A MULTISECTORAL MODEL OF INCOME DISTRIBUTION, POVERTY AND GROWTH : SOME POLICY EXERCISES FOR INDIAN ECONOMY

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CHAPTER 1

Introduction And Plan Of The Study

The extent of poverty in any country depends upon two factors viz. the average level of income and the degree of inequality in its distribution. The central theme in the continuing debate on the relationship between growth and poverty is whether past growth process in the developing countries has caused any significant benefit to the poor. Kuznets (1955) was first to observe from cross country data that process of development is likely to be accompanied by increase in inequality, which would reverse itself only at a relatively advanced stage. This hypothesis has been subsequently confirmed to some extent by several authors. Empirical evidence on the incidence of poverty and extent of income inequality in developing countries have also raised question on the desirability of growth oriented development strategy which implicitly assumed that growth, through its so-called " trickle down" effect, will take care of these problems.

Several micro and macro-economic explanation of this phenomenon has been put forward in the literature. While " Kuznets effect" stresses the role of structure of employment associated with pattern of modern growth, Lewis (1954), Fei and Ranis (1964) argue, in a dual economy model, that growth of modern sector takes increasingly capital intensive form with income per person raising rapidly but with limited increase in employment for unskilled labour. On the other hand, some authors like Taylor and Bacha (1976), Taylor and Lysy (1979), Ahluwalia et al (1979) feel that public policy is as much as important as the growth in changing economic condition of the poor. Consequently debate has also centred around design of policies to alleviate poverty and reduce income inequality. One group of policy makers consider that the major objective should be acceleration of growth with special concessions to the poorest among them and others feel that distributional objective should be treated as an integral part of overall development strategy.

However, discussion of these issues requires a framework which provides an integrated treatment of growth, income distribution and poverty so that one is able to evaluate and rank the different growth and redistributive policies. This follows from the complex nature of interactions involved in evaluating the impact of different policy instruments. Policies designed to benefit the target group may have adverse effect on other groups and may even hurt the target group itself because of income linkage between the groups. Moreover, as the effect of different policies take time to work themselves out, we need a framework in which the effects of alternative policies can be compared over time.

The present study suggests a quantitative framework for analysing the relationship between income distribution, poverty and growths and use it for highlighting the major characteristics of different redistributive policies in terms of their impact on growth of income of different socio-economic groups. As there is not yet an adequate statistical basis for formal analysis of the key relationship between growth, poverty and income distribution, our main concern, while modelling such relationship, has been to make the best possible use of available data.

The present study is divided into ten chapters. In the next chapter we review the quantitative studies on the interrelationship between income distribution, poverty and growth, and also point out certain limitations of the existing methodology for analysing this relationship in input-output framework. The basic analytical framework of the present study, which has been called the 'basic model', is presented in Chapter three. The objective of the model is to depict the process of income generation and distribution in so far as it affects economic position of the poor. The economic position of any economic group in a real economy, however, is determined by complex interaction of different economic, social and political parameters and it is not possible to capture all aspects of this process in a single model. This model primarily focuses on the role of output price-income distribution interaction process in an economy for determining the level and share of income of the poor.

The central theme of this interaction process is interdependence of output, price and income distribution. The basis of this interdependence, as considered in this model, is that income distribution across socio-economic classes affects the level of structure of output and price in the economy via its influence on the level and pattern of demand; the level and structure of output and price, on the other hand, affects income distribution via their influence on the pattern of factor income across socio-economic classes.

In the present model this interdependence is considered in input-output framework by dividing the economy into a number of productive sectors and the population into a number of socio-economic groups. The primary justification for this segmentation is that : (a) an underdeveloped economy like India cannot be said to be governed by a single rule - either for price formation or for output determination and income generation in different productive sectors, and (b) the socio-economic groups in such an economy show wide variation with respect to their income sources and consumption behaviour. These heterogeneities of the productive sectors and the socio-economic classes play an important role in determining the economic position of the poor.

In order to estimate the output and prices we mainly focus on the conditions of supply in different productive sectors. The elasticities of supply of primary products (specially that of agricultural produce) in India are likely to be small. In fact, agricultural production depends more on such exogenous factors as weather than on economic variables. Therefore, the output of primary products like agriculture, which are mostly unresponsive to demand, are taken either as exogenous or determined by supply response function while their prices are determined by forces of demand and supply. Industrial sectors, on the other hand, are generally marked by presence of excess capacity and imperfect oligopolistic market structure. Output of industrial products are, therefore, elastic and determined by demand while their prices follow mark-up pricing rule.

A major component of demand viz., private consumption is endogenised in the model by considering output income-price-consumption relationship for each socio-economic group. These relations reflect both consumption pattern and savings behaviour of different socio-economic groups, and enable one to study the impact of income redistributions on the level and pattern of aggregate private consumption demand.

Finally, in order to determine the distribution of income the model focuses on two sources of inequality. First is the inequality in the distribution of income between profit and wage. The second is the inequality in distribution of wage earning which reflect the differential access to employment due to difference in skill characteristics among socio-economic groups.

Thus the model, while considering the interdependence between output, prices and income distribution, mainly focuses on (i) differential access to employment due to differences in skill characteristic among socio-economic groups and resultant inequality in employment earning, (ii) different rules of price and output determination in agriculture and industry arising out of their different supply consitions, and (iii) different consumption and savings behaviour of the socio-economic classes. These factors, which have important bearing on the level and share of income of the poor, have not been formally combined together in other models, although some of them have been considered individually in models of growth, income distribution and poverty.

