \quad W_1 \neq 0 \text{ (since}$$

$$x_i = \pi_i + \delta_i + \Psi_i e_i \text{ and } \beta_i = \pi_i + \delta_i + \varepsilon_i \Psi_i e_i).$$

The usual criterion function under the objective of aggregate consumption is given by

$$\underset{i}{\text{maximize}} \; x_i - \hat{\Psi}_i e_i \quad \text{where} \quad \hat{\Psi}_i = \frac{(s_o - 1)(1 - \varepsilon_i)\Psi_i}{s_o}$$

Comparing the two criteria it is easily seen that application of the latter

criterion is equivalent to applying the former criterion

$$\underset{i}{\text{maximize}} \quad x_i - \left[(1 - \varepsilon_i)\psi_i - \frac{W_2}{W_1}\right] e_i \quad \text{or} \quad W_1 \beta_i + W_2 e_i$$

if $$W_1 = \frac{s_o}{s_o + (1 - \varepsilon_i)\psi_i} \quad \text{and} \quad W_2 = \frac{\psi_i (1 - \varepsilon_i)}{s_o + \psi_i (1 - \varepsilon_i)}$$

Thus, it is shown that the project choice criterion under the objective of aggregate consumption implicitly assigns weights on the objectives of output growth (savings) and employment [vide para 2.3.10 of Chapter II].

5.2.12 In backward developing economies with large army of surplus labour, the use of shadow wage rate lower than the market wage rate has been suggested so that relatively labour-intensive projects are chosen and unemployment is reduced. In the present study, a formula for shadow wage rate has been derived which explicitly takes account of the relative social importance attached to the macro-objectives of eradicating large-scale unemployment and raising the growth rate of national output. Three equivalent criteria have been suggested : (a) $\underset{i}{\text{maximize}} \; W_1 \beta_i + W_2 e_i$, (b) $\underset{i}{\text{maximize}} \; \beta'_i$ where β'_i is the surplus per unit of investment evaluated at shadow wage rate ψ'_i given by (5.9), and (c) $\underset{i}{\text{maximize}} \; (\bar{\pi}_i + \bar{\delta}_i)$ where the $(\bar{\pi}_i + \bar{\delta}_i)$ is the profit plus depreciation (or net value added minus wages) evaluated at the shadow wage rate $\bar{\psi}_i$ given by (5.10).

Choice Among Incompatible Project Variants

5.2.13 The ratio W_2/W_1 reflects the society's trade-off between output growth objective and employment objective. In other words, when there exists a conflict between these two objectives the society is assumed to trade one

unit of labour employment in exchange for $\frac{W_2}{W_1}$ units of savings (since savings are regarded as an index of output growth contribution of a project). For choice among projects which are incompatible in the sense that choice of any one among them precludes the choice of any other, the ratio $\frac{W_2}{W_1}$ may be used in a criterion that is equivalent to the criterion maximize $W_1\beta_i + W_2 e_i$. Let alternative projects (β_1, e_1) (β_2, e_2), ..., (β_m, e_m) be such that $\beta_1 > \beta_2 > \beta_3 > \cdots > \beta_m$ and $e_1 < e_2 < e_3 < \cdots < e_m$[76]. The savings-employment potential trade-off coefficient of successive (adjacent) alternatives i is defined as

$$A_i = \frac{\beta_{i-1} - \beta_i}{e_i - e_{i-1}} \qquad \ldots \quad (5.14)$$

Let the projects be arranged in ascending order of potential trade-off coefficient such that

$$\frac{\beta_1 - \beta_2}{e_2 - e_1} < \frac{\beta_2 - \beta_3}{e_3 - e_2} < \cdots < \frac{\beta_{f-1} - \beta_f}{e_f - e_{f-1}} < \cdots < \frac{\beta_{m-1} - \beta_m}{e_m - e_{m-1}} \qquad \ldots (5.15)$$

The criterion of choice among the above projects is

$$\underset{i}{\text{maximize}} \left[\frac{W_2}{W_1} - A_i \right] \qquad \ldots \quad (5.16)$$

In other words, $\frac{W_2}{W_1}$ is the allowable maximum trade-off between savings and employment. It can be shown that (a) criterion (5.16) is equivalent to criterion (5.5) and (b) the existence of intermediate projects which do not satisfy the ordering (5.15) raises no problem for criterion (5.16) because such intermediate projects cannot be selected (i.e., the ordering implied by (5.15) is an efficiency requirement).

76/ This ordering of output growth contribution (β_i) and employment contribution (e_i) of projects follows from the notion of efficiency (vide para 5.2.2).

5.2.14 To prove (a), let alternative f be such that

$$\underset{i}{\text{maximize}} \left[\frac{W_2}{W_1} - A_i \right] = \frac{W_2}{W_1} - A_f.$$

Therefore,

$$A_2 < A_3 < \ldots < A_{f-1} < A_f \leq \frac{W_2}{W_1} < A_{f+1} < \ldots < A_m$$

It follows, therefore,

$$W_1 \beta_1 + W_2 e_f < W_1 \beta_2 + W_2 e_2 < \ldots < W_1 \beta_{f-1} + W_2 e_{f-1} \leq$$

$$W_1 \beta_f + W_2 e_f > W_1 \beta_{f+1} + W_2 e_{f+1} > \ldots > W_1 \beta_m + W_2 e_m$$

Thus, alternative f is the project that maximizes

$$W_1 \beta_i + W_2 e_i$$

5.2.15 It may now be shown that the existence of intermediate projects not satisfying ordering (5.15) is not consistent with the criterion $\underset{i}{\text{maximize}}\ W_1 \beta_i + W_2 e_i$. Let there be an intermediate project k such that

$$\frac{\beta_{k-1} - \beta_k}{e_k - e_{k-1}} > \frac{\beta_k - \beta_{k+1}}{e_{k+1} - e_k} \qquad \ldots (5.17)$$

where $\beta_{k-1} > \beta_k > \beta_{k+1}$ and $e_{k-1} < e_k < e_{k+1}$.

Now, if intermediate project k is the optimal project under criterion $\underset{i}{\text{maximize}}\ W_1 \beta_i + W_2 e_i$, it is necessary that

$$\left.\begin{aligned} W_1 \beta_{k-1} + W_2 e_{k-1} &< W_1 \beta_k + W_2 e_k \\ \text{and} \quad W_1 \beta_{k+1} + W_2 e_{k+1} &< W_1 \beta_k + W_2 e_k \end{aligned}\right\} \qquad \ldots (5.18)$$

If follows from (5.18)

$$\frac{\beta_{k-1} - \beta_k}{e_k - e_{k-1}} < \frac{W_2}{W_1} \quad \text{and} \quad \frac{W_2}{W_1} < \frac{\beta_k - \beta_{k+1}}{e_{k+1} - e_k}$$

In other words, (5.18) implies

$$\frac{\beta_{k-1} - \beta_k}{e_k - e_{k-1}} < \frac{\beta_k - \beta_{k+1}}{e_{k+1} - e_k} \quad \text{which contradicts (5.17)}$$

5.3. Formal Derivation of the Weights and Shadow Wage Rates[77/]

5.3.1 The weights to be assigned to the objectives of output growth and employment in the project choice criterion function $\max_i W_1 \beta_i + W_2 e_i$ suggested in para 2.8 earlier, may be formally derived in terms of certain macro-relations. Let the production possibilities open to economy be given by

$$F(X_1, L_1, K_1; X_2, L_2, K_2; \ldots; X_t, L_t, K_t; \ldots) = 0 \quad \ldots(5.19)$$

where X_t, L_t and K_t denotes, respectively, output, employment and capital in period t. F is assumed to be continuous and differentiable. Since all that is not consumed is thought of as investment, the time path of capital is given by the relation

$$K_{t+1} - K_t = X_t - (1 - \varepsilon_t) \Psi_t L_t \quad \ldots \quad (5.20)$$

where Ψ_t is the wage rate in period t and ε_t is the savings propensity of the wage earners.

77/ A similar mathematical derivation of criterion function and shadow wage rate under the objective of aggregate consumption is given in Little and Mirrles [(1969) Appendix].

Let the social welfare function of the society depend on X_t and L_t and be given by

$$V = \sum_t U_t$$

$$= \sum_t U(X_t, L_t) \qquad \ldots (5.21)$$

Clearly, the economy in order to be able to maximize social welfare, will choose the levels of employment as would maximize $(V - p.F)$ where p is the undermined lagrange multiplier. The first order condition of optimality requires

$$U_{X_t}(1 - \varepsilon_t)\Psi_t + U_{L_t} = p \quad F_{X_t}(1 - \varepsilon_t)\Psi_t + F_{L_t} \qquad \ldots (5.22)$$

where U_{X_t} is the partial derivative of U with respect to X_t; U_{L_t}, F_{X_t} and F_{L_t} are similar partial derivatives. It is possible to suggest the following interpretations : $p.F_{X_t}$ is the shadow price of output in period t discounted to the present (or, the marginal utility of output in period t) and $p.F_{L_t}$ is the shadow price of labour in period t discounted to the present (or, the marginal utility of labour employed in period t). Evidently, if a Rupee of investment in a project generates x_t units of output and e_t units of employment in period t, the social value (or, the discounted social profit) of the project would be given by

$$\sum_t p.F_{X_t} \cdot x_t + \sum_t p.F_{L_t} e_t \qquad \ldots (5.23)$$

or, $$x \sum_t p.F_{X_t} + e \sum_t p.F_{L_t} \qquad \ldots (5.24)$$

if, $x_t = x$ for all t and $e_t = e$ for all t.

Now, if (5.17) holds good and, if it is assumed, for simplicity, that $\varepsilon_t = \varepsilon$ for all t and $\Psi_t = \Psi$ for all t, relation (5.19) reduces to

$$x \sum_t p.F_{X_t} + e \sum_t (U_{X_t} - p.F_{X_t}) (1-\varepsilon) \Psi + e \sum_t U_{L_t}$$

or, $$\sum_t p.F_{X_t} \left[x - (1-\varepsilon) \Psi e \right] + \sum_t \left[U_{X_t} (1-\varepsilon) \Psi + U_{L_t} \right] e \quad \ldots (5.25)$$

Clearly, if

$$p.F_{X_t} = W_1 \quad \text{and} \quad U_{X_t} (1-\varepsilon) \Psi + U_{L_t} = W_2 \quad \ldots (5.26)$$

(5.23) or (5.25) reduces to $W_1 \beta + W_2 e$. Thus, social value of the i-th project is given by $W_1 \beta_i + W_2 e_i$. This, evidently, corresponds to the criterion $\underset{i}{\text{maximize}}\ W_1 \beta_i + W_2 e_i$ suggested earlier (para 5.2.4).

5.3.2 The shadow wage rate (Ψ') may also be derived on the basis of above analysis. Ψ' is the wage rate at which the surplus generation rate should be equal to (5.25) ; i.e., (5.25) should be equal to

$$\sum_t p.F_{X_t} \left\{ x - (1-\varepsilon) \Psi' e \right\} \quad \ldots (5.27)$$

If follows, $$\Psi' = \Psi - \frac{\sum \left\{ U_{X_t} (1-\varepsilon) \Psi + U_{L_t} \right\}}{\sum p.F_{X_t}} \cdot \frac{1}{(1-\varepsilon)} \quad \ldots (5.28)$$

or, $$\Psi' = \Psi - \frac{W_2}{W_1} \cdot \frac{1}{(1-\varepsilon)} \quad \ldots (5.29)$$

which corresponds to the formula for shadow wage rate given by (5.9) in para 5.2.7 above. Again, shadow wage rate $\overline{\Psi}$ is defined as the wage

rate at which (5.25) should be equal to

$$\sum_t p.F_{X_t} \left\{ x - \bar{\Psi} e \right\} \qquad \ldots (5.30)$$

It follows that

$$\bar{\Psi} = \Psi(1 - \varepsilon) - \frac{W_2}{W_1} \qquad \ldots$$

which corresponds to the shadow wage rate formula given by (5.10) in para 5.2.7.

5.4 Linkages and Externalities

5.4.1 In the models developed in Chapter IV and the criteria evolved in the previous sections of this Chapter, the role of linkages and externalities has not been explicitly taken account of. Linkages associated with investment projects may be defined as the effect which the undertaking of one or a group of investment projects is expected to produce by throwing incentives/disincentives for the expansion/decline in the level of activity elsewhere in the economy. As noted earlier in section 2.6 of Chapter II and para 4.4.7 of Chapter IV, the existence of such linkages and external effects may considerably influence the ranking and selection of investment projects. The setting up of a number of cold storage plants in a potato growing region may induce farmers to invest more in the cultivation of potato relative to competing crops. Thus, cold storage units may produce positive backward linkage effects on potato growing activity and negative linkage or external effect on cultivation of other crops. Thus, along with generation of re-investible surplus and employment in cold storage plants,

there is likely to be an increase in employment and surplus generation in potato growing and a decline in employment and surplus generation in the cultivation of other crops. An example of positive forward linkage effect would be the increase in the number of automobile servicing shops induced by the introduction of a large fleet of minibuses on the roads of a town or the growth of petro-chemical units resulting from the setting up of an oil refinery in an area. Once these linkage effects are taken into consideration, the total contribution of a project may turn out to be higher (or lower) than the direct contribution of the project towards the macro-objectives of output growth and employment growth.