In Chapter 4 we develop and analyse the data base of the present study. In building up the data base we have used informations from various sources and matched them consistently with each other using analytical techniques. For constructing the employment distribution matrix, as used in the basic model, we have mainly used informations provided by National Sample Survey Organisation, Labour Bureau, National Council of Applied Economic Research, Reserve Bank of India etc. Such informations are then matched with exogenously specified informations on sectoral wage, aggregate consumption of the poor and the non-poor and the percentage of people below poverty line following RAS method. Informations on other technological, behaviourial and policy parameters of the basic model have been taken from Sixth Plan Technical Note, Annual Survey of Industries, National Accounts Statistics published by Government of India. Thus informations on input-output coefficient matrix, sectoral labour coefficient, exogenous sectoral final demand components and sectoral indirect tax rates as required in the basic model are taken from Sixth Plan Technical Note and are aggregated according to sectoral classification of the present study. Parameters of LES demand functions for the poor and the non-poor are given in Sixth Plan Technical Note for the 13 broad commodity groups and are disaggregated into our sector classification scheme on pro-rata basis. Other informations on policy parameters are taken from Annual Survey of Industries, Government of India.

The Chapter 5 of the study examine and compare the two alternative assumptions regarding technology in input-output system viz. commodity technology and industry technology assumption. Either of the two assumption is generally required for calculating output and prices for commodities and industries from commodity/industry input-output informations. Analysing the implication of these two assumptions for the model solution we retain one assumption for use in subsequent analysis.

Next, in Chapter 6 we carry out comparative static analysis with the basic model to explore how poverty and income distribution respond to variety of redistributive policies. The objective here is to compare and rank, in the light of model results and other informations, these policies in terms of their effectiveness for reducing poverty and income inequality. The policies considered for the purpose are (i) indirect tax-subsidy (ii) income transfer and wage policy viz. minimum wage and wage redistribution policy (iii) agricultural output and investment policy (iv) export promotion and import substitution policy. These policies, it can be noted, vary in operational significance in a mixed economy as in India and, as they affect poverty and income inequality through different channels, may be mutually substitute or complementary to each other. Again, because of highly non-linear nature of the model, the effect of a number of policies applied simultaneously need not be additive. To examine their combined effect we also simulate the model with a package of above mentioned policies.

The policy analysis considered in Chapter 6 of this study should be viewed as illustrations of the major characteristics of the different growth and redistributive policies. But the scope of these analyses is necessarily limited as income distribution and growth are not completely integrated with each other in the basic model. As a result, impact of different redistributive policies on the poor are evaluated in isolation from that of growth and investment policies. But ideally they should be examined conjointly as redistribution and growth are interrelated with each other. The basis of this integration is that income redistribution affects economic growth via its impact on the investible resources of the economy; and economic growth, in turn, influences income distribution process by affecting level and structure of output and prices. Moreover, as effects of growth and income redistribution take time to work themselves out, it is necessary to consider the policy analysis within a specific time frame of analysis so that one can compare the impact of any redistributive policy over time and can translate them into specific strategies for achieving targets of poverty and inequality reductions. Consideration of this two-way linkage between income distribution and growth within a specific time frame would also clearly bring into focus both long run and short run impact of different redistributive policies and help to estimate the trade-off between redistribution and growth. Our objective in this part of the study is to integrate income distribution and growth in a planning model and use it for : (a) comparing two alternative approaches to poverty reduction viz. 'growth maximisation approach and inequality reduction approach', and (b) estimating the 'trade-off' between short run income redistribution and long run growth of income and consumption of the poor.

Integration of income distribution and growth in a plan model, however, requires addition of new dimensions to the traditional plan model. First, the distribution of income between the poor and non-poor should be determined within the model structure by tracing their income linkage with different productive sectors and identifying the forces that affects their economic position. Private consumption in such a model should also be estimated endogenously from the disposable income of the two groups of population. Second major requirement is that the import should be estimated endogenously from the sectoral requirement of import for both intermediate and final use. Endogenous treatment of private consumption and import, therefore, will enable one to study the repurcussion of income redistribution on household and foreign savings which are supposed to be two major constraints of economic growth in a developing economy. Next, in order to capture the impact of growth on income distribution, the level and structure of investment, which affect the level and structure of output and prices, should be linked with aggregate as well as sectoral rates of growth of the economy. Fourth, these growth rates have to be estimated endogenously in the system in such a way that the growth programmes achieve the 'targets' at the specified points of time. These considerations, however, require that (a) static consistency between output, price, income and/or consumption distribution at each period and (b) intertemporal consistency between investment at one period and growth of output and investment at subsequent period, are maintained within the model. The planning model, as described in Chapter 7, considers the above mentioned dimensions in a two-period intertemporal framework through a system of interdependent macro and sectoral relations at the two points of time.

In Chapter 8 we present a method for estimating the plan investment, sectoral as well as aggregate, along with its different components viz. pipeline committed investment, plan investment for capacity creation during plan and post-plan periods, using a distributive lag model of investment. This model, which is similar to those of Chakraborty (1969), Eckaus and Parikh (1968), Lahiri (1976) etc. considers adequate time structure behind accelerator type relation between investment and capacity output, and expresses the total plan investment as a function of pre- as well as post-terminal rates of growth of capacity output.

These rates of growth, on the other hand, can be treated as unknown solution variables in a plan model and the total plan investment can be estimated consistently with plan objectives. In this chapter we use this model for estimating the total plan investment during the sixth plan period of India. The results obtained by our method are compared and discussed in relation to those reported in the Technical note on the sixth plan of India (1981).

In Chapter 9 we carry out variational exercises with the plan model. The purpose of such exercises is to highlight the growth and income distributional characteristics of certain policy instruments in our plan model. For this we first obtain the 'basic solution' of the plan model under some preferred variant of the 'targets' and compare the alternative solutions of the plan model with the 'basic solution' for analysing the growth and distributional impact of different policy instruments.

Finally, the Chapter 10 of the study reviews the contribution of the present study in the light of the recent and growing literature on the relationship between growth, poverty and income distribution. The reference here is to a class of models all of which are of a mixed analytical empirical character. Individual studies in this class differ significantly from one another in respect of details and have a different set of problems before them. In this review we shall be concerned with certain basic and common elements in modelling the relationship between growth, poverty and income distribution as considered in these studies. Thus we shall review our work in terms of methodological approach towards the problem of modelling the process of income distribution and growth in input-output framework and the empirical results obtained from such models.

CHAPTER 2

Quantitative Studies On The Relationship Between Income Distribution And Growth : A Survey

2.1 Introduction

Empirical evidence on poverty and income inequality in many developing countries have raised serious doubts about the socalled 'trickle down' effect of growth which assumes that problems of poverty and income inequality could be solved if growth could be accelerated. Consequently there have been several attempts in recent years to provide empirical evidence on the relationship between income distribution and growth; and also to examine the policy responsiveness of this relationship. In this chapter our purpose is to review these theoretical and empirical studies on interrelationship between income distribution and growth.

In terms of technique of analysis and the approach towards the problem these studies may be divided into two groups. One group of studies, which are econometric in nature, use the cross section and time series information to estimate this relationship. In these studies indices of income inequality is taken as dependent variable and are assumed to be influenced by such variables as GNP, agricultural output, investment, technology, household and regional characteristics. The earliest instance of such a study is by Kuznets (1955), the latest is by Gaiha (1985).

The other set of studies formalize this relationship between income distribution and growth through mathematical models on the basis of stylized facts regarding the economy under consideration and use the model to simulate the effect of different policies on income distribution, poverty and growth. This group of studies can be further subdivided on the basis of type of relationship and the framework of analysis. One group of studies is carried out in input-output framework and captures one way relationship between growth and income distribution viz. the effect of income redistribution on growth. Modelling of income distribution in input-output framework was first attempted by Pyatt et al (1972) and was subsequently used to estimate the effect of income redistribution on growth and other macro-economic variables for different countries. The other group of studies uses Computable General Equilibrium (CGE) models to explain the causes and policy responsiveness of income distribution and growth in developing countries. Finally, there are redistributive planning models e.g. Fifth and Sixth Plan models of India, which study the implication of poverty reduction through income redistribution on planned economic growth.

This chapter is organised as follows. In next section we give a brief summary of econometric studies on the relationship between income distribution and growth. In section 2.3 we describe the models of income distribution and growth built in input-output and Computable General Equilibrium framework and empirical conclusion regarding certain policy issues drawn from such models. Finally, in section 2.4 we examine the methodological and empirical aspects of redistributive planning models for Indian economy.

2.2 Econometric studies on relationship between income distribution and growth

Empirical evidence on the relationship between growth and income distribution was first provided by Kuznets (1955), who predicted, from cross country data, that in early phases of industrilization in the under developed countries, income inequality would tend to widen before levelling forcess become strong enough to stabilize and then to reduce income inequality. The justification of the observed phenomenon was to be found in the growing importance of political and sociological forces counteracting unequalitarian tendencies due to economic mechanism. Soon modified this became an economic law under which income inequality necessarily increase during the first stage of economic growth and latter decreases automatically. Subsequently Oshima (1962) reached similar hypothesis. By distinguishing four phases of economic development viz. undeveloped, underdeveloped, semideveloped and fully developed, he reached the following conclusions : Before any development takes place, inequality is low, with introduction of capitalistic industries and commerce inequality grows and reaches its peak at some point in semi-developed stage and thereafter it decreases. A number of studies have been devoted to the empirical verification of these ascertions. They are mainly based on econometric analysis of cross section data. In this context we may mention the works of Ahluwalia (1974, 1976), Paukert (1973), Adelman (1974), Chenery and Syrquinn (1975), etc. In all these studies an attempt is made to establish an association between percapita GDP, taken as an indicator of economic development, and various indicators of income inequality. Typological analyses also look for discriminant factors as dualism, distribution of assety etc. which might correspond to different patterns of growth [see for example, Adelman and Morris (1973)]. These studies have confirmed the view of Kuznets as well as of Oshima. Moreover, the recent time series evidence on the level of GNP and inequality provided by Ahluwalia (1979) supports the cross section result as far as worsening phase of inequality is concerned. Further these studies conclude that income distributional policies have been at least as important to poverty alleviation as to changes in aggregate growth rates.

Poverty, on the otherhand, is often viewed as a direct consequence of the development strategies pursued by the developing countries. Khan and Griffen (1977), for instance, argue, on the basis of selected observations on Asian countries, that type of development strategies used in these countries has meant increased impoverishment of large section of population. Analysis of Indian experience provoked by Khan and Griffen have, however, yielded mixed results. While analysis of Ahluwalia (1980) suggests an inverse relationship between rural poverty and indices of agricultural output (that is, output per head) at the all India level, the state level results present a somewhat different picture. The inverse relationship between index of agriculture production and rural poverty is observed in some states but there is also evidence that there are forces at work which tend to increase the incidence of poverty independently of variations in the index of agricultural output. The view that increase in agricultural production has reduced rural poverty has been challenged by Saith (1981) on the ground that, while rural poverty is directly related to cost of living index and inversely to agricultural production, the underlying time trend indicates a residual rising term in rural poverty after accounting for the influences of these factors. Consequently Gaiha (1986) shifts the attention from the indices of agricultural production and cost of living to (i) aspects of village development (ii) new agricultural technology and (iii) demographic and household characteristic for explanation of rural poverty. Using the logit model Gaiha calculates the conditional probability of a household being poor given the above mentioned variables, and finds that village specific, technological and household specific variables exercise a strong influence on the risk of being poor. Further it was noticed that the new agricultural technology has a strong poverty reducing effect by raising agricultural yields as well as creating new employment opportunities. However, this poverty reducing effect of new technology was found to be reducing over time. Thus the empirical studies seem to suggest that it is not growth itself but the types of policies which promote growth and the socio-economic structure in which growth takes place that determine whether it is equitable or not.