5.4.2 The direct contribution to the output growth objective of project A may be higher than that of project B i.e. $\beta_A > \beta_B$. But project A may throw off incentives for the setting up of projects associated with values of which are lower than the values of β associated with the projects induced by the undertaking of project B. Thus, the total contribution of project A is expected to be lower than project B towards the output growth objective. Similarly, with substantial linkage effects, it may be misleading to rank projects on the basis of their direct contribution towards employment growth objective. The direct employment generation by a project comprises (i) the employment involved in the construction of a project and (ii) employment necessiated on account of operation and maintenance of the project. The total employment contribution of a project should include both the direct employment generation and the probable increase/decrease in employment in linked sectors/projects in the economy, which are induced by

the project under consideration. The total employment impact of a hydro-electric project may be considerably higher than what it directly involves in construction, operation and maintenance; in fact, operation and maintenance may require relatively small labour input. The increase in employment in industries supplying necessary equipments and raw materials for construction of the hydro-electric project may be substantially greater. Besides, with the increase in the availability of power from the hydro-electric project, large number of labour-intensive industries may come to be established in the hinterland. Similarly, a fertiliser project which require relatively low manpower for its operation, may generate large-scale employment in agricultural occupation and distribution of fertilizers in the countryside. Again, the introduction of tractors in agriculture in an area will lead to some displacement of labour in ploughing and harvesting activities, but, depending on the scale, technique and organization of production in agriculture in the area, may help generate considerable employment in non-farm activities like diary, poultry farming etc., and in custom-service occupations. Once the linkage effects are taken into account, even if the direct employment contribution of project A may be higher than that of project B, project B may be preferred because of substantially greater indirect employment generation in sectors linked to project B. Often economists have suggested the use of 'employment multiplier' for ranking projects from the point of view of the macro-objective of employment [Peacock and Shaw (1971)]. The 'employment multiplier' has been defined as the sum total of direct and indirect employment generated in the economy

as a result of the undertaking of investment project A divided by the investment outlay involved in project A.

5.4.3 The linkage effects, however, cannot be so easily incorporated in the investment project choice criterion as the concept of 'employment multiplier' tendsto suggest. In the first place, it is not always possible to estimate precisely the probable (indirect) employment generation in linked sectors. Secondly, there may be considerable uncertainty as to whether the incentives to increase (or, disincentive to decrease) employment and output elsewhere in the economy, which are thrown off by a particular project, will actually be fully realized, if at all. For example, the undertaking of a fertilizer plant may not lead to large employment generation in agricultural occupations and fertilizer distribution because of the inability of the farmers to take to high-yielding variety crops for want of adequate electricity/diesel supply for running irrigation pumps. Thirdly, it may be difficult to isolate the linkage effects induced by one project from those induced by another project. For example, if two projects — a fertilizer project and a hydro-electric project — are undertaken simultaneously and this leads to an increase in employment and surplus generation in agriculture the following problem arises : What part of the increases in employment and surplus generation in agriculture should be ascribed to the fertilizer project and what part to the hydro-electric project? Finally, when there exists a chain linkage relationship among projects if may be difficult to attribute the increased activity in one project as the linkage effect of another project. For example, an electricity project may induce

an increase in farm investments on tractors and pump-sets, which, in turn, may induce investments in custom-service shops and investments in projects turning out tractors and pump-sets. The problem would be to determine how far one should go; should one include the effects on custom-service shops and farm machinery manufacturing projects in a social cost benefit analysis of the electricity project? It may be noted, however, that it may not be always difficult to get around problems of this sort in real situations. Ideally, the chain of linkage effects ends at the point at which the output manufactured is meant for final consumption. In practical application of SCBA, however, a long drawn chain of linkages would be difficult to handle. It would be advisable to take into account the substantially strong chain linkages; after a few steps in the chain, linkages are likely to be less significant and may be partially dependent on linkages of some other projects.

5.4.4 The problems referred to above notwithstanding, it any be necessary to take into account, as far as practicable, the potential changes in employment and surplus generation elsewhere in the economy while undertaking a social cost benefit analysis of a project. In particular, this would help maximize the total contribution towards the macro-objectives of output and employment growth, of groups of projects selected. One method of taking linkage effects into account would be to treat substantially inter-linked projects as single combined projects. These combined projects may then be ranked in terms of the criterion

$$\underset{j}{\text{maximize}} \quad Z_j = W_1 \bar{r}_j + W_2 e_j \qquad \cdots (5.32)$$

where j stands for the j-th combined project. For example, let the cost and

benefit of the projects be as follows :

b_{it} : profit (including depreciation) on capital investment of project i in period t;

o_{it} : savings of wage earners of project i in period t;

l_{it} : employment generated in project i in period t; and

K_{it} : capital investment in project i in period t.

Let t refer to calender time period. Also, $K_{it} = 0$ for all t except for that calendar time period when project i is implemented. In other words, it is assumed that the investment projects are characterized by one-shot capital investment. Also, the possibility of different projects being undertaken in different calendar time period is allowed.

Now, let projects i = 1, 2, ..., m be a set of substantially inter-linked projects and be referred to as the combined project A. Similarly, the set of substantially inter-linked projects i = m+1, ..., n be referred to as the combined project B. The costs and benefits of projects A and B will clearly be as follows :

$$b_{At} = \sum_{i=1}^{m} (b_{it} + o_{it}) \quad \text{and} \quad b_{Bt} = \sum_{i=m+1}^{n} (b_{it} + o_{it}) \quad \cdots \quad (5.33)$$

(clearly, b_{At} and b_{Bt} represent value added less consumption)

$$l_{At} = \sum_{i=1}^{m} l_{it} \quad \text{and} \quad l_{Bt} = \sum_{i=m+1}^{n} l_{it} \quad \cdots \quad (5.34)$$

$$K_{At} = \sum_{i=1}^{m} K_{it} \quad \text{and} \quad K_{Bt} = \sum_{i=m+1}^{n} K_{it} \quad \cdots \quad (5.35)$$

The time stream of capital outlays may be reduced to a single outlay in the current period by means of discounting as follows :

$$K_A = \sum_{t=1}^{T_A} K_{At} (1+i^*)^{-t} \quad \text{and} \quad K_B = \sum_{t=1}^{T_A} K_{Bt} (1+i^*)^{-t} \quad \ldots \quad (5.36)$$

where T_A and T_B are the span of life of projects A and B, respectively, and i^* is the rate of return on re-investment. The true rate of return (TROR) for surplus generated over time by the combined projects A and B will be given by $\bar{r}_A$ and $\bar{r}_B$ where

$$K_A = \sum_{t=1}^{T_A} (b_{At} - \bar{r}_A \cdot K_A) (1 + i)^{T_A - t}$$

and

$$K_B = \sum_{t=1}^{T_B} (b_{Bt} - \bar{r}_B \cdot K_B) (1 + i)^{T_B - t} \quad \ldots \quad (5.37)$$

Given a rate of discount which helps compare the employment generated in any period to the employment generated in any other period, it is possible to find constant employment streams which are equivalent to employment streams $e_{At} : e_{A1}, e_{A2}, \ldots\ldots, e_{AT_A}$ and $e_{Bt} : e_{B1}, e_{B2}, \ldots, e_{BT_B}$ where e_{At} denotes employment per unit of initial investment K_A, generated in period t. Let the equivalent streams be, respectively, $e_A : e_A, e_A, \ldots, e_A$ and $e_{Bt} : e_B, e_B \ldots\ldots, e_B$. Now, the combined projects A and B may be compared; project A is preferrable to project B if

$$Z_A = W_1 \cdot \bar{r}_A + W_2 e_A > W_1 \cdot \bar{r}_B + W_2 e_B = Z_B \quad \ldots \quad (5.38)$$

5.4.5 In the preceding para discussion of interdependence among projects have been restricted to new investment projects which are inter-linked. As noted earlier, a new project may also produce substantial external effects on the existing projects in operation or construction in the economy [Ref. Sec. 2.7 of Chapter II]. The undertaking of a new project may increase/decrease surplus generation in the existing projects; this external effect will primarily operate though (a) a rise/fall in the capacity utilization as a result of increased demand/supply of outputs of or increased supply/demand of inputs of the existing projects consequent upon undertaking of the new project (if there is capacity expansion in the existing projects, this may be considered a linked new project and may be taken account of in SCBA though the method suggested in para 5.4.4); (b) higher/lower sales revenue due to rise/fall in prices of outputs of the existing projects as a result of increased demand/supply consequent upon the undertaking of the project; and (c) higher/lower costs of production of the existing projects due to rise/fall in prices of their inputs as a result of increased demand/supply of these inputs consequent upon the undertaking of the project. The external employment effects may also be brought about [by] similar changes. Once these sources of external effects are identified, it would not be difficult to estimate, even on an approximate basis, the net effect on surplus generation and employment in the existing projects. Let the net effect of increase and decrease in surplus generation in different existing projects due to the undertaking of a new

project A be given S'_A and the net effect of increase and decrease in employment generation in different existing projects due to the undertaking of project A be given by E'_A. If β_A and e_A be the direct contribution of project A towards output growth and employment growth, the weighted sum of total contribution (direct plus indirect) of project A to these two macro-objectives would be measured by

$$Z_A = W_1 (\beta_A + \beta'_A) + W_2 (e_A + e'_A) \quad \text{where}$$

$$\beta'_A = \frac{S'_A}{K_A}, \quad e'_A = \frac{E'_A}{K_A}$$

and K_A is the initial capital investment in project A. Also, project A will be preferred to project B if

$$Z'_A > Z'_B \quad \text{i.e., if}$$

$$W_1(\beta_A+\beta'_B) + W_2(e_A+e'_A) > W_1(\beta_B+\beta'_B) + W_2(e_B+e'_B) \quad \ldots (5.39)$$

5.4.6 A new project may lead to capacity expansion in an existing project. As noted earlier, it is possible to treat this capacity expansion as a new project and use the method indicated in para 5.4.4 for SCBA. But it is also possible to use the method indicated in para 5.4.5 in this case. For this it would be necessary that in calculating S'_A the investment outlay on capacity expansion is treated as a decline in surplus generation elsewhere in the economy; the increase in surplus generation and employment as a result of capacity expansion in the existing project will also affect the estimates of S'_A and E'_A in the same manner as the external

effects arising out of (a), (b) and (c) referred to in para 5.4.5, will do.

5.4.7 It is possible that of the two projects which are compared in SCBA, the linkage effects of one project is restricted to incentives for investments in new projects, while those of the second project may be restricted to output expansion or sales expansion or cost reduction in existing projects. Since for the second project little or no capital investment would be required to realize the linkage effects, choice under the criterion function suggested in paras 5.4.4 and 5.4.5 will tend to prefer the second project to the first.

Chapter VI

A PLAUSIBLE AREA OF APPLICATION

6.1 Bank Lending and Employment Generation

6.1.1 Project appraisal in India so far has been guided, implicitly or explicitly by one or more of the following macro-objectives : (i) maximization of national income growth, (ii) maximization of aggregate consumption, (iii) static efficiency in resource allocation and (iv) foreign exchange conservation. There are also instances where employment potential of projects has been evaluated; but in ranking and choice of projects, employment has seldom been treated as an independent national objective. It is felt that since employment growth has been increasingly establishing itself as a national objective (as is evident from the increasing emphasis laid on special employment programmes under Indian Five Year Plans, incentives offered for the growth of labour-intensive small-scale units and so on), ranking and choice of projects in the country should be based on criteria which explicitly take account of the contribution of projects towards the employment objective. The application of the criteria of weighted sum of contributions of projects towards the objectives of output and employment growth suggested in Chapter V [criterion implied by (5.3) and (5.31) or (5.5) and (5.51)] is expected to help reorient project appraisal exercises in the light of the need for eradicating widespread and growing unemployment in the country.

6.1.2 Generation of employment is a part of the process of growth of the national economy and basically dependent on the nature of projects undertaken. Inasmuch as financial intermediaries like commercial banks play a crucial role in the process of economic growth by mobilizing the savings of the people and canalizing these resources towards productive investment projects, appropriate reorientation of their appraisal procedures for judging the creditworthiness of projects can go a longway in stimulating employment in the country. The Committee to Review the Special Credit Schemes of Banks with particular reference to their employment potential observed that the different special credit schemes of banks were formulated without specific consideration of employment generation. It has been suggested that while considering financial assistance, banks should give due weightage to the aspect of employment generation. This will be helpful in a country where capital is scarce and manpower resources are abundant [Reserve Bank of India (1971)]. The Committee also recommended a set of guidelines for the commercial banks so that they could effectively increase their involvement in employment generation. However, neither the Committee nor the Reserve Bank of India has so far suggested how the operational criterion for judging the creditworthiness of projects should be appropriately adjusted to take into account the aspect of employment generation explicitly. It is suggested that the criterion implied by (5.3) and (5.31) or (5.5) and (5.51) of Chapter V may be used by the banks for ranking of applications for term loans from different economic activities.

6.2 Usual Criterion

6.2.1 A generalized version of the appraisal procedure usually adopted by commercial banks in the country for examining the credit-worthiness of investment proposals for term loans is discussed in what follows. The proposals for term loans are subjected to the following tests : (i) whether the investment proposal is viable from the point of view of the prospective borrower; and (ii) whether the term loan applied for in the proposal is worthwhile from the point of view of the financing bank.

6.2.2 So far as the prospective borrower is concerned, the viability of the investment project (for which a term-loan from bank is sought) depend on the time-stream of benefits b_{it} (value added less wages and salaries per unit of initial investment in period t of the project's life). A project i is viable if the rate of return $\bar{\pi}_i$ per unit of initial investment is greater than zero, i.e., $\bar{\pi}_i > 0$ where

$$\left[\sum_{t=1}^{T} (b_{it} - \bar{\pi}_i)\ (1+\bar{\pi}_o)^{T-t}\right] K_i = (1+\bar{\pi}_o)^T K_i$$

i.e., $\bar{\pi}_i > 0$ where $\sum_{t=1}^{T} (b_{it} - \bar{\pi}_i)\ (1+\bar{\pi}_o)^{-t} = 1$ ... (6.1)

with $\bar{\pi}_o$ being the rate of interest charged by the bank and K_i the initial investment outlay in project i. Again, so far as the financing bank is concerned, the rate of return on the amount of loan must be positive, i.e.,

$$\bar{\pi}'_i > 0 \quad \text{where} \quad \sum_{t=1}^{N} (b_{it} - \bar{\pi}'_i)\ (1+\pi_o)^{-t} = \alpha \qquad \ldots (6.2)$$

with $\bar{\pi}_o$ being the rate of interest charged by the bank, N being the maximum allowable period for repayment of bank loan ($N \leq T$), and α being

the share of bank term loan L in the initial capital outlay ($\alpha K=L, 0<\alpha \leq 1$).