2.3 Simulation models for analysing income distribution and growth

The key argument regarding the link between growth and income distribution is that different classes have different tendencies to consume, rather than accumulate. Thus any redistribution between socio-economic classes will change the overall savings rate and economic growth. The Keynesian view point, on the other hand, relates aggregate savings rate, not to different socio-economic classes as done by Adam Smith, but to income groups; and also reach the familiar conclusion that redistribution of income from the rich to the poor will reduce the overall savings rate and growth of the economy. Against this, a converse argument, that has some relevance for the developing countries, is that if growth is slowed by shortage of aggregate demand then redistribution of income in favour of the lower income groups will accelerate growth. Perhaps one may note, in this context, the argument stemming from demand theory, which was used by Paukert (1973), that propensity to consume different items varies between income groups with the consequence that income distribution influences the balance of payment to the extent that total supply of some consumption goods rely more heavily on imports than others. More specifically, it is argued that the goods which carry a relatively high weight in the budget of the higher income groups will involve a relatively high import content. Thus, to the extent the balance of payment constraint is binding, redistribution of income to the lower income groups will ease that constraint and constribute to a faster growth[1/]. Moreover,

[1/] This sort of mechanism has been explored by Pyatt et al (1973) and the Paukert, Skolka and Maton (1974). In the latter study it was found that redistribution, although lower the import content of GDP, increase the absolute level of import.

it has been argued that income redistribution from the rich to the poor may increase growth by lowering the capital - intensity of production and the over-all capital - outpur ratio. In the recent years there have been several attempts to incorporate these arguments in static semi closed input-output frame-work to analyse the impact of income redistribution on growth. The models used in these studies work on Keynesian line of demand determining output and focus on differential consumption pattern and import use by the different socio-economic groups and the differential capital and labour intensity across sectors of production.

Modelling of relationship between income distribution and growth in static semi closed input-output framework was first attempted by Pyatt et al (1972). Pyatt's methodology was subsequently used by Cline (1972), Lopes (1972), Weiskoff (1973), Paukert, Skolka and Maton (1974), Sinha et al (1979), Mohammad (1981) etc. India's Fifth and Sixth Plan models also used this methodology in 'open-loop' framework. This methodology, which captures only one way relationship between growth and income distribution is mainly used to estimate the impact of hypothetical income redistribution on output, employment, domestic savings and other macro-economic variables. The impact of income redistribution on growth is mainly assessed via the impact of income redistribution on domestic savings. As should be expected from the variety of references the studies differ among themselves in a number of technical details of modelling the relationship and also in types of policy analysis. However, these studies follow a 'common' methodology and we shall be concerned, in this review, with certain basic and common elements in their approach towards modelling the relationship between income distribution and growth in input -output framework. These common elements are :

(a) the methodology uses a semi-closed input-output model with endogenous private consumption. The basic framework is the conventional macro-economic circular flow of income where the distribution of personal income is determined from the pattern of factor earnings which, in turn, affect level and pattern of private consumption demand. In otherwords this methodology incorporates the distributional aspect in a circular flow of income framework considering output-income-expenditure relationship. In corporation of income distributional aspect, however, implies, apart from interdependence among productive sectors as considered in 'open-loop' input-output model, interdependence between income distribution, output and expenditure.

(b) To take care of this interdependence, and the implied consistency, the methodology determines the distribution of household income from the profile of personal income generated in different productive sectors. The different studies differ in technicalities of determining household income from the personal income generated in different productive sectors. However, all the studies use some form of exogenous income distribution parameter to determine the household income distribution by size class from the personal income generated in production process. To cite examples we may mention the earlier work by Paukert, Skolka and Maton (1974) and the recent work by Sinha et al (1979). Paukert, Skolka and Maton (1974) determine the household income distribution from the aggregate personal disposable income generated in the economy by the exogenous income distribution parameters. In this content we may mention that Mohammad (1981) also follow the same procedure of Paukert et al (1974) for determining the size distribution of income. Sinha et al (1979), on the other hand, determine the distribution of income across low, middle and high income classes as follows. First the distribution of aggregate percapita personal income is obtained from (i) a log-linear relationship between aggregate per capita consumption and aggregate per capita personal income, (ii) the distribution of aggregate per capita consumption which is assumed to follow three parameter log normal distribution with mean and variance parameters estimated from consumption data provided by National Sample Survey Organisation (NSSO) and the Central Statistical Organisation (CSO), Government of India. Next the average income of the three classes, which are designated by apriori fixed percapita income level, and percentage of population within each class, are obtained from the distribution of percapita personal income. Finally, the income linkage of the three classes of population with different productive sectors are obtained from independently estimated percentage distribution of sectoral value added across the three income classes. This value-added distribution matrix is then multiplied with the vector of sectoral output to determine the aggregate percapita income of the three income classes. Finally, the aggregate as well as sectoral private consumption of the economy are obtained from the income levels of the different income classes using different savings ratios for different classes of population and different engel curves for different commodities. Thus, in this model the distribution of household income is ignored and the distribution of personal income is derived not from distribution of factor income but from distribution of total personal income generated within each industry accross the three income classes. However, since the elements of value-added distribution matrix is not explicitly related to the distribution parameters of aggregate per capita personal income the percentage of population within each income class, which is estimated once for all from the two parameter lognormal distribution of aggregate per capita personal income, do not vary under alternative redistribution schemes[2/].

(c) The level and pattern of private consumption expenditure, in this methodology, are determined by considering the different savings and consumption functions for different income classes. In the semi-closed input-output model these functions transmit the change in the distribution of personal income caused by imposition of the stipulated income redistribution upon changes in level and pattern of private consumption as well as of private savings. Ideal concumption and savings functions which would correspond to the requirements of the analysis, should be smooth, linear and fulfill additivity condition and react to a change in income distribution by a change in the structure of total private consumption and of total savings. Such functions, however, do not exists. The different studies differ in modelling savings and consumption expenditure behaviour of the different classes. In one extreme the aggregate consumption and savings are obtained by using fixed savings and consumption ratios for different income classes as done by Paukert, Skolka and Maton (1974). Skolka and Garzuel (1976), Sinha et al (1974), on the other hand, use more general consumption and savings functions. Commodity composition of the aggregate private consumption demand is determined by using engel functions for different commodities. The level and pattern of aggregate consumption are then obtained by aggregating them over different expenditure classes. Finally, sectoral private consumption demand so obtained are used in an input-output system, with

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[2/] It may be noted that if aggregate per capita consumption (C) follows three parameter lognormal distribution then the aggregate percapita personal income (Y) will follow two parameter lognormal if $\log C = \alpha + \beta \log Y$.

exogenously given public consumption, investment and export, to estimate the impact of the hypothetical income redistribution on output, employment, domestic savings and growth. The second round effect of the changed factor income, due to change in level and pattern of output, are estimated by an iterative procedure feeding the effects of the changed factor payment back into consumption demand. The earliest instance of application of this methodology is by Paukert et al (1974) for Iranian economy, the latest application is by Mohammed (1981) for Indian economy.