6.2.3 It may be noted, however, that a project that satisfies condition (6.1) may not satisfy condition (6.2) and hence may not be admissible for bank financing given a specified value of N. From (6.1)

$$\bar{\pi}_i = \frac{\sum_{t=1}^{T} b_{it} (1 + \bar{\pi}_o)^{T-t} - 1}{\sum_{t=1}^{T} (1 + \bar{\pi}_o)^{T-t}} \quad \ldots (6.3)$$

Similarly from (6.2)

$$\bar{\pi}'_i = \frac{\sum_{t=1}^{N} b_{it} (1 + \bar{\pi}_o)^{N-t} - \alpha}{\sum_{t=1}^{N} (1 + \bar{\pi}_o)^{N-t}} \quad \ldots (6.4)$$

Assuming $b_{it} = b_i > 0$ for all t for simplicity, it follows from (6.3) and (6.4),

$$\bar{\pi}_i - \bar{\pi}'_i = \frac{\alpha}{\sum_{t=1}^{N} (1 + \bar{\pi}_o)^{N-t}} - \frac{1}{\sum_{t=1}^{T} (1 + \bar{\pi}_o)^{T-t}} \quad \ldots (6.5)$$

It is easily seen that if N=T and $\alpha = 1$, $\bar{\pi}_i = \bar{\pi}'_i$. If $N \neq T$ and $\alpha < 1$, it is possible that $\bar{\pi}_i > 0$ although $\bar{\pi}'_i \leq 0$ and $\bar{\pi}'_i > 0$ although $\bar{\pi}_i \leq 0$. Since

$$\sum_{t=1}^{N} (1 + \bar{\pi}_o)^{N-t} < \sum_{t=1}^{T} (1 + \bar{\pi}_o)^{T-t} \quad \text{and} \quad \alpha < 1, \quad \bar{\pi}_i \gtrless \bar{\pi}'_i$$

according as

$$\alpha \gtrless \frac{\sum_{t=1}^{N} (1 + \bar{\pi}_o)^{N-t}}{\sum_{t=1}^{T} (1 + \bar{\pi}_o)^{T-t}} \quad \ldots (6.6)$$

6.2.4 If the banks do not finance those projects which fails to satisfy any one of the conditions (6.1) and (6.2), the possibility of rejecting a viable project arises. For, a viable project (i.e., a project satisfying the first condition) may be unable to satisfy the second condition (6.2) simply because the value of N specified by the bank is relatively low. It is possible in such a case to increase the value of N (subject to $N \leq T$) appropriately so that condition (6.2) may also be satisfied. The Committee on Bank's Special Credit Schemes pointed out that 'rigid and unrealistic repayment schedules result in defaults by borrower which ultimately disqualify him for continued assistance' [Reserve Bank (1971), p.12] and suggested that "the period over which the entire loan and interest accrued during the 'start-up' period is to be liquidated should be worked out on the basis of cash generation capacity of the business". It is thus suggested that the value of N for a project satisfying condition (6.1) be determined from a relation of the following type

$$\sum_{t=1}^{N} (b_{it} - \bar{\pi}_i^o) K_i (1 + \bar{\pi}_o)^{N-t} = L_i (1 + \bar{\pi}_o)^N \quad \ldots (6.7)$$

where $\bar{\pi}_i^o$ is exogenously fixed on the basis of the maximum share of the rate of return $\bar{\pi}_i$ [as determined by condition (6.1)] that the borrower may be allowed to retain with him until the loan amount L_i is fully liquidated, i.e. $\bar{\pi}_i > \bar{\pi}_i^o > 0$.[78] Inasmuch as for most small-scale labour-intensive projects which satisfy condition (6.1) rates of return ($\bar{\pi}_i$)

78/ Let a project satisfy condition (6.1). The minimum value of N which can make a project viable from the point of view of bank financing is given by $\bar{\pi}_i^o = 0$ in (6.7).

are relatively low, specification of an arbitrarily low value of N and application of condition (6.2) may imply $\bar{\pi}_i' < 0$ (i.e., denial of bank credit).

6.2.5 It is apparent that the generalized version of the existing criteria [conditions (6.1) and (6.2) or (6.7)] adopted by banks for judging the credit-worthiness of investment projects are essentially based on the generation of surplus from the projects and, thus, implicitly leads to ranking of such projects in terms of their contribution to the macro-objective of long-term output growth; the contribution of projects to the objective of employment is not taken account of in project appraisal for purposes of financing by banks*.

6.3 Employment Orientation

6.3.1 Since nationalization in July 1969, the public sector banks in India have been formulating and implementing various schemes primarily with a view to creating employment opportunities. The investment-employment ratio of these projects is generally low and initial investment outlays are relatively small. In particular, emphasis has been laid on financing self-employed persons. The Committee on Bank's Credit Schemes identified the following areas where there is considerable scope for employment potential including self-employment and where bank finance may be channelized [Reserve Bank (1971), p.8]; (i) agriculture, dairy, poultry farming and fishing, (ii) small-scale industries; (iii) household and cottage industries (iv) professional services (e.g., doctors, lawyers, engineers, architects,

---

* A short review of the more important section of the relevant literature on project appraisal criteria in Indian Banks on the basis of which the generalized version of the existing criteria [conditions (6.1) and (6.2) or (6.7)] has been developed is presented in Appendix to this Chapter.

interior decorators, designers, accountants, carpenters, blacksmiths, cobblers, plumbers, electrical repairers etc.; (v) small trade and small business, and (vi) transport services (taxi, auto-rickshaws, barges etc.). Many of the self-employed in the above categories would provide employment to other persons also (for example, a doctor appoints a compounder or a nurse). However, within the class of borrowers listed above, there is a need for selecting projects in terms of a criterion which takes into account their employment contribution explicitly. Inasmuch credit dispensation by the banks in the country has reached a stage where the portfolio of credit assistance to these self-employed borrowers is required to be handled on a more organized basis [Reserve Bank(1971)] the criterion implied by (5.3) and (5.31) or (5.5) and (5.1) in Chapter V may be adopted to impart the desired employment orientation to the banks appraisal procedure for judging the credit-worthiness of investment projects of these borrowers.

6.3.2 Let there be two projects A and B. Let $\bar{\pi}_A > 0$ and $\bar{\pi}_B > 0$, i.e., the projects are viable from the point of view of the borrower. Let N be determined in a manner that ensures $\bar{\pi}'_A > 0$ and $\bar{\pi}'_B > 0$, i.e., the projects are also credit-worthy from the point of view of the banks. Now, given the values of $\bar{\pi}_A$, $\bar{\pi}_B$ as also the values of x_{At}, x_{Bt}, ψ_{At}, ψ_{Bt}, e_{At}, e_{Bt}, ε and ε', the surplus generated by the projects in different periods of their life-span will given by

$$\beta_{it} = x_{it} - (1 - \varepsilon)\psi_{it} e_{it} - (1 - \varepsilon')\bar{\pi}_i \qquad \ldots\ (6.8)$$

$i = A, B$

where β_{it} is the surplus generated per unit of initial investment for project i in period t of its life-span (surplus include savings our of profits, depreciation and savings out of wages and salary);

θ_i is the life-span of project i (assuming $\theta_i = \theta$ for all projects);

x_{it} is the value added per unit of initial investment for project i in period t;

w_{it} is the wage rate per unit of labour employed in project i period t;

e_{it} is the labour employment per unit of initial investment for project i in period t;

$\bar{\pi}_i$ is the profit accruing to the self-employed entrepreneur of project i in each period of the project's life;

ε is the savings per unit of wage income in each period;

ε' is the savings by the entrepreneur from his profit income in each period;

Given the values of β_{it} and e_{it}, the contribution of projects towards the objectives of output and employment growth will be determined as follows. The contribution towards output growth will be given by the true rate of return for surplus generation $\bar{r}_i$ where

$$\sum_{t=1}^{\theta_i} (\beta_{it} - \bar{r}_i)(1 + i_o)^{\theta_i - t} = 1 \qquad \ldots \quad (6.9)$$

where i_o is the surplus rate of return on re-investments (this equation corresponds to equation (4A.12) of Chapter IV). The contribution towards employment growth would be given by $\bar{e}_i = \sum_{t=1}^{\theta_i} h_t \cdot e_{it}$. If there exists wise dominance, i.e., $\bar{r}_A > \bar{r}_B$ and $\bar{e}_A > \bar{e}_B$ (or $\bar{r}_B > \bar{r}_A$ and $\bar{e}_B > \bar{e}_A$), clearly project A will be preferred to project B (or project B will be preferred

to project A). Such pointwise dominance, however, is unlikely to hold in general. If the projects be such that $\bar{r}_A > \bar{r}_B$ but $\bar{e}_A < \bar{e}_B$, the criterion implied by (5.3) and (5.31) of Chapter V may be adopted to rank (i.e., to determine the priority of) the projects. In other words, project A will be preferred to project B or vice versa according as

$$W_1\bar{r}_A + W_2\bar{e}_A \gtrless W_1\bar{r}_B + W_2\bar{e}_B \qquad \ldots (6.10)$$

provided that $\bar{r}_A > 0, \quad \bar{r}_B > 0$ ... (6.101)

where W_1 is the weight on the objective of output growth and W_2 is the weight on the objective of employment growth. Condition (6.101) is the viability restriction referred to para 5.2.4 of Chapter V; if $\bar{r}_i < 0$, project i cannot recoup its initial investment outlay and hence is not acceptable.

6.3.3 If $\beta_{it} = \beta_i$, $x_{it} = x_i$, $\gamma_{it} = \gamma_i$, $e_{it} = e_i$, the criterion implied by (5.5) and (5.51) may be adopted for purposes of ranking investment projects. As discussed in para 5.2.4 of Chapter V, in this situation, the contribution of project i towards the employment objective may be measured by e_i and the contribution towards output growth may be measured by β_i. The bank should prefer project A or B according as

$$W_1 \beta_A + W_2 e_A \gtrless W_1 \beta_B + W_2 e_B \qquad \ldots (6.11)$$

provided that

$$\beta_A \theta_A \geq 1 \quad \text{and} \quad \beta_B \theta_B \geq 1 \qquad \ldots (6.111)$$

In other words, the criterion would be

$$\text{maximize } W_1 \beta_i + W_2 e_i \text{ subject to } \beta_i \theta_i \geq 1 \qquad \ldots (6.12)$$

6.3.4 While criterion (6.12) may be used for appraisal of investment projects (for which term-loans for capital investments are required) irrespective of the sector under which such projects fall, its application for evaluating term-loan proposals are particularly important for the xxxx proposals emanating from self-employed and other borrowers of different categories listed in para 6.3.1. In the first place, finance to these borrowers are encouraged by the Government primarily with a view to expanding employment opportunities. The ranking of projects and schemes according to criterion (6.12) and channelizing increasing proportion of total priority sector advances to projects and schemes to such of the priority sectors as have higher ranking would imply greater satisfaction of the macro-objectives of output growth and employment growth. Secondly, since banks are required to maintain a statutory minimum degree of liquidity and a desirable mix of short-term loans and term loans for capital investments, and show reasonably high profitability, it is unlikely that in the allocation of incremental loanable funds to low-yielding priority sectors (interest rates on advances to the categories of borrowers in the priority sectors have been set at lower levels by the Government compared to the interest rate on other advances) will continue to enjoy increasing share in future. In other words, a limitation on loanable funds to low-yielding priority sectors is likely to appear and the banks are unlikely to be able to meet the entire credit requirements of as many number of term loan proposals emanating from priority sectors as they like. Therefore,

to ensure maximum employment effect from their allocation of funds to the priority sectors they might be required to be selective in choosing among various proposals from these sectors.

6.3.5 It may be noted that banks do not get hold of all term loan proposals at a single point of time for purposes of processing, appraisal and granting of credit line. Flow of proposals and financing is a continuous affair. It is, thus, difficult to conceive of banks applying the criterion (6.12) for purposes of ranking all investment projects (requiring term loans) proposed for a given year and then select the projects for financing in descending order of rank till loanable funds are exhausted. Nevertheless, banks may collect and maintain data on β_i, e_i, θ_i and $W_1 \beta_i + W_2 e_i$ for every project it financed and worked out, at periodic intervals, the average values of β, e, θ and $W_1 \beta + W_2 e$ for each sector, industry, scheme or activity under which the projects financed fall (while working out the averages, appropriate corrections for inter-temporal changes in economic environment, prices and production structure etc., that might have taken place in the national economy should be made). Subsequent allocation of loanable funds of the banks (quantum of new term loans) among various sectors/industries/schemes/activities is to be made in order of the ranking they get in terms of the average value of $W_1 \beta_i + W_2 e_i$. This would help the banks to contribute more effectively towards the process of employment generation in the country.

6.4 Simplified Illustrations

6.4.1 In this section two simplified illustrations of the application of the criterion (6.12) are presented. One major simplification made in these illustrations is the use of market prices as indicators of social benefits and social costs of outputs and inputs. For one thing, for the purpose of illustration of the criterion without any loss of generality, the market prices may be assumed to be equal to shadow prices which reflect the real scarcities of output and inputs from the point of view of the society. Secondly, since the banks are expected to finance an increasingly large number of small investment projects which are similar to those illustrated, the use of shadow prices would be practicable and meaningful if there exists a central office of project evaluation which works out and dictates the shadow prices of the inputs; the estimates of shadow prices are likely to differ from bank to bank as well as from project evaluator to evaluator within the same bank if individual banks are allowed to work out the shadow prices independently on their own. Thirdly, so long as the banks' performance are judged in terms of profits at market prices, the shadow prices cannot be used. For, if such prices are used the banks may have to finance some projects which are unprofitable at market price. Finally, the use of market prices does not mean that the projects selected under the criterion (6.12) would not imply an improvement. This is because criterion (6.12) ensures that those projects which make higher contribution towards employment objective would be chosen even if market prices are used. Thus, even at market prices, the use of criterion (6.12) will help ensure that the projects which are socially

more desirable (by taking into account the aspect of employment generation explicitly) than the projects which would have been chosen exclusively on the basis of the criteria implied by (6.1) and (6.7) $\left[\bar{\pi}_i > 0, \quad \bar{\pi}_i' > 0,\right.$ and N chosen appropriately$\left.\right]$. For the same reasons even if the banks choose those projects which satisfy criterion (6.12) as well as the usual criterion implied (6.1) and (6.7), this will constitute an improvement from the society's point of view compared to the situation when banks chose projects exclusively on the basis of usual criteria implied by (6.1) and (6.7). However, if the usual criteria were not used and projects were chosen exclusively on the basis of the criterion (6.12), this would have been still better. Similarly, the use of shadow prices which reflect the real scarcities of output and inputs would have led to further improvements.