In this content we may note that in any study on income redistribution one should consider three sets of variables viz. (1) the distribution of personal income generated within each industry (2) the distribution of household income by size classes and (3) a mapping which translates the distribution of personal income into household income. While distribution of personal income generated within each industry depends upon the distribution of ownership of capital asset and the distribution of employment over different wage classes, the mapping of this distribution into distribution of household income depends upon the number of employed persons per household and the household size. Ideally two of these three variables should be endogenously determined in an income distribution model so that the third variable can be determined residually.

In the above mentioned methodology the distribution of personal income within each industry is not explicitly considered and is assumed to be fixed. The share of personal income in value-added of each industry are, therefore, kept constant. Moreover, a certain mapping between implicit personal income distribution and exogenous household income distribution under alternative hypothetical redistribution of income is assumed to exist, although it is not specified. Thus, in this methodology neither personal income distribution nor household income distribution are endogenously estimated. As a result it is assumed that hypothetical redistribution of household income neither affects nor is affected by the distribution of personal income within each industry. Consequently the alternative level and pattern of output under alternative stipulated redistribution of income, although changes the level of average income in different fractile groups of households, it leaves the inequality in household income unaltered. This is mainly because the household income distribution in this methodology is not derived from the distribution of personal income generated within each industry.

Apart from the above mentioned deficiencies in modelling of income distribution the above methodology ignores the role of prices, unequal distribution of productive assets, inequality in structure of wage earnings which play important role in shaping both personal income distribution and household income distribution in developing countries. Moreover, these models ignore the output constraint and capital constraint which are typically found in developing countries. Absence of such constraints in these models unnecessarily exaggerates the feasibility of the different income redistribution schemes analysed in these studies. Moreover, these models are not suitable for formulation of income redistribution policy measures as the income redistribution in such models can not be expressed in terms of different income redistributive policy instruments like indirect tax subsidy, wage rates, investment etc.

The Pyatt's methodology was first applied on Iranian economy to estimate the effect of hypothetical income redistribution on GDP, employment, private consumption and other important macro-economic variables. Subsequently this methodology was applied on other countries by different authors. viz. Paukert, Maton and Skolka (1974) for Philippines, Skolka and Garzul (1976) for Cylon, Mohammad (1981) for India. It was found that redistribution towards greater equality would increase GDP and employment. Redistribution of income towards lower income group also changes the pattern of output towards labour intensive sectors and increase the labour intensity of production in the economy. Thus Paukert et al (1974) found that, for Philippines economy, any hypothetical redistribution of income towards poor led to significant rise in employment, to a lower degree of capital intensity of production and to lower capital output ratio. Other studies point to the offsetting reduction in the demand for services as a result of redistribution, leading to the conclusion that redistribution may have only limited impact on the demand for labour. In so far as the impact of redistribution on balance of payment is concerned, Pyatt et al (1973), Paukert et al (1974) found that inspite of lowering of impact content of GDP absolute level of import rises due to rise in GDP level as a result of income redistribution towards lower income group. Domestic private savings and its rate are also found to fall due to income redistribution from the rich to poor. Thus Skolka and Garzuel (1976) in their study on Iranian economy found significant fall in private savings due to income redistribution.

Recently Mohammad (1981) applied this methodology for Indian economy. His finding supports the positive effect of income redistribution on GDP, employment and personal income. According to his estimate reduction of inequality in personal income distribution through income redistribution will increase GDP, employment, personal income but reduce the personal savings. His results, however, indicate that the absolute level of import in Indian economy remains more or less unaltered due to redistribution of income. It is also reported that the capital output ratio increase as the income is redistributed progressively towards the poor.

The Pyatt's methodology have also been used to study the trade-off between income redistribution and long run growth in GDP by showing the negative impact of income redistribution on aggregate personal savings. Empirical estimates given by different authors show that a certain growth - equity trade-off exists but its magnitude is rather small. Thus Chinn (1972) found for Taiwan and Korean economy low negative growth effect of progressive income redistribution. Cline (1972) found that imposition of income distribution of U.K. would cause a reduction in annual growth rate of GDP in Brazil and Argentina. Mohammad (1981) also found that annual percentage rate of growth of GDP for Indian economy would fall as the income inequality is reduced through hypothetical income redistribution[3/]. But the model on the basis of which the growth equity trade-off is estimated considers the impact of income redistribution only on private savings, leaving aside the impact on public and corporate saving which may be significantly positive. Further, he assumed that entire private savings will be translated in productive investment within the economy. Apart from these limitation, the model suffer from a fundamental limitation. This is the absence of complete integration between growth and income distribution on the basis of two way relationship between them. Because of this, the model, although considers the impact of income redistribution on private consumption and savings, leaves the investment unaffected due to income redistribution.

[3/] In Mohammad (1981), long run GDP growth rate is calculated by applying a global capital output ratio on aggregate personal savings generated by the model neglecting other components of aggregate savings.

Consequently it is assumed that income redistribution, although affects growth, leaves the level and structure of investment unaffected. This however, is an unrealistic assumption. Thus, use of this model for studying the growth-equity trade-off would go beyond its scope. For such an analysis one has to determine the income distribution and growth endogenously taking into consideration the two-way relationship between them.