Small Job Printing Projects

6.4.2 Often self-employed entrepreneurs are found to apply for bank loans for projects turning out the same or similar products/services but which have different surplus generation and employment implications because of differences in machinery and equipment as well as raw materials used, organization, etc. Job printing is one of the activities from which such proposals for financing emanate. The following two printing press projects may be considered[79].

79/ The projects were formulated in 1972-73 at the prevailing market prices and demand-supply conditions in Calcutta by two self-employed prospective bank loanees which were found to be technically feasible by officers of a bank.

Table 1 : Data Relating to Job Printing Projects

(Amounts in Rs.'000)

	Project A	Project B
1. Capital Investment	20.0	30.0
of which		
(a) Plant & Machinery etc.[80]	16.0	24.0
(b) Working Capital	4.0	6.0
2. Cost of Production (annual)	52.0	67.0
of which		
(a) Raw Materials	36.5	46.8
(b) Wages (including salary of entrepreneur)	9.6	13.2
(c) Rent	1.0	1.9
(d) Depreciation Provision	2.4	3.6
(e) Others	2.5	3.5
3. Estimated Value of Sales (annual)	54.0	70.9
4. Estimated Net Profit (annual)	2.0	3.3
5. Employment Generated (mandays per year)	1,500	2,100
6. Surplus Generated (annual)	4.4	6.9
[4 plus 2(d); no savings from wage income is assumed, but entire profit income is assumed to be saved.]		
7. Operating Life Period	θ_A = 8 years	θ_B = 10 years

The rate of surplus generation (β) works out to $\beta_A = 0.22$ and $\beta_B = 0.23$; the employment generation coefficients (manhours per Rupee of capital investment) $e_A = 0.075$ and $e_B = 0.07$. Clearly, if output growth is the only macro-objective of the society, project B is to preferred to Project A. But,

80/ The difference in capital cost of plant and machinery is due to differences in make/type.

from the point of view of the employment objective project A is to be preferred to project B. From the point of view of the Bank project B will be preferrable because this offers quicker repayment possibilities compared to project A. Evidently, in this case, the usual appraisal criterion of bank financing would be consistent with a relatively high weightage on the income growth objective compared to the employment growth objective.

6.4.3 The results of applying the criterion (6.12) which takes into account the relative weightage of output growth and employment growth objectives may now be examined. It is easily seen that both the projects satisfy the viability restriction : $\beta_A \theta_A > 1$ and $\beta_B \theta_B > 1$. If now it is assumed that the employment objective has a weight $W_2 = 0.7$ and output growth objective $W_1 = 0.3$, under the criterion (6.12) project A is preferable to project B because $Z_A = W_1 \beta_A + W_2 e_A = 0.119$ and $Z_B = W_1 \beta_B + W_2 e_B = 0.118$ (i.e., $Z_A > Z_B$). Thus, with the introduction of criterion (6.12) financing of projects by banks will help contribute more effectively towards meeting the need for employment generation in the country. It may be argued that if project B were chosen, employment would be higher in absolute terms without any loss in surplus generation rate. But banks do not generally finance one single project of job printing and given that a limited amount of funds could be channelized to job printing projects during a given period of time, the larger the number of job printing projects similar to project A are chosen compared to those similar to project B, the higher will be the absolute level of employment generated in the economy.

6.4.4 The ranking of the projects under the criterion of weighted sum of contributions given by (6.12) obviously depends on the values of relative weight attached to the objectives as is indicated by the value of Z_i (i = A, B) in the Table below :

Table 2 : Value of $Z_i = W_1 \beta_i + W_2 e_i$ for Job Printing Projects

Project (i)	W_1 = 0.00	0.20	0.30	0.333	0.40	0.50	0.80	1.00
	W_2 = 1.00	0.80	0.70	0.666	0.60	0.50	0.20	0.00
A		0.075	0.114	0.119	0.120	0.133	0.148	0.191	0.220
B		0.070	0.106	0.118	0.120	0.134	0.150	0.214	0.230

It is apparent from Table 2 above, that project B is preferrable to project A for all weight distributions satisfying $W_1 > \frac{1}{3}$, $W_2 < \frac{2}{3}$, $W_1 + W_2 = 1$. But A is preferred to B for weight distributions satisfying $W_2 > \frac{2}{3}$, $W_1 < \frac{1}{3}$, $W_1 + W_2 = 1$. Thus, there is a preference switching weight distribution given by $W_1 = \frac{1}{3}$, $W_2 = \frac{2}{3}$ and $W_1 + W_2 = 1$ at which both the projects are equally good and have the same ranking. The preference switching weight distribution (W_1^*, W_2^*) is determined from the following relations :

$$W_1^* \beta_A + W_2^* e_A = W_1^* \beta_B + W_2^* e_B \quad \text{and} \quad W_1^* + W_2^* = 1$$

i.e., from the relation

$$\frac{\beta_A - \beta_B}{e_B - e_A} = \frac{1 - W_1^*}{W_1^*} \quad \text{and} \quad W_2^* = 1 - W_1^*$$

The higher is the preference reswitching value of W_1^*, the higher the importance of employment contribution of the projects. In other words, if

the society attaches even a small weight on employment objective, the project (i) with higher e_i but lower β_i compared to project j will be preferred if the preference switching (switching between projects i and j) value of W_1^* is relatively high (i.e., W_2^* is relatively low). The information on the value of W_1^* and W_2^* is particularly useful when the exact values of the weights W_1 and W_2 are not known. The higher the value of W_1^* (or W_2^*) the greater is the likelihood that the choice of the project that makes higher contribution towards the objective of employment (output growth) would be optimal from the point of view of the society.

Farm Mechanization Projects

6.4.5 Since nationalization in 1969, major commercial banks in India have been found to formulate and implement credit schemes for increasing production and productivity in agricultural crops and raising the income of the agriculturists. Along with short-term crop loans for inputs, terms loans are extended to the farmers to enable them to shift to higher technological levels through purchase and installation of farm equipments such as pump sets and tube-wells for irrigation and tractors/power tillers to quicken farm operations. It would be interesting to study the implications of agricultural financing projects of banks on output growth and employment growth objectives of the society. For this purpose a hypothetical project for bank financing is drawn upon the bais of the current practices of the banks in India[81]. Consider the prospects of agricultural development of a

81/ The productivity, cost and price data used in the building up of hypothetical project are primarily based on the estimates given in Dutt (1972) and United Bank of India (1972, 1973).

rural area in the State of West Bengal. The area is cultivated only under rainfed conditions and there being no assured supply of irrigation water, the area is mono-cropped, the crop raised being paddy. The financing bank has selected 740 small farmers each having more or less one acre of landholdings. The individual holdings are fragmented and scattered. The existing cropping pattern, value of output, cost of production, net income and employment relating to the farming operations of these 740 farmers are given in Table 3 below.

Table 3 : Non-mechanized Mono-cropping Situation

1. Crop cultivated	Paddy (Kharif)
2. Area sown (in acres)	800 acres
3. Crop yield per acre (in mds.)	20
4. By-product per acre (in mds.)	30 (straw)
5. Value of output per acre (Rs.)	575
6. Cost of production per acre (Rs.)	300
7. Net income per acre (Rs.)	275
8. Employment per acre (mandays)	70
9. Total net income (Rs.)	2,20,000
10. Total employment (mandays)	56,000

Total capital investment involved in cultivation under the existing situation is estimated at Rs.0.7 lakh representing primarily the present value of bullocks, ploughs and other small traditional implements.

6.4.6 Since the operational holdings of the farmers are scattered, fragmented and relatively small, the possibility of improvement on an individual basis is remote. It would be highly uneconomic for an individual farmer to

acquire and install pump sets and tube wells for irrigation and tractor for ploughing. The financing bank may, therefore, extend credit for the purchase of these farm equipments on a group or community basis. The farmers may be pursuaded to form an Agro Service Co-operative (ASC) which will procure these equipments with bank loan, install them and provide irrigation and tractor services to the farmers against payment of service charges. Repayment of bank loan would be made from the income of the ASC. From the point of view of agricultural mechanization two alternative projects (or stages) may be thought of -

Alternative I : ASC provides irrigation services only.

Alternative II : ACS provides both irrigation and tractor services.

The capital investment and manpower requirement of ASC under these two alternatives would be as given in Table 4 below.

Table 4 : Capital and Manpower Requirements of ASC

	Alternative I	Alternative II
CAPITAL INVESTMENT REQUIREMENT		
1. Cost of 100 tube-wells, pump-sets and pump-houses @ Rs. 8,000	Rs. 8,00,000	Rs. 8,00,000
2. Cost of 3 tractors with attachments @ Rs. 35,000	-	Rs. 1,05,000
3. Cost of 2 power tillers with attachments	-	Rs. 20,000
4. Cost of tractor garrage-cum-workshop	-	Rs. 15,000
Total	Rs. 8,00,000	Rs. 9,40,000
MANPOWER REQUIREMENT		
Mechanics, store-keeper-cum-accountant, nightguards, tube-well operators	60 nos: (18,000 mandays)	65 nos: (19,500 mandays)
Tractor-driver-cum-mechanic	-	3 nos: (900 mandays)
Total	60 nos: (18,000 mandays)	68 nos: (20,400 mandays)

It is assumed that under alternative II, the tractor and power tillers will supplement the existing capital stock in the form of bullocks and traditional ploughs; there will be no displacement of bullocks and ploughs as a result of the use of tractors and tillers. There will be increased demand for ploughing etc., with the raising of multiple crops in a year which will become possible with assured irrigation. The ASC will meet this increased demand under alternative II. Under alternative I, however, the farmers will be provided with loans by the bank on individual basis to purchase additional bullocks and ploughs. The capital investment on this account would be Rs.50,000 under alternative I. Thus, the additional capital investment involved under alternative I would be Rs.8.5 lakhs. Under alternative II, additional capital investment in cultivation would be Rs.9.4 lakhs.

6.4.7 The cropping pattern, cost of production, value of output, net income and employment under these two alternatives would be as given in Table 5 below.

Table 5 : Cropping pattern, value of output, cost of production, net income and employment under the alternatives

	Alternative I			Alternative II		
	Paddy	Jute	Wheat	Paddy	Jute	Wheat
1. Area sown	700	300	700	700	300	700
2. Value of fertilizer required per acre (Rs.)	175	125	175	175	125	175
3. Value of pesticides required per acre (Rs.)	65	50	45	65	50	45
4. Value seed required per acre (Rs.)	25	20	100	25	20	100
5. Labour cost per acre (Rs.)	315	490	280	250	385	210
6. Irrigation charges per acre (Rs)	225	225	170	225	225	170
7. Maintenance cost of bullocks etc. per acre (Rs.)	10	5	10	5	2	5
8. Tractor service charges per acre (Rs.)				60	63	70
9. Total cost of cultivation per acre (Rs.)	815	915	780	805	870	775
10. Value of output per acre (including by-product straw) (Rs)	1270	1170	1130	1270	1170	1130
11. Net income per acre	455	255	350	465	300	355
12. Employment per acre (mandays)	90	140	80	70	110	60

Thus total net income of the farmers under alternative I will be (Rs.455 x 700 + 255 x 300 + 350 x 700) = Rs.6.4 lakhs and that under alternative II will be (Rs. 465 x 700 + 300 x 300 + 355 x 700) = Rs.6.6 lakhs Assuming that with increase in income (from Rs.2.2 lakhs in the non-mechanized monocropping situation) the farmers' propensity to save out of increased income will be 0.05. The increase in savings by the farmers will be Rs.21,000 under alternative I and Rs.22,000 under alternative II. So far as employment is concerned, under alternative I total number of mandays employed will rise to (90 x 700 + 140 x 300 + 80 x 700) = 1.61 lakhs from 0.56 lakh under the existing non-mechanized mono-cropping situation, i.e., additional employment generation of 1.05 lakh mandays. Under alternative II, additional employment generation works out to (70x700 + 110x300 + 60 x 700) - 56,000 or 0.68 lakh mandays.

6.4.8 Apart from the above surplus generation (savings of farmers) and employment generation in cultivation, the ASC will also throw off some surplus generation and employment. It has already been noted that under alternative I and II, employment of 18,000 mandays and 20,400 mandays, respectively, will be created. So far as surplus generation from ASC is concerned, this may be worked out from the likely Income-Expenditure Statement of ASC as given in Table 6 below.

Table 6 : Anticipated income-expenditure statement of ASC

(Figures in Rs.)

Income/Expenditure/Surplus	Alternative I	Alternative II
INCOME	3,41,000	4,51,000
of which		
(i) Water charges	3,41,000	3,41,000
(ii) Tractor and power tiller services	-	1,10,000
EXPENDITURE	2,20,000	2,85,000
of which		
(i) Salary and wages	1,00,000	1,20,000
(ii) Electricity charges	1,00,000	1,00,000
(iii) Fuel and lubricants	-	35,000
(iv) Others including maintenance costs	20,000	30,000
SURPLUS (including depreciation)	1,21,000	1,66,000

6.4.9 The employment and output growth contributions of different alternative projects of bank-financed agricultural development may now be evaluated. Table 7 below sums up the relevant costs and benefits.