In recent years there have been attempts to analyse the causes and policy responsiveness of income distribution in developing countries using Computable General Equilibrium models. A compact one sector verson of such models along with their qualitative characteristics is presented in Taylor and Lysy (1979). In this context we may note that qualitative characteristic of these models, as pointed out by Sen (1962) and Marglin (1976), depend upon the specific assumptions one makes to close the system, that is to make its solution determinate. Performance of these model has been examined under three alternative closure rules which have been called Keynesian, Neo-classical and classical closure rules. In Keynesian closure rule investment is fixed in real terms independently of available savings in the economy. Real wage is also stable as the changes in money wages and other prime costs are passed along into changes in prices of output. Macro-economic savings investment identity is restored through changes in output level. In neo-classical closure rule the aggregate price level is held fixed so that when money wage changes real wage changes by equal amount. Investment is determined by available savings and change in relative prices of output and factors of production play the central role in maintaining macro economic equilibrium. Finally in classical closure rule real wages are exogenous and aggregate output and employment are determined by production needs. In this context we note that despite the sophisticated rules of income generation with built in wage differentials between sectors and the different types of labour, functional distribution of income and the measures of inequality in these models show very little response to changes in tax and other policy parameters. Thus Tayler and Lysy (1976) found that increasing employment taxes by 50.0 percent reduced inequality measures by 10.0 percent or less. GNP also was found to be virtually unaffected by tax changes. Similarly change in profit taxes or transfer of profit income to wage earners induce only marginal variations in income distribution and structure of production. In this context we may mention that income growth and income distribution is more responsive to policy changes under classical closure rule than the Keynesian and neo-classical closure rules.

2.4 Redistributive planning models

In this section we briefly describe the structure of the different redistributive planning models which have been constructed for Indian economy. Perspective Planning Division (1962) was first to carryout such an exercise which was followed by Srinivasan, Saluja and Sabherwal (1965), Planning Commission, 1973) and Perspective Planning Division (1973, 1979). Major purpose of these studies was to study the implication of different postulated poverty reduction targets on the level structure of sectoral output and overall growth. While a detailed description of structural specifications of these models (except Perspective Planning Division 1979) and its implication for the analysis of relationship between income distribution, poverty and growth is given in Tendulkar (1971), the same for the Fifth and the Sixth Plan models of India (Perspective Planning Division, 1973, 1979) can be found in Majumder and Panda (1981). In what follows we give a brief summary of the crucial features of these models.

It may be mentioned at the outset that all the models adopt a modified 'open loop' input-output system for carrying out the growth and income redistribution exercises. While Srinivasan et al (1965) and Perspective Planning Division (1962, 1973) carryout income redistributional exercises in a single period static input-output framework, the Perspective Planning Division (1979) considers two period framework by linking terminal year and perspective year through investment and growth. Srinivasan et al (1965) stipulates the level of private consumption at the terminal year exogenously and adopts a semi-endogenous treatment of terminal year aggregate investment. Perspective Planning Division (1962) and Technical Note (1973, 1981), on the other hand, exogenously postulates a maximum feasible growth of GDP and arrive at the terminal year private consumption and investment.

Terminal year investment in Fifth Plan model (Perspective Planning Division 1973) was determined exogenously. For this the total plan investment was first estimated by applying a global incremental capital output ratio to the increase in GDP over the plan period and then the aggregate terminal year investment is obtained after phasing the total plan investment over the different years of the plan period by a step function. Total terminal year investment thus obtained is distributed among different input-output investment goods sector by exogenously fixed sectoral proportions and are used as investment demand by origin in input-output system. Srinivasan et al (1965) and Perspective Planning Division (1979), on the otherhand, determine the terminal year investment endogenously. While Srinivasan et al (1965), following Mann and Rudra (1964), uses stock flow conversion factor for determining terminal year investment from total five year plan investment Perspective Planning Division (1979) determines the terminal year investment by destination on the basis of accelerator type investment functions relating investment by destination at the terminal year with growth of sectoral value added during the post-terminal period. Post-terminal growth rates of sectoral value added are, however, assumed to be a constant multiple of pre-terminal growth rates[4/]. Next the terminal year investment by origin are estimated in both Srinivasan et al (1965) and Perspective Planning Division (1979) by using the socalled capital coefficient matrix.

All the studies, except Srinivasan et al (1965), follow a similar procedure of determining terminal year aggregate private consumption residually from a macro model after deducting terminal year investment and other uses of national income from the targeted terminal year GDP. Srinivasan et al (1965), however, treats the terminal year aggregate consumption as targets.

Given the terminal year aggregate consumption the next problems is to determine sectoral private consumption demand which are to be used in determining the sectoral output. For this it is necessary (i) to determine the average level of total or percapita expenditure for any sub group of population distinguished either by fractile groups or by class intervals according to monthly total expenditure per capita and (ii) to determine the commodity composition of aggregate consumption expenditure of different groups of population.

In determining the total or per capita consumption expenditure for different groups of population all these studies make uniform assumption regarding the size distribution of consumer expenditure viz. it is assumed to follow a two-parameter log-normal distribution that is fully specified by an overall mean level of total expenditure per capita and a variance parameter. The

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[4/] This assumption, as we shall show latter, leads to certain inconsistency in estimation of total Five Year Plan investment.

variance parameter is determined consistently with the given target for removal of poverty at the terminal year.

To specify the commodity composition of total expenditure for different subgroups of population Perspective Planning Division (1962) and Srinivasan et al (1965) use base year engel curves defined as a smooth free hand curve passing through observed base year commodity consumption for different subgroups of population. Perspective Planning Division (1973) specifies a proportionally fixed commodity consumption of total consumption expenditure for 27 subgroups of population separately for rural and urban India. Perspective Planning Division (1979), on the otherhand, uses linear Expenditure System of demand functions for 13 broad commodity groups for determing commodity consumption of four groups of population viz. rural poor, rural non-poor, urban poor and urban non-poor.

It may be noted that all the studies belong to what is termed as 'open loop' model. They are mainly concerned with the problem of determining sectoral output level consistently with the targeted growth of GDP and postulated reduction in poverty. The following assumptions are implied by the structural specifications of these models as noted by Tendulkar (1974).

(i) The technology as well as organisation of production remains invariant to the redistribution of consumer expenditure. This, in turn, implies that postulated redistribution has negligible second order effects in terms of choice of technique.

(ii) The specification of a maximum feasible growth rate can be made independently of the target for removal of poverty and remains invariant to the extent of the postulated redistribution.

(iii) The postulated redistribution is that of consumption expenditure. This implies that redistribution takes place at the stage of disposition of income rather than at the accrual stage in the generation of income.

(iv) The mobilisation as well as condisation of the required quantum of domestic savings (for an exogenously given level of foreign exchange) can always be undertaken in real terms so as to finance the given quantum of investment. It is invariant to the postulated redistribution.

An important implication of the structure specification of these models is the relative invariance of growth rates of 'core sectors' to the extent of redistribution of consumption expenditure. This invariance, as noted by Tendulkar (1974), implies that on the empirical ground the basic growth strategy is functionally independent of the social objective of redistribution or removal of poverty. In otherwords these studies indicate that empirically there is no conflit between growth and redistribution in Indian content. It also ignores the problems and issues connected with unpleasent trade-off between growth and equity. Tendulkar attributes this phenomenon of invariance to the 'open loop' specification of these models. Questioning the appropriateness of 'open loop' framework to study the inter-connection between growth, income distribution and poverty, Tendulkar (1974) argues that the framework by its very construction rules out any inter-connection between growth and income distribution by virtue of their specification independently of each other. He also argued in favour of 'closed loop' framework to ensure mutual consistency between plan investment and its sectoral allocation on one hand, and its internal and external resource requirement on the other. For this one has to establish mutual consistency between production process, resulting income generation and its uses among different components of demand - so that aggregate growth rate, level and pattern of consumption and investment become endogenous to the specification of targets and policy parameters. This framework, Tendulkar (1974) argued, expli explicitly allow for interdependence between growth and income redistribution. The closed loop framework, is as pointed out by Tendulkar (1971), also represents a more appropriate description of institutional specification in Indian context. 'Closed loop' specification of Tendulkar (1971), however, does not go beyond functional grouping of population into wage and non-wage earners -- which were assumed to have homogeneous consumption pattern. Further no attempt was made to carryout redistributive exercise in Tendulkar (1971). Thus Tendulkar (1974) noted " the specification of redistributive social objective as incorporated in size and/or occupational distribution of income and its integration with the rest of the planning model, putting the model in an intertemporal framework as well as introduction of operational features of institutional framework from policy point of view are the three areas which require further experimentation so that dynamic interconnection between growth and redistribution can be meaningfully examined in a unified framework" .

CHAPTER 3

The Basic Model

3.1 Introduction

The objective of the model is to depict the process of income generation and distribution in so far as it affects economic position of the poor. The economic position of any economic group in a real economy, however, is determined by complex interaction of different economic, social and political parameters and it is not possible to capture all aspects of this process in a single model. This model primarily focuses on the role of output price-income distribution interaction process in an economy for determining the level and share of income of the poor.

The central theme of this interaction process is interdependence of output, price and income distribution. The basis of this interdependence, as considered in this model, is that income distribution across socio-economic classes affects the level of structure of output and price in the economy via its influence on the level and pattern of demand; level and structure of output and price, on the other hand, affects income distribution via their influence on the pattern of factor income across socio-economic classes.

In the present model this interdependence is considered by dividing the economy into a number of productive sectors and the population into a number of socio-economic groups. The primary justification for this segmentation is that : (a) an underdeveloped economy like India cannot be said to be governed by a single rule - either for price formation or for output determination and income generation in different productive sectors : and (b) the socio-economic groups in such an economy show wide variation with respect to their income sources and consumption behaviour. These heterogeneitics of the productive sectors and the socio-economic classes play an important role in determining the economic position of the poor.

In order to estimate the output and prices we mainly focus on the conditions of supply in different productive sectors. The elasticity of supply of primary products (specially that of agricultural produce) in India is likely to be small and can not be assumed to be 'demand-determined'. The output of such sectors should be treated either as exogenous or by farmer's response to economic stimuli; while the prices are determined by forces of demand and supply. Industrial sectors, on the other hand, are generally marked by presence of excess capacity and imperfect oligopolistic market structure. Output of industrial products are therefore, elastic and determined by demand while their prices follow mark-up pricing rule[1/].

Secondly, a major component of demand viz., private consumption is endogenised in the model by considering output-income-price-consumption relation for each socio-economic group. These relations reflect both consumption and savings behaviour of different socio-economic groups, and anables one to study the impact of income redistributions on the level and pattern of aggregate private consumption demand.

1/ This basic dichotomy in output and price behaviour in underdeveloped countries is clearly spelt out in Robinson and Eatwell (1974, pp. 145-57). In this context we may note that Kalecki (1971) in studying the dynamics of advanced capitalistic economy concerned himself exclusively eith 'cost-determined prices'. Moreover, we may further note that a number of econometric studies in India point to the importance of demand and cost of production in the determination, respectively, of agricultural and manufacturing prices (see, for example, Chakrabarty (1970), Agarwala (1970), Maity (1975) etc.).

Finally, in order to determine the distribution of income the model focuses on two sources of inequality. First is the inequality in the distribution of income between profit and wage - the basic determinants of which are sectoral mark-up. The second source is the inequality in distribution of wage earning and reflect the differential assess to employment due to difference in skill characteristics among socio-economic groups.

Thus the model, while considering the interdependence between output, price and income distribution, mainly focuses on the following factors typical of an underdeveloped economy like India :

(1) Differential access to employment due to differences in skill characteristic among socio-economic groups and resultant inequality in employment earning.

(2) Different rules of price and output determination in agriculture and industry arising out of their different supply conditions.

(3) Different consumption and savings behaviour of the socio-economic classes.

These factors, which have important bearing on the level and share of income of the poor, have not been formally combined together in other model, although some of them have seen considered individually in models of growth, income distribution and poverty[2/]. We may take this opportunity to point out a

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2/ A representative sample of these models would be : Pyatt et al (1972), Paukert and Skolka (1972), Pyatt and Thorbecke (1976), Weisskoff (1976), Sinha et al (1979), Mohammed (1981), India's Fifth and Sixth Plan Models (1973, 1979) etc. These models mainly study the impact of income redistribution on output and growth in input-output framework. Our indebtedness to this literature will be pointed out in specific contexts.

few limitations of these models used in analysis of growth, income distribution and poverty, the limitations we try to overcome in the present work.