Table 7 : Bendfits and costs associated with alternative projects

	Alternative I	Alternative II
COSTS		
A. Increase in capital investment over the existing mono-cropped situation (Rs.'000)		
(i) By ASC	800	940
(ii) By the farmers	50	-
Total	850	940
B. Increase in working capital requirements over the existing mono-cropped situation (Rs.'000)		
(i) By ASC	20	25
(ii) By the farmers	400	400
Total	420	425
Total of (A +B)	1270	1365
BENEFITS		
A. Increase in Savings or Surplus generation over the existing mono-cropped situation (Rs.'000)		
(i) By ASC	121	165
(ii) By the farmers	21	22
Total	142	188
B. Increase in Employment over the existing mono-cropped situation ('000 mandays)		
(i) By ASC	18	20
(ii) On the farms	105	68
Total	123	88

From Table 7, the contribution of the alternatives to the objectives of output growth and employment growth works out of follows : $\beta_1 = 0.112$, $e_1 = 0.097$, $\beta_2 = 0.138$, $e_2 = 0.065$. Since $\beta_2 > \beta_1$, i.e., the rate of surplus generation is higher under alternative II compared to alternative I, alternative II makes a higher contribution towards the output growth objective[82]. But, since $e_2 < e_1$ alternative I is preferable to alternative II from the point of view of the objective of employment generation. The preference-switching weight distribution in this case works out to $W_1^* = 0.55$ and $W_2^* = 0.45$. Thus, if weightage on employment is greater than 0.45 (and that on output growth less than 0.55), alternative I is preferrable to alternative II. Although here weight distribution is characterized by $W_1 > W_2$ subject to $W_1 < 0.55$ (i.e., employment objective is assigned a weight smaller than the weight on output growth objective) the project with higher employment contribution is preferred to project with lower employment contribution. This is because tractorization leads to greater surplus generation only through savings in labour costs of production and, therefore, output remaining the same, causes substantial displacement of employment.

6.4.10. Clearly, if the banks are expected to contribute towards the eradication of unemployment in the countryside, it is necessary that the

---

82/ It may be checked that the alternatives satisfy the viability restriction $\beta_i \theta_i \geq 1$ in (6.12) assuming that the life of the capital equipments under each alternative is eight years. Since the working capital will remain in tact at the end of the life of the projects, for the purpose of viability restriction $\beta_i \theta_i \geq 1$, β_i is to be worked out as surplus generation per unit of investment in fixed capital only; for alternative I and II, this surplus generation rate works out to 0.167 and 0.200, respectively. Thus, fixed capital is recouped within six and five years, respectively. Working capital is by definition always recouped.

projects financed by them are suitably designed to achieve this objective. If the exercise above is any indicator, it seems appropriate that, under the cost, output, price and other conditions assumed, the banks should finance projects like alternative I if weight on output growth objective relative to that on employment objective (W_1/W_2) is not higher than 1.22 (i.e., $W_2/W_1 > 0.82$ approx.). This, however, is not to rule out the possibility of tractorization in the country. For one thing, with improvement in the employment situation in the country W_1/W_2 is expected to exceed 1.23, which would then signal the undertaking of projects like alternative II. Secondly, the cost and yield rate data may differ from area to area due to differences in soil conditions etc., so that the preference switching weight distribution works out $W_1^* = 0.45$ (say), in which case alternative II would be preferable to alternative I even with a relative weight (W_1/W_2) < 1. Thirdly, the indirect effects of tractorization leading to substantial increase in the level of non-farm activities such as poultry, dairying by the farmers may create considerable indirect employment opportunities.

Treatment of Linkages

6.4.11 In paras 5.4.1-5.4.7 of the previous Chapter (Chapter V) the problems with linkage effects have been discussed and two procedures of incorporating linkage effects into the project choice criterion function suggested. It is possible to adopt these procedures of treating linkage in the case of appraisal of term-loans extended by banks. In fact, banks

sometimes take account of linkages while sanctioning loans. For example, in an area richly endowed with national resources like lime-stone, term loans to set up one particular type of economic activity (say, line-stone quarrying) may be encouraged more and that to another type of economic activity (say, processing of agricultural crops) may not be encouraged by the banks because the former type of activity -- it being a growth-sector -- is expected to induce growth of a large number of linked sectors and lead to faster income generation in the area and may lead to larger demand for bank credit as well as a faster accretion of bank deposits in future. Again, assistance to a group of farmers with term loans for purchasing power-pumps, motors (for irrigation), tractors, trailors and the like may create a demand for technical services for maintenance and repairing of such agricultural implements and machinery in the locality. Thus, the bank will subsequently have to extend term loan for a agro-cum-custom service unit to cater to the needs of the farmers (in the absence of such services the repayment of term loans by the farmers might be adversely affected). In this case, the term loans provided for acquiring capital inputs like tube-wells, pump-sets and tractors, sprayers etc., by a large number of farmers in an area may be treated as a project (i) which induces the undertaking of the linked projects in the form of agro-cum-custom service centres (j). The attractiveness of the first project may, therefore, be evaluated in terms of the criterion (6.12) by combining the projects (i) and (ii) as has been done in paras 6.4.10. This is the procedure suggested in para 5.4.4 of Chapter V for applying the criterion (5.27).

6.4.12 In the case of relatively small term loan projects, however, linkage effects are small and difficult to estimate. For example, the linkage effect (on the demand for automobile servicing) of three different types of small transport projects e.g., financing a bus or a taxi or a minibus will be marginal and in such a case linkage effects may be ignored. But banks generally do not finance a single bus or a single taxi or a single minibus during a period in a locality. Generally quite a large number of buses, taxis and minibuses are financed during a given period of time. The indirect surplus generation and employment impact on automobile servicing will depend on the number of vehicles of various categories financed by the banks. It is possible to think of reducing the discomfort of passengers in a crowded city or town by introducing, say, any one of the following combination of additional vehicles : (i) 20 buses; (ii) 15 buses and 10 taxis; (iii) 50 taxis; (vi) 35 minibuses and so on. The income-growth and employment-growth contribution (taking into account the potential linkage effect on automobile servicing) of these combinations will be different. Each of these combinations may be regarded as a combined project and the procedure of taking into account of linkage effects suggested in para 5.4.5 in Chapter V may be applied. It would be desirable to choose that combination which maximize $Z' = W_1(\beta_i + \beta_{ij}) + W_2(e_i + e_{ij})$ where i refers to different combinations of vehicles of different categories and j refers to the automobile servicing industry; β_{ij} is the increase in surplus generation in automobile servicing per unit of investment in project i, e_{ij} is the increase in employment in automobile servicing per unit of investment in project i. This is the procedure of applying criterion (5.34) suggested in para 5.4.5 in Chapter V. The banks in consultation with the transport authority of the locality may work out the combination optimal in terms of the above criterion and finance term loans to the passenger-transport sector accordingly.

Appendix to Chapter VI.

LITERATURE ON EVALUATION CRITERIA FOR BANK-FINANCED PROJECTS

A generalized version of the appraisal methods usually adopted by commercial banks in India for examining the bankability of investment proposals for term-loans has been presented in section 6.2 of Chapter VI. This generalized version of banks' appraisal criteria is developed on the basis of both a close observation of the actual process of pre-sanction credit appraisal in Indian commercial banks as well as the relevant available literature. It must be noted, however, that the available literature consists primarily of guidelines and notes issued by the Reserve Bank of India and Ministry of Finance, Government of India, unpublished internal appraisal notes and occasionally published booklets of commercial banks and other financial institutions (such as the Agricultural Refinance and Development Corporation, Industrial Credit and Investment Corporation of India, etc.), and articles appearing in various journals such as the Reserve Bank of India Bulletin, Economic and Political Weekly, Yojana, Financing Agriculture, Indian Journal of Agricultural Economics, etc.

As regards the unpublished notes and booklets of financial institutions, the primary objectives of these are evaluation of impact of financing on groups of borrowers and highlighting the progress of financing under different credit schemes being implemented. The analyses are generally based on expost data on output, employment, income and standard of living before financing and two/three years after financing. The treatment and coverage of most of the articles in different journals are also similar in nature. Apart from indicating the change in output, employment, income and

standard of living in the post-financing period, attempts have also been made to work out the private internal rates of return, present value, and benefit-cost ratios of different projects financed. The appraisal of farm investments appears to have received much greater attention than appraisal of other types of investments financed by banks. Besides, discussions on essential methodological issues have been conspicously absent in a major portion of the relevant literature. Some methodological issues concerning the formulation of suitable criteria for appraisal of projects by Indian banks have been raised only in a limited number of articles. The discussions in these contributions are briefly reviewed in the remaining part of this Appendix in the light of the generalized version of the existing bank-credit appraisal criteria and the evaluation criteria suggested in Chapter VI of the present dissertation.

Two tests were suggested for evaluation of farm investments to be financed by banks in an article by Jakhade and Gadgil (1970). The primary consideration that influenced the design of the tests, according to the authors, was "to evolve (and demonstrate the application of) a method of benefit-cost analysis suited to the peculiar needs of banks". The tests, it was felt, would synthesize, to the extent possible, "the needs of good banking business with those of social welfare" [Jakhade and Gadgil (1971)]. The two tests suggested by them were : (a) Economic Feasibility Test and (b) Repayment Capacity Test. Economic feasibility requires that the increase in gross farm income due to bank financed investment must not be less than the annual capital charge on account of repayment of bank loan plus increase in operation and maintenance costs plus a provision for improvement in the levels of living of the borrowing household and for adverse weather conditions

unfavourable changes in
and/cost price relations over the life of the project. The Repayment Capacity test examines whether the borrower would be able to repay the loan. Although the Economic Feasibility Test, as formulated in Jakhade and Gadgil (1970) establishes the self-liquidating character of the bank loans, this in itself does not ensure the repayment of loans. Since most agricultural borrowers are at very low levels of standard of living and often have certain pre-existing debts to moneylenders (other than commercial banks), it is possible that the borrowers might divert a significant portion of the increased net income from the project towards meeting hitherto unsatisfied consumption needs and repayment obligations on pre-existing or new debts to the money-lenders. Unless the project generates sufficient additional net income, the repayment of bank loan may be affected because of such mismanagement on the part of the borrowers. The Repayment Capacity of a borrower is defined as the excess of his total household income over his total household consumption expenditure at pre-investment level plus the repayment obligations on pre-existing debt liabilities plus a provision for the probable increase in the two latter types of expenditure. A project is regarded as bankable if the repayment capacity worked out as above, is not less than the annual capital charge towards repayment of bank loan.

Jakhade and Gadgil demonstrated the application of these two tests with help of data on sampled farmers in five different districts where irrigation projects were financed by banks. The sampled farmers were from different groups, namely, (i) those without wells or pumpsets, (ii) those with wells but without pumpsets, (iii) those with both wells and pumpsets,

(iv) those with tractors and (v) those without tractors. The results were as follows :

investment by farmers in (1)	no. of districts satisfying test of Economic Feasibility (2)	Repayment Capacity (3)
(a) wells	2	1
(b) pumpsets	2	5
(c) both wells and pumpsets	3	4
(d) tractors	nil	nil

In a rejoinder to Jakhade and Gadgil (1970), Samuel Paul (1970) calculated internal rates of return of investments in wells, pumpsets and tractors. It was shown that all these investment proposals were economically feasible in all districts provided the interest rate on bank loans is 9 % or less. The differences in results were primarily due to differences in assumptions made by Jakhade and Gadgil (1970) and Paul (1970). Apart from using discounting technique instead of annutized values used by Jakhade and Gadgil (1970), Paul (1970) made the following changes in assumptions :

(a) period of loan allowable by banks extended from 5 years to 10 years,

(b) upward adjustment of net farm income to include income from sale of irrigation water and tractor-hours to other farmers (this was not included by Jakhade and Gadgil (1970) because of the uncertainties associated with such income),

(c) adjustments for cost savings due to use of tractors,

(d) replacement of safety provision for adverse weather (as done by Jakhade and Gadgil) by cyclical adjustment of the gross income profile.

So far as (b), (c) and (d) above are concerned, these may be regarded as improvements. But from a conceptual point of view, selection of the time period used for discounting purposes or for arriving at annutized capital charge for repayment of bank loans should not be made arbitrarily. For economic feasibility, it is the life of the project which is relevant and not the maximum allowable term for which banks extend loans. The latter is relevant for judging the bankability or creditworthiness of the project by the banks. Thus, in section 6.2 of Chapter VI of the present dissertation, two different tests have been proposed. Economic feasibility or viability is to be tested in terms of condition (6.1) given by

$$\bar{\pi}_i > 0 \quad \text{where} \quad \sum_{t=1}^{T} (b_{it} - \bar{\pi}_i)(1 + \bar{\pi}_o)^{-t} = 1 \qquad \ldots\ (6.1)$$

where $\bar{\pi}_o$ is the rate of interest charged by the bank,

b_{it} is the value added less wages and salaries per unit of initial investment outlay in project i,

and T is the life of the project.

The test of bankability of (the self-liquidating character of the bank loan for financing) project i would be made in terms of condition (6.2) which is given by

$$\bar{\pi}'_i > 0 \quad \text{where} \quad \sum_{t=1}^{N} (b_{it} - \bar{\pi}'_i)(1 + \bar{\pi}_o)^{-t} = \alpha \qquad \ldots\ (6.2)$$

where N is the maximum allowable period for repayment of bank loan ($N \leq T$) and α is the share of bank term loan in the initial investment outlay ($0 < \alpha \leq 1$).

It is also pointed out in section 6.2 of Chapter VI that there could be conflict between (6.1) and (6.2) in the sense that an economically viable project satisfying condition (6.1) may be denied bank credit because the repayment period fixed arbitrarily (N) is so low that condition (6.2) is not satisfied. In view of this it was suggested that the banks adopt condition (6.7) in place of condition (6.2). Condition (6.7) is given by

$$\sum_{t=1}^{N} (b_{it} - \bar{\pi}_i^o)(1 + \bar{\pi}_o)^{N-t} = \alpha(1 + \bar{\pi}_o)^N \qquad \ldots (6.7)$$

where $\bar{\pi}_i^o$ is exogenously given maximum share of the rate of return $\bar{\pi}_o$, which the borrower may be allowed to retain with him until the loan is repaid, and N is the variable (period of loan) which is to be determined from (6.7). It is to be noted that Jakhade and Gadgil's economic feasibility test and repayment capacity tests are more in the nature of conditions (6.2) and (6.7). Inasmuch as they had chosen N as the relevant period for determining economic feasibility, this is clearly faulty.

An important feature of the economic feasibility and repayment capacity test of Jakhade and Gadgil (1970) is the inclusion of a provision for increase in the standard of living. Such a provision can also be incorporated in conditions (6.1) or (6.2) referred to above. But this will make these conditions more restrictive in the sense that the rates of return worked out after such provision would be lower. Rather, condition (6.7) may be used with advantage to take care of the probable increase in the standard of living and pre-existing debt repayment obligations. The

value of $\bar{\pi}_i^o$ fixed exogenously may take into account the provision required to be made in respect of any of the above factors. In other words, $\bar{\pi}_i^o$ will include a provision for the minimum need-based increase in standard of living referred to in Jakhade and Gadgil (1970) as well as a provision for past debt repayment obligations and contigencies, etc.

The purpose of introducing a provision for increase in consumption expenditure is essentially for the following two reasons : (a) ensure that repayment of bank loan is not affected by diversion of funds to meet increased consumption expenditure and (b) ensure allocation of finance to projects which lead to rise in the standard of living of the people. It may be point out that the Repayment Capacity Test takes care of (a) and, therefore, need not be incorporated in the Economic Feasibility Test. The provision for such increased consumption expenditure, however, may be made in the Bankability Test implied by condition (6.2) or preferrably condition (6.7) as suggested in the preceeding paragraph.

The Repayment Capacity Test proposed by Jakhade and Gadgil may or may not be more severe than their Economic Feasibility Test (which may better be termed as Self-Liquidating Loan Test or Bankability Test for reasons explained earlier) depending on whether in the pre-investment period the borrowing household was making any positive net savings or not. This may be shown in terms of the notations explained below :

items	pre-investment situation			post-investment situation		
	project financed	other sources	total	project financed	other sources	total
(1)	(2)	(3)	(4)	(5)	(6)	(7)
gross value of output	G_o	-	G_o	G_1	-	G_1
all costs other than own labour	H_o	-	H_o	H_1	-	H_1
net income	$R_o = G_o - H_o$	N_o	$R_o + N_o = Y_o$	$G_1 - H_1 = R_1$	N_1	$R_1 + N_1 = Y_1$
household consumption expenditure	-	-	C_o	-	-	C_1
debt obligation	-	D_o	D_o	δ	D_1	$\delta + D_1$
total expenditure	-	-	$C_o + D_o = E_o$	-	-	$C_1 + D_1 + \delta = E_1$
net savings	-	-	$Y_o - E_o = Z_o$	-	-	$Y_1 - E_1 = Z_1$

Now, Self-Liquidating Loan Test requires

$$Y_1 - Y_o \geq \delta + (C_1 - C_o) + (D_1 - D_o)$$

or, $\Delta Y \geq \delta + \Delta C + \Delta D$.

Repayment Capacity Test requires

$$Z_1 = Y_1 - E_1 \geq 0$$

i.e., $Y_1 - (C_1 + D_1 + \delta) \geq 0$

i.e., $Y_1 - (C_o + D_o + \Delta C + \Delta D) \geq \delta$

i.e., $(Y_1 - Y_o) + (Y_o - C_o - D_o) - (\Delta C + \Delta D) \geq \delta$

i.e., $\Delta Y \geq \delta + \Delta C + \Delta D - Z_o$

Clearly, if $Z_o = 0$, the tests are identical. If $Z_o < 0$, the second test is more restrictive than the first. If $Z_o > 0$, the reverse holds true. Thus, either of the two tests above is sufficient to take care of the considerations implicit in both the tests. Depending on the value of Z, one may make provisions for ($\Delta C + \Delta D$) or ($\Delta C + \Delta D - Z_o$) in condition (6.7) and test for the bankability of the projects.

The debts (pre-existing or new) incurred by the agriculturists generally meet certain contingency consumption expenditure. And, it is because they are usually non-productive in nature that a provision has to be made for judging the probability of repayment of new productive loans extended by banks. Had those debts been productive, they would also have been self-liquidating and economically viable in nature. To the extent the above is true and to the extent the expenditure on account of repayment and servicing obligations of such debts would be actually incurred because of the availability of funds flowing from the project they may be treated as consumption expenditure. In otherwords, it may be said that a project to be viable should generate adequate savings or surplus to cover at least the annutized capital costs. The annutized capital cost is given by δ. The surplus is given by $\Delta Y - (\Delta C + \Delta D)$. If $\Delta Y < \Delta C + \Delta D + \delta$, $\Delta Y - (\Delta C + \Delta D) < \delta$. Thus, the project would not be viable. The value of β_{it} would be less than δ and $\bar{r}_i$ would be negative in equation (6.8) and (6.9), respectively. And, in view of condition (6.101), the project would not be viable in terms of the appraisal criteria suggested in

Chapter VI [the criteria comprise the conditions (6.1), (6.2) or (6.7), and (6.8), (6.9), (6.10) and (6.101) in section 6.3]. In otherwords, if the suggested appraisal criterion is adopted, it will automatically take care of the Repayment Capacity Test (unless, of course, non-repayment of loans is deliberate).

The incorporation of such factors as the minimum consumption needs and the pre-existing debt servicing and repayment obligations of small borrowers into the two tests suggested by Jakhade and Gadgil (1970) or the generalized version of the existing criteria developed in section 6.3 of Chapter VI of the present dissertation, no doubt imparts a social welfare orientation to the evaluation of projects for financing by banks. Nevertheless, the evaluation of projects by banks on the basis of the above tests or criteria will continue to serve the society's objective of output growth and will not be able to take into account another important objective of the society, namely, employment expansion. The criterion suggested in section 6.3 of Chapter VI, however, takes into account, in explicit terms, the contribution of projects towards employment generation. And, as suggested in para 6.4.1 of Chapter VI, if the banks choose those projects which satisfy both the suggested criterion [(6.8), (6.9), (6.10) and (6.101) in section 6.3] as well as the usual tests of [viability and bankability] [(6.1) and (6.2) or preferably (6.7)], this will impart the much-talked-about employment orientation to bank financing activities.

LIST OF REFERENCES

Arrow, K. J. (1963) : Social Choice and Individual Values, John Wiley & Sons, New York.

_____ (1966) : "Discounting and Public Investment Criteria" in Kneese, A. V. and Smith, S. C. (ed.), Water Research, John Hopkins Press.

_____ and Levhari, D. (1969a) : "Uniqueness of the Internal Rate of Return with Variable Life of Investment", Economic Journal, Vol. 79.

Arrow, K. J. (1969b) : "The Social Discount Rate" in Somers, G. G. and Woods, W. D. (eds), Cost-Benefit Analysis of Manpower Policies, Proceedings of a North American Conference, Industrial Relations Centre, Queen's University, Kingston, Ontario.

_____ and Kurz, M. (1970a) : Public Investment, the Rate of Return and Optimal Fiscal Policy, Baltimore, 1970.

_____ and Lind, R. C. (1970b) : "Uncertainty and the Evaluation of Public Investment Decisions", American Economic Review, Vol. 60.

Bacha, E. L., de Mata, M. and Modenesi, R. L. (1972) : Encargos Trabalhistas a Absorcão de Mao-de-obra, una Interpretacao do Problema e Sev Debate, Rio de Janeiro, IPEA-INPES, Colecao Relatorios de Pesquisa, No. 12.

Bacha, E. and Taylor, L. (1971) : "Foreign Exchange Shadow Prices : a Critical Review of Current Theories", Quaterly Journal of Economics, Vol. 85, no. 2.

Baer, Werner and Herve Michel (1966) : "Employment and Industrialization in Developing Countries", Quarterly Journal of Economics, Vol. 80, No.1, February, pp.88-107.

Baranson, J. (1969) : Industrial Technologies for Developing Countries, New York, Praeger.

Baumol, W. J. (1951) : Economic Dynamics - An Introduction (2nd Edition), The Macmillan Co., New York.

_____ (1965a) : Welfare Economics and the Theory of the State (Second Edition), Harvard University, Cambridge.

_____ and Quandt, R. E. (1965b) : "Investment and Discount Rates under Capital Rationing - A Programming Approach", Economic Journal.

Baumol, W. J. (1965c) : Economic Theory and Operations Analysis, Prentice-Hall.

_____ (1968) : "On the Social Rate of Discount", American Economic Review, Vol. 58.

Bergson, A. (1938) : "A Reformulation of Certain Aspects of Welfare Economics", Quarterly Journal of Economics.

Bershed Max (1966) : See ..... Solomon, J. M. (1966).

Bhardwaj, R. C. (1964) : "Factor Proportionsand Full Employment" Economic Internazionale, Vol.17, No.2.

Blaug, M. (1962) : Economic Theory in Retrospect, Irwin, Honewod, Illinios.

Blitzer, C. R. and Manne, A. S. (1974) : "Employment, Income Distribution and Shadow Prices in a Dulaistic Economy", Sankhyā : The Indian Journal of Statistics, Vol. 36, Series C, Pts. 2 & 4.

Bose, Deb Kumar (1975) : "Next Stage in Planning", Discussion Paper No. Econ./14/75, Indian Statistical Institute, Calcutta.

Boulding, K. E. (1968) : Beyond Economics, University of Michigan Press, Ann Arbor.

_____ (1969) : "Economics as a Moral Science", American Economic Review, Vol. 59.

Bradford, David, F.(1970) : "Constraints on Public Action and Rule for Social Decisions", American Economic Review, Vol. 9, No. 4.

Brody, A. (1965) : "Three Types of Price Systems" in Economics of Planning.

Bruno, M. (1965) " "The Optimal Selection of Export Promoting and Import Substituting Projects", Paper delivered at the First UN Inter-Regional Seminar on Developmental Planning, Ankara, Turkey.

Carter, C. F. & Others (1957) : Uncertainty and Business Decisions, Liverpool University Press.

Carter, N. G. (1969) : "A Linear Programming Model of the Output and Employment Possibilities of the Economy of Jamaica, 1965-1975 : Preliminary Results", IBRD, Working Paper-8.

Chakraborti, S. (1964) : "The Use of Shadow Prices in Programme Evaluation" in Rosenstein-Rodan, P.N.(ed.), Capital Formation and Economic Development, George Allen and Unwin Ltd., London.

Chandra, N. K. (1970) : "Theory and Practice of Soviet Price Reforms" in Yearbook of East European Economics.

Chase, S. B. (ed.) (1968) : Problems in Public Expenditure Analysis, Brookings Institution.

Chenery, H. B. (1953) : "The Application of Investment Criteria", Quarterly Journal of Economics.

Chenery, Hollis B. and Raduchel, William, J. (1971) : "Substitution in Planning Models" in Chenery (ed.), Studies in Development Planning, Cambridge, Mass. Harvard University Press.

Currie, Lauchlin (1971) : "The Exchange Constraint on Development — a Partial Solution to the Problem", Economic Journal, Vol. 81, 324.

Czarnek, F. (1966) : "Efficiency of Investment — a General Characterisation of the Concept and the Range and Methods of Research", in Efficiency of Investment in a Socialist Economy (ed.) M. Rakowski, Pergamon Press, Oxford.

Daly, H. E. (ed.) (1973) : Towards a Steady-State Economy, W. H. Freeman, San Francisco.

Dandekar, V. M. (1972) : Unemployment and Inbalances in the Economy, Forum of Free Enterprises, Bombay.

Das, Nabagopal (1972) : "The Unemployment Trap - Need to Regulate Technological Changes", The Statesman, Febaruary 9, 1972.

_____ (1968) : Unemployment and Employment Planning. Orient Longmans Ltd., Calcutta.

Dasgupta, P. (1970) : "Two Approaches to Project Evaluation", Industrialization and Productivity.

(1973) : "A Comparative Analysis of the UNIDO Guidelines and the OECD Manual", Bulletin of the Oxford University Institute of Economics and Statistics, Vol. 34.

Datta Chaudhuri, M. and Sen, Amartya (1970) : "Durgapur Fertiliser Project : An Economic Evaluation", Indian Economic Review, Vol. V, (New Series) No. 1.

Dave, S. A., and Bhatt, V.V. (1971) : "Criteria for Evaluation for Capital Projects", Economic and Political Weekly, Vol. VI, No.35.

Dhar, E. N. and Lydall, H. F. (1961) : The Role of Small Enterprises in Indian Economic Development, Delhi, Asia Publishing House.

Diamond, P. (1968) : "The Opportunity Cost of Public Investment : Comment", Quarterly Journal of Economics, Vol. 82.

Diaz-Alejandro, Carlos, F. (1973) : "Turning from Import Substitution to Export Promotion in Columbia" (mimeo.), Yale University Economic Growth Centre, New Haven, Conn.

Dixit, A. (1968) : "Optimal Development in the Labour-Surplus Economy", Review of Economic Studies, Vol.35.

Dobb, M. (1960) : An Essay on Economic Growth and Planning, Routledge & Kegan Paul, London.

Domar, E. D. (1946) : "Capital Expansion, Rate of Growth and Employment", Econometrica, Vol. 14, No.2.

Dorfman, R. (1962) : "Basic Economic and Technological Concepts : A General Statement" in Mass (1962).

Dutt, B. K. (1972) : A Plan for Total Development of Agriculture, United Bank of India, Calcutta.

Dutt, R. and Sundharam, K.P.M. (1975) : Indian Economy, S. Chand & Co.(P) Ltd. New Delhi.

Eckaus, R. S. (1955) : "The Factor Proportions Problem in Underdeveloped Countries", American Economic Review, Vol.45.

Eckstein, O. (1957) : "Investment Criteria for Economic Development and the Theory of Intertemporal Welfare Economics", Quarterly Journal of Economics.

_____ (1961) : "A Survey of the Theory of Public Expenditure Criteria", in R. W. Houghton (ed.), Public Finance, Penguin.

_____ (1958) : Water Resources Development, Harvard University Press.

Farrell, M. J. (1958) : "In Defence of Public Utility Price Theory", Oxford Economic Papers.

Fei, J. C. H. and Ranis Gustav (1972a) : "Growth and Employment in South Korea and Taiwan". (mimeo.), Yale University Economic Growth Centre, New Haven. Conn.

_____ and _____ (1972b) : "A Model of Growth and Employment in the Open Dualistic Economy : The Cases of Korea and Taiwan" (mimeo.), Yale University Economic Growth Centre, New Haven, Conn.

Feldstein, M. S. and Flemming, J. (1964) : "The Problem of Time Stream Evaluation - Present Value versus Internal Rate of Return Rules", Bulletin of the Oxford University Institute of Economics and Statistics, Vol. 26.