Firstly most of these models have not considered role of prices in determining distribution of income across socio-economic classes - particularly for determining the level and share of income of the poor. However, present day experience reveal that prices may have considerable effect on income distribution and the level and structure of output[3].

Secondly, the models tread on Keynesian line of demand determining output. However, as we have argued above, in an economy like India supply of many commodities (particularly agricultural commodities) are inelastic and hence redistributive policies aimed at improving the condition of the poor may result in increase in prices and may even worse their position.

Finally most of these models ignore the pattern of factor income across socio-economic classes. In these models distribution of income is mainly derived from aggregate or sectoral value-added, not from distribution of profit and wage across socio economic classes. This, as we have already argued, ignores some basic constraint on growth of income of the poor viz., lack of access to productive assets and employment of the poor in the economy.

3/ The variables in the present model are valued at both at producer's price and market price. For the base year (1979-80), sectoral producer's price and market price indices are unity. At these prices all the economic variables are considered to be at constant prices. Sectoral as well as aggregate prices as estimated by the model under alternative policy configurations, however, may be different from unity. Economic variables when measured at these changed prices will be referred as 'valued at current prices'.

Moreover, as these factors represent crucial constraint on growth of income of the different socio economic groups, particularly of the poor, absence of any of them in such models exaggerates the flexibility of economic structure and feasibility of policies for alleviating poverty and reducing income inequality.

In this present model that follows we combine the above discussed factors in an IO framework to study their implication on the growth of income of the poor.

3.2 Structure of the model :

The primary objective of the model, as we have stated above, is to consider the interdependence of output, price and income distribution in an economy for determining the level and share of income of the poor. This interdependence can be best examined by disaggregating the economy into a number of productive sectors and the population into a number of socio-economic groups. Ideally one should consider a large number of productive sectors and socio-economic groups to reflect the numerous differences in their respective production and socio-economic characteristics. But the information requirement of a highly disaggregated model becomes enormous and one has to strike a balance between size and scope of the model.

In this model we divide the economy into a number of productive sectors which may be broadly identified as agriculture, mining, manufacturing, electricity and services. These productive sectors have fixed coefficient Leontief technology and, therefore, are mutually interdependent. Moreover, agriculture sector differ in supply condition from other sectors of production.

This difference in supply condition and the interdepence among productive sectors play an important role in determining the prices and output in the economy.

Population, on the other hand, is divided into two socio-economic groups called 'poor' or the 'target group' and 'non-poor' or the non-target group'[4]. This minimal step in dividing the population into two groups brings focus on the poor by contrasting them with non-poor. However, our treatment of the non-poor as a single homogeneous group ignores the variation of income and consumption pattern amongst them. Our model and its results are restrictive in so far as these variations affect the economic position of the poor.

The target group in the model consists of the members of those households in the economy whose percapita income is <u>less than or equal</u> to the 'minimum per capita' income necessary to meet the aggregate per-capita consumption corresponding to a given poverty line (π_0). This income <u>definition</u> of the poor, it should be noted, approaches the ~~pattern~~ problem of poverty from notion of ability[5]. A poor person, according to this definition, is one who does not have enough income to meet the poverty line aggregate consumption. Further, this income definition does not gurantee that actual consumption of those with 'minimum per capita income' will satisfy the normative calorie requirement corresponding to the poverty line. It merely ensures their income ability to buy the normative consumption busket.

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[4] We shall use the terms 'target group' and 'poor' interchangeably.

[5] Further, it assumes a single set of commodity prices and uniform consumption behaviour for the target group. However, consumption behaviour of the target group and prices faced by them vary over regions, climate, age-sex composition and even religion. (See Bhattayacharya and Chatterjee (1974, 1977), Bardhan (1973), Vaidyanathan (1974), Radha Krishna and Sharma (1975), We however, supress all these dimensions in the present model.

The two socio-economic groups are linked with different productive sectors through their income and consumption. The target group is linked with productive sectors through " employment" and their income consists of only 'wage' income[6/]. The non-target group, on the otherhand, is linked with production via employment as well as ownership of assests. Thus income of the non-target group consists of wage and profit income. The consumption linkages of the target and non-target groups are reflected in their consumption pattern of output produced in different sectors of production. These two socio-economic groups are also implicitly linked with each other through commodity trade as change in level and pattern of consumption by one group will change the level and share of income of the other group via its impact on the level and structure of output and prices in the economy. These income and consumption linkages of the socio-economic groups are crucial for analysis of different growth and redistributive policies because impact of these policies are transmitted to different socio-economic groups mainly through these linkages. Moreover, the implicit linkage between target and non-target groups enables us to take into account the adverse effects of reduced growth of income in the non-target group on the income of the target group. Given these linkages among different productive sectors and the target groups and non-target groups, the mechanism for determining output, prices and the level and share of income of the target and non-target groups are explained in the section 3.2.2. However, only the main equations determining the basic endogenous variables of the model are explained in the text

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6/ The term employment includes both employment as hired labour and self-employment. Correspondingly the term 'wage' include contractual wage payment as well as earning from self employment.

while the complete mathematical structure is given in the Appendix-A. The notations used in model are given in the following section.

3.2.1 Notations

The notations defined below are used in both Chapters 3 and 7 of the study. They are arranged in alphabetical order under three broad categories viz. endogenous variables, exogenous variables and parameters. Further, a few other notations are used in different places which are explained in specific contexts. Subscripts i, j refer to IO sectors, the subscript k to wage classes and superscript m to socio-economic groups.

Endogenous Variables :

β = percentage of population in the target group.

C = private consumption at current market price.

c_a = per capita aggregate consumption of the non-target group at current market price.

c_b = per capita aggregate consumption of the target group at current market price.

c^m = per capita aggregate consumption of mth group of population viz. rural poor, urban poor, rural non-poor, urban non-poor, at current market price (m = 1, 2, 