Feldstein, M. S. (1964a) : "The Social Time Preference Discount Rate in Cost Benefit Analysis", Economic Journal, Vol. 74, No.2.

_____ (1964b) : "Net Social Benefit Calculation and the Public Investment Decision", Oxford Economic Papers (New Series), Vol.16.

_____ (1965) : The Derivation of Social Time Preference Rates, Kyklos.

_____ and Flemming, J. (1968) : "Shadow Prices in Industrial Evaluation" in UN (1968a).

Feldstein, M. S. (1970) : Choice of Technique in the Public Sector : A Simplification, Economic Journal, Vol.20.

Fisher, D. W. (1970a) : "The Problem of Public Investment Criteria-A Critique", The Engineering Economist, (Engineering Economy Division of the American Society for Engineering Education), Vol. 15, No.2.

_____ (1970b) : "The Relevance of Benefit Cost Analysis for Economic Development", The Engineering Economist, Vol. 15, No.2.

Fiszel, Henryk (1966) : Investment Efficiency in a Socialist Economy. (English ed.), Pergamon Press Ltd., Oxford, London.

Flowerdew, A. D. J. (1972) : Choosing a Site for the Third London Airport : the Roskill Commission's Approach in Cost Benefit Analysis, Layard, R. (ed.), Penguin.

Forrester, J. W. (1971) : World Dynamics, Wright Allen Press, Cambridge, Massachusetts.

Foster, C. D. (1966) : "Social Welfare Funchons in Cost Benefit Analysis" in Lawrence, L. (ed.), Operational Research and the Social Sciences, Tavistock Publications, London.

Freeman, A. M. (1967) : "Income Distribution and Planning for Public Investment", American Economic Review, Vol. 57, No.3.

Friedman, M. and Savage, L. J. (1948) : The Utility Analysis of Choice Involving Risk, Journal of Political Economy, Vo.56.

Furtado, Celso (1967) : Development and Underdevelopment, Berkeley, California University Press.

Galbraith, John Kenneth (1958) : The Affluent Society, Houghton Mifflin, Boston.

Galenson, W., and Leibenstein, H. (1955) : "Investment Criteria, Productivity and Economic Development", Quarterly Journal of Economics, Vol. 69, No.3.

Garret, H. (1968) : "The Tradegy of the Commons", Science, December 13, 1968.

Green, H. A. J. (1961) : "The Social Optimum in the Presence of Monopoly and Taxation", Review of Economic Studies.

Gould, J. R. (1972) : "On Investment Criteria for Mutually Exclusive Projects", Economica, Vol.39 (New Series).

Harberger, A. C. (1968) : "Survey of Literature on Cost Benefit Analysis for Industrial Project Evaluation in UN (1968a).

Harrod, R. F. (1968) : Towards a Dynamic Economics, Macmillan, London.

Haveman, Robert H., and Krutilla John V. (1968) : Unemployment, Idle Capacity and the Evaluation of Public Expenditures : National and Regional Analyses, Johns Hopkins Press, Baltimore, Maryland.

Henderson Hazel (1973) : "Ecologists Versus Economists", Harvard Business Review.

Henderson, P. D. (1965) : "Investment Criteria for Public Enterprises: in Public Enterprise : Selected Readings edt. R. Turvey, Penguin, Middlesex, England.

Hertz, D. B. (1964) : Risk Analysis in Capital Investment, Harvard Business Review.

Kicks, J. R. (1940) : "The Valuation of Social Income", Economica, May, 1940.

Higgins, B. (1966) : Economic Development : problems, principles and policies, Central Book Depot, Allahabad.

Hiller, F. S. (1963) : "The Derivation of Probabilistic Information for the Evaluation of Risky Investments", Managerial Science.

Hirschman, Albert, O. (1958) : The Strategy of Economic Development, New Haven, Conn., Yale University Press.

Hirsheleifer (1958) : "On the Theory of the Optimal Investment Decisions", Journal of Political Economy, Vol. 66.

Hirshleifer, J., De Haven, J. C. and Milliman, J. W. (1960) : Water Supply : Economics, Technology and Policy, University of Chicago Press.

Hirshleifer, J. (1965) : "Investment Decision under Uncertainty : Choice-Theoretic Approaches", Quarterly Journal of Economics, Vol. 79.

_____ (1966) : "Investment Decision under Uncertainty: Applications of the State Preference Approach", Quarterly Journal of Economics, Vol. 80.

Hervart, R. (1968) : "The Rule of Accumulation in a Planned Economy", Kyklos, Vol. 21, No. 4.

Hotelling, H. (1931) : The Economics of Exhaustible Resources, Journal of Political Economy.

Houghton, R. W. (ed.) (1970) : Public Finance, Penguin.

Hunt, Pearson and Andrews Victor L. (1968) : Financial Management : Cases and Readings, Richard D. Irwin, Inc. Homewood, Illinois.

Indian Planning Commission (1973) : Technical Papers for Approach to Fifth Five Year Plan, New Delhi.

International Labour Office (1961) : Employment Objectives in Economic Development, Report of a Meeting of Experts, Geneva.

ILO or International Labour Office (1972) : Employment, Incomes and Equality : A Strategy for Increasing Productive Employment in Kenya, Geneva.

_____ (1975) : "Time for Transition — A Mid-term Review of the Second United Nations Development Decade", Review in Financial Express, July 29-31, 1975, Bombay.

Ishikawa, Shigeru (1972) : "A Note on the Choice of Technology in China", Journal of Development Studies, Vol. 9, No. 1.

Jalan, B. (1973) : "The Little-Mirlees Manual — An Evaluation of Its Relevance for the Developing Countries", Economic and Political Weekly, Annual No, February 1973, Bombay.

Jakhade V.M. & Gadgil V.M. (1970) : "Production And Repayment Capacity Oriented Lending for Farm Investments," Reserve Bank of India Bulletin, January 1970.

-do- (1971) : "Investment in Agriculture - A Cost Benefit Analysis : A Reply" Economic & Political Weekly, Vol 6?

Kaldor, N. (1957) : "A Model of Economic Growth", Economic Journal, Vol. 67.

_____ (1960) : Essays on Value and Distribution, London, Duckworth.

Kapp, K. W. (1950) : Social Costs of Private Enterprise. (Revised Edition), Schocken Books, New York.

_____ (1952) : "On the Nature and Significance of Social Costs", Kyklos, Vol. 22.

_____ (1971) : Social Costs, Neo-Classical Economists, Environmental Planning : A Reply, Mouton, Paris.

Karcher, Martin (1973) : "Unemployment and Underemployment in the People's Republic of China", (mimeo.), Cambridge, Mass., Harvard University, Centre for International Affairs.

Kim, Young Chin and Kwon, Jene, K. (1973) : "Capital Utilization in Korean Manufacturing, 1962-71 : Its Level, Trend and Streucture", (mimeo.), Northern Illinois University.

Krutilla, J. and Eckstein, O. (1958) : Multiple Purpose River Development, Studies in Applied Economic Analysis, John Hopkins Press, Baltimore.

_____ and _____ (1966) : "Welfare Aspects of Cost Benefit Analysis" Journal of Political Economy.

Lamberton, D. M. (ed.)(1971) : The Economics of Information and Knowledge, Penguin, Middlesex, England.

Lancaster, Kelvin and Lipsey, R.G.(1956) : "The General Theory of Second Best", Review of Economic Studies, Vol. 24, no.1.

Lancaster, Kelvin,(1966) : "New Approach to Consumer Theory", Journal of Political Economy, Vol. 74, no.2.

Layard, R. (1972) : Cost Benefit Analysis (ed.), Penguin.

Lefeber, L. (1968) : "Planning in a Surplus Labour Economy" American Economic Review, Vol. 58.

Lewis, W. A. (1966) : Developmental Planning, George Allen and Unwin Ltd., London.

Little, I.M.D. (1960) : A Critique of Welfare Economics, (Second Edition), Oxford University Press.

_____ (1964) : "The Real Cost of Labour and the Choice between Consumption and Investment", Quarterly Journal of Economics, February 1961, Reprinted in Rosenstein Rodan, P. N. (ed.), Pricing & Fiscal Policies, George Allen and Unwin Ltd., London.

_____ (1965) : "Public Sector Project Evaluation in Relation to Indian Development", a Delhi School of Economics Lecture of 1965, in Bhuleshkar, A.V. (ed.), Indian Economic Thought and Development, Essays in Memory of Jawaharlal Nehru, Bombay.

_____ and Mirrlees, J. A. (1969) : Manual of Industrial Project Analysis in Developing Countries, Vol. II, Social Cost Benefit Analysis, Development Centre of the Organization for Economic Co-operation and Development.

_____ and _____ (1972) : "A Reply to Some Criticisms of the OECD Manual, Bulletin of the Oxford University Institute of Economics and Statistics, Vol.34.

_____ and _____ (1974) : Project Appraisal and Planning for Developing Countries, Heinemann Educational Books, London.

Livington, A. (1935) : Pareto (translation, vol. IV), Hartcourt Brace & Co., New York.

Loucks, Daniel P. (1973) : "Conflict and Choice : Planning for Multiple Goals", (mimeo.), Development Research Centre, Interactional Bank for Reconstruction and Development, Washington D.C.

Lubell, Harold (1947) : "Effects of Redistribution of Income on Consumers' Expenditures", American Economic Review, Vol. 37, 1.

Maass, Arthur (1966) : "Benefit Cost Analysis : Its Relevance to Public Investment", Quarterly Journal of Economics.

Maass, A., Hufschmidt, M, Dorfman, R., Thomas, H.A., Marglin, S.A., and Fair, G. M. (1962) : The Design of Water-Resources Systems : New Techniques for Relating Economic Objectives, Engineering Analysis and Governmental Planning, Macmillan, New York.

Malinvaud, E. (1953) : "Capital Accumulation and Efficient Accumulation of Resources", Econometrica, Vol.21.

Mangum, G. L., and Bowen, H. R. (1966) : Automation and Economic Progress, Prentice-Hall Inc., Englewood, Cliffs, N. J.

Manne, A. S.(ed.) (1967) : Investments for Capacity Expansion : Size, Location and Time-Phasing, George Allen and Unwin Ltd., London.

Marglin, S. A. (1963a) : "The Social Rate of Discount and the Optimum Rate of Investment", Quarterly Journal of of Economics, Vol. 77.

_____ (1963b) : "The Opportunity Costs of Public Investment", Quarterly Journal of Economics, Vol.77.

_____ (1963c) : Approaches to Dynamic Investment Planning, North Holland.

_____ (1967) : Public Investment Criteria, George Allen & Unwin Ltd., London.

Margolis, J. (1957) : "Secondary Benefits, External Economies, and the Justification of Public Investment", Review of Economics and Statistics, Vol.39.

Marglen, Keith (1966) : "The Role of Small Enterprises in the Industrialization of the Developing Countries", (mimeo.), Geneva, ILO.

_____ (1970) : "Towards a Synthesis of Economic Growth and Social Justice", International Labor Review, Vol. 101, No.5.

Mayer, R. (1970) : "Capital Investment Analysis – Another Way", Industrial Engineering, Vol.2, No.7.

McGuire, M. C. (1969a) : "Problems in the Co-operative Allocation of Public Expenditures", Quarterly Journal of Economics.

_____ and Garn, H. A. (1969b) : "The Integration of Equity and Efficiency Criteria in Public Project Selection", Economic Journal.

McKean, R. N. (1958) : Efficiency in Government through Systems Analysis, Wiley, New Yrok, 1958.

_____ (1968) : "The Use of Shadow Prices " in S. B. Chase(ed.) Problems in Public Expenditure Analysis, Brookings Institution, 1968.

_____ : "Cost Benefit Analysis and Its Applicability" in Planning and Markets, (Edit) Dunlop and Fedorenks.

Meade, J. E. and Hahn, F. H. (1965) : "The Rate of Profit in a Growing Economy", Economic Journal, Vol. 75.

Mehta, B. V. (1969) : "Size and Capital-Intensity in Indian Industry", Bulletin of Oxford University Institute of Economics and Statistics, Vol. 31, 3.

Mera Koichi (1967) : "Trade off Between Aggregate Efficiency and Interregional Equity : A Static Analysis" Quarterly Journal of Economics.

Mishan, E. J. (1964) : Welfare Economics, Ramdon House.

_____ (1967a) : "Criteria for Public Investment : Some Simplifying Suggestions", Journal of Political Economy, Vol. 75.

_____ (1967b) : "A Proposed Normalisation Procedure for Public Investment Criteria", Economic Journal.

_____ (1971) : Cost Benefit Analysis : An Informal Introduction, George Allen & Unwin Ltd., London.

Morawetz, David (1973) : Elasticities of Substitution in Industry : What Do We Learn from Econometric Estimates? Jerusalem, Hebrew University, Economics Department, Research Report No.51.

_____ (1974) : "Employment Implications of Industrialization in Developing Countries : A Survey", Economic Journal, Vol. 84, No.335.

Musgrave, R. A. (1959) : The Theory of Public Finance, McGraw Hill.

_____ (1969) : "Cost Benefit Analysis and the Theory of Public Finance", Journal of Economic Literature, Vol. 7.

Muthoo, M. K. (1970) : "Planned Growth and the Rate of Discount for Project Appraisal in Developing Countries with Special Reference to India", Economic Affairs, Vol. 15, Nos. 1-2.

_____ (1971) : "Which Discount Rate for Social Investment Analysis ? Especially in Developing Country", Economic Affairs, Vol. 16, Nos. 1-4.

Nanchane, D. M. (1972) : "A Note on Optimal Development in a Labour-Surplus Economy", Indian Economic Journal, Vol. 19, No.3.

Nerlove, Marc. (1967) : "Recent Empirical Studies of the CES and Related Production Functions" in Murray Brown (ed.), The Theory and Empirical Analysis of Production, New York, NBER, Studies in Income and Wealth, Vol.31, Columbia University Press.

Newbery, D. M. G. (1972) : "Public Policy in the Dual Economy", Economic Journal, Vol. 82, No.326.

Novozhilov, V.V. (1964) : "Cost Benefit Comparisons in a Socialist Economy" in the Use of Mathematics in Economics (English ed. by Nove, A.), Oliver & Boyd Ltd., Edinburgh & London.

_____ (1968-69) : "Problems of Cost Benefit Analysis In Optimal Planning" in Mathematical Studies in Economics & Statistics in the U.S.S.R. & Eastern Europe, Vol. V, No. 2-3-4, International Arts and Science Press, Inc. White Plains, New York.

OECD (1969) : See Little & Mirrlees (1969).

Ostrowski, M. and Sandowski, Z. (1968) : "Pricing Problems in Project Evaluation" in UN (1968a).

Pack, Howard (1972a) : "Employment and Productivity in Kenyan Manufacturing", Eastern Africa Economic Review, Vol. 4, No.2.

_____ (1972b) : "The Employment-Output Trade-off in Less Developed Countries : A Micro-economic Approach", (mimeo.) Swarthmore, Penn., Swarthmore College.

Pack, Howard and Todaro, Michel P. (1969) : "Technological Transfer, Labour Absorption, and Economic Development", Oxford Economic Papers, Vol. 21, 3.

Pasinetti, L. L. (1962) : "Rate of Profit and Income Distribution in Relation to the Rate of Economic Growth", Review of Economic Studies, Vol. 29.

Paul Samuel (1970) : "Investment in Agriculture - Cost Benefit Analysis" Economic & Political Weekly, Vol 5.

Pauly, M. V. (1960) : "Risk and the Social Rate of Discount", American Economic Review, Vol. 60.

Peacock, Alan and Shaw, G. K. (1971) : Fiscal Policy and the Employment Problem in Less Developed Countries, O.E.C.D. Paris.

Pearce, D. W. (1971) : Cost Benefit Analysis, Macmillan.

Pearl, Arthur (1971) : "An Ecological Rationale for a Human Service Society", Social Policy.

Peters, G. H. (1966) : Cost Benefit Analysis and Public Expenditure, Eaton Papers, No. 8, Institute of Economic Affairs, London.

Pigou, A. C. (1932) : The Economics of Welfare, 4th Edn., Macmillan.

Philipines National Economic Council (1957) : The Five Year Economic and Social Development Program for Fiscal Years 1957-1961, Manila.

Prest, A. R. and Turvey, R. (1965) : "Cost Benefit Analysis : A Survey", Economic Journal, Vol. 75.

Qayum, A. (1960) : Theory and Policy of Accounting Prices, Amsterdan, North Holland Publishing Co.

Raiman, J. R. (1966) : "A Study of Prices in a Planning Model", in Price Formation in Various Economies, (ed. by) Hague, D. C.).

Rakowski, M. (ed.)(1966) : Efficiency of Investment in a Socialist Economy, Pergamon Press, Oxford.

Ramsey, J. B. (1970) : "The Marginal Efficiency of Capital, the Internal Rate of Return and Net Present Value: An Analysis of Investment Criteria", Journal of Political Economy, Vol. 78.

Rangarajan, C. and Mampilly, P. (1971) : "Net Present Value versus Internal Rate of Return", Economic & Political Weekly, Vol. VI, No.48.

Ranis, G. (1957) : "Factor Proprotions in Japanese Economic Development", American Economic Review, Vol. 47, 5.

_____ (1972) : "Technology, Employment and Growth : The Japanese Experience", in ILO, Automation in Developing Countries, Geneva.

Reddaway, W. B. (1967) : The Development of the Indian Economy, Allen and Unwin, London.

Reserve Bank of India (1971) : Guidelines to Commercial Banks Regarding Special Credit Schemes with Particular Refererence to Employment Potential, Circular letter dated March 19, 1971 issued to all Commercial Banks and Report of the Committee to Review the Special Credit Schemes of Banks with Particular Reference to their Employment Potential, Bombay.

Robinson, J. (1956) : The Accumulation of Capital, Macmillan, London.

Roemer, Michael (1972) : The Neo-classical Employment Model Applied to Ghanian Manufacturing, Cambridge, Mass, Harvard University of Development Research Group, Economic Development Report No. 225.

Rudra, A. (1972) : "Use of Shadow Prices in Project Evaluation", Indian Economic Review, Vol.VII, No.1.

Samuelson, P.A. (1963) : Foundations of Economic Analysis, Harvard University Press, Cambridge.

_____ and Modigliani, F. (1966) : "The Pasinetti Paradox in Neo-classical and More General Models", Review of Economic Studies, Vol. 33.

Sandesara, J. C. (1966) : "Scale and Technology in Indian Industry", Bulletin of Oxford University Institute of Economics and Statistics, Vol. 28, No.3.

_____ (1969) : "Size and Capital Intensity in Industry : Some Comments", Bulletin of Oxford University Institute of Economics and Statistics, Vol.31, No.4.

Sau, R. K. (1971a) : "Approaches to Project Evaluation", Economic and Political Weekly, Vol. 6, No.35.

_____(1971b) : "Market Price, Shadow Price and All That", Economic and Political Weekly, Vol. 6, No.48.

Schmid, A. (1967) : "Non-market Values and Efficiency of Public Investment in Water Resources", American Economic Review, Papers & Proceedings.

Sen, A. K. (1967) : "Isolation, Assurance and the Social Rate of Discount", Quarterly Journal of Economics, Vol. 81.

_____ (1968a) : Choice of Techniques, Oxford, Basil Blackwell.

_____ (1968b) : "General Criteria for Industrial Project Evaluation" in U. N. Industrial Development Organisation, Evaluation of Industrial Projects, New York.

_____ (1969a) : "Choice of Technology : A Critical Survey of a Class of Debates", in Planning for Advanced Skills and Technologies, New York, Vienna, UNIDO, Industrial Planning Programming Series No. 3.

_____(1969b) : "The Role of Policy-makers in Project Formulation and Evaluation", Industrialisation and Productivity Bulletin 13.

_____(1970a) : "Interrelations between Project, Sectoral and Aggregate Planning". United Nations Economic Bulletin for Asia and the Far East, Vol. 21, No.1 and 2.

_____ (1970b) : "Profit Maximisation and the Public Sector," Unpublished Text aof John Mathai Memorial Lecture, 1970, Kerala University, Trivandrum.

_____ (1971) : "Control areas and Accounting Prices : An Approach to Economic Evaluation", Economic Journal, Vol. 82.

Sigurdson, J. (1972) : "Rural Industry - A Traveller's View", The China Quarterly, Vol. 50.

_____ (1973) : "Technology and Employment in China", presented at Ford Foundation Seminar on Technology and Employment, Delhi.

Sharpston, Michael J.(1973) : "Capital-Labour Substitution Possibilities: An Empirical Approach, (mimeo.), IBRD, Development Economics Department.

Singh, B., and Misra, S. (1965) : "Benefit-cost Analysis of the Sarada Canal System", Asia Publishing House, Bombay.

Smith, V. L. (1974) : "An Optimistic Theory of Exhaustible Resources", Journal of Economic Theory, Vol.9, No.4.

Solomon, E. (1956) : "The Arithmatic of Capital Budgeting Decisions", Journal of Business, Vol.29.

_____ (1959) : The Management of Corporate Capital, The Free Press of Glencoe, New York.

Solomon, J. M. (1966) : Project Analysis : A System for Shaping and Appraising Projects with Special Application to Newly Developing Countries, Appendix E, Department of Economic Affairs, Pan American Union, The Organisation of American States, Washington, D. C.

Soligo, Ronald (1972) : "Factor Intensity of Consumption Patterns, Income Distribution and Employment Growth in West Pakistan", (mimeo.), Rice University Program of Development Studies, Houston, Texas.

_____ and James, W. (1972) : "Models of Development Incorporating Distribution Aspects", Rice University Program of Development Studies, Houston, Texas.

Solow, R. M. (1963) : "Capital Theory and The Rate of Return", North Holland Publishing Co., Amsterdam.

_____ (1974) : "The Economics of Resources", American Economic Review, Vol. 64.

Steiner, P. O. (1959) : Choosing Among Alternative Public Investments in the Water Resource Field", American Economic Review.

Stern, N. H. (1972) : "Optimum Development in a Dual Economy", Review of Economic Studies, No. 118.

Stewart, F. and Streeten, P. (1971a) : "Conflicts Between Output and Employment Objectives in Developing Countries," Oxford Economic Papers, Vol. 23, No. 2.

_____ and _____ (1971b) : "Little-Mirrlees Methods and Project Appraisal", Bulletin of the Oxford University Institute of Economics & Statistics, Vo. 34.

Stewart, F. (1971a) : "The Choice of Techniques : A Case Study of the Manufacture of Cement Blocks in Kenya," (mimeo.), Oxford, Queen Elizabeth House.

_____ (1972a) : "Trade and Technology" presented at Cambridge Conference on Development, Cambridge, England.

_____(1972b) : "Choice of Technique in Developing Countries" Journal of Development Studies, Vol.9.

_____ (1973) : "Technology and Employment in Less Developed Countries", presented at Ford Foundation Conference on Technology and Employment in Delhi, Oxford, England, Queen Elizabeth House.

Stoleru, L. A. (1965) : "An Optimal Policy for Economic Growth", Econometrica, Vol.33.

Streeten Paul (1971) : Cost Benefit and Other Problems of Method, Mouton, Paris.

_____ (1972) : The Frontier of Development Studies, Macmillan.

Tarascio, V. J.(1969) : "Paretian Welfare Theory : Some Neglected Aspect", Journal of Political Economy Vol.77, No.1.

Tinbergen, J. (1958) : The Design of Development, John Hopkins Press, Baltimore.

_____ (1960) : "Optimum Savings and Utility Maximization", Econometrica, Vol. 28.

_____ (1963) "Project Criteria" in Economic Planning edited by L. J. Zimmerman, Mouton Co., The Hague.

Tintner and Patel(1966-67) : "Evaluation of Indian Fertilizer Projects: An Application of Consumers' and Producers' Surplus, Journal of Farm Economics.

Tockman, V.E. (1972) : "Distribución del Ingresco, Tecnologia Y Empleo en el Sector Industrial de Venezuela" (mimeo). I-620-72-S, OEA-ILPES, Santigo, Chile.

Tock, J. E. (1971) : Size of Firm and Efficiency in Columbian Manufacturing", Williams College Centre for Development Economics, Williamstown, Mass, Research Memorandum-41.

Tovissi, L, and Tiganescu, E. (1971) : "Nature of Shadow Price and Their Utilization In Substantiating Economic Decisions" in Economic Computation and Economic Cybernetics Studies and Research No.3. (The Centre of Economic Computation and Economic Cybernetics, Bucharest - Romania).

Turvey, R. (1963) : "Present Value versus Internal Rate of Return-An Essay in the Theory of Third Best, Economic Journal, Vol. 73.

_____(ed.)(1968) : Public Enterprise, Penguin.

Usher, D. (1969) : "On the Social Rate of Discount : Comment", American Economic Review, Vol. 59.

United Bank of India(1972): Bolepur Project For Minor Irrigation, Calcutta.

_____(1973) : Berohi Anchal : Its Economy and Credit Plan for Development, Calcutta.

United Nations, ECLA (1958): Manual of Economic Development Project.

_____ ; Dept. of Economic and Social Affairs (1963) : Planning for Economic Development, New York.

_____ ; Industrial Development Organisation (1968a) : Evaluation of Industrial Projects, New York.

_____ ; ECAFE(1968b) : "Measurement Standards for Project Evaluation, Prices and Interest", Economic Bulletin for Asia and The Far East, Vol. 13, No.3.

_____ ; ECE (1970) : Multi-level Planning and Decision-making.

UNIDO, or United Nation Industrial Development Organisation (1972) : Guidelines for Project Evaluation, (by Das Gupta, P, Marglin, S.A. & Sen, A.K.)

Vainshtein, B. (1971) : "On Methods of Determining the Economic Effectiveness of Capital Investments", Voprosy ekonomiki, No.12.

Von Neumann (1945-6) : "A Model of General Equilibrium" (translated by Morgenstern), Review of Economic Studies, Vol.13.

Wallich, H.C. (1972) : Article in Fortune, October, 1972.

Walsh, V. C. (1970) : Introduction to Contemporary Micro-economics, McGraw Hill Book Company, New York.

Weisbrod, B. A. (1961) : "The Valuation of Human Capital", Journal of Political Economy, Vol.69.

_____ (1968) : "Income Redistribution Effects and Benefit Cost-Analysis" in Samuel, B, Chase Jr.(ed.), Problems in Public Expenditure Analysis, Washington : The Brookings Institution.

Weisskoff, Richard, Levy, R., Nisonoff, L. & Wolff, E. (1973) : "A Multi-Sector Simultaneous Model of Employment, Growth and Income Distribution in Puerto Rico: A Re-evaluation of Successful - Development Strategy," (mimeo), Yale University Growth Centre, New Haven, Conn., Yale.

Weisskoff, W.A.(1971) : Alienation and Economics, E. P. Dutton New York.

Williams, A. (1972) : "Cost Benefit Analysis, Bastard Science? and/or Insidous Poison in Body Politic", Journal of Public Economics, Vol. 1, No.2.

World Bank (1970) : Technique of Project Appraisal Under Uncertainty, Staff Paper No.106, John Hopkins Press, Baltimore.

ABOUT THE AUTHOR

Born in 1948, the author obtained the school leaving certificate in 1963; his schooling was at St. Mary's and K. K. Hindu Academy at Dum Dum. He took his undergraduate lessons at Moulana Azad College and Presidency College in Calcutta and graduated from the Calcutta University in 1966 with honours in Economics. He secured First Class in the Master of Arts (Economics) Examination, 1968 of the Calcutta University with Special Papers in Mathematical Economics, Statistics and Econometrics. After completing the training under the Research Course leading to Ph. D. Degree (1969-70) of the Indian Statistical Institute, Calcutta, he took up the present dissertation work.

Working for more than four years as one of the economists at the Research Division, United Bank of India, Calcutta he has published articles on special interest in such aspects of banking as inter-branch transfer pricing, long-range business planning and performance budgeting, lead banking and area development, etc. For sometime, he also taught Economics at a undergraduate Commerce College in Calcutta.

Married in 1973, the author resides with his wife and their month-old son at Dum Dum, Calcutta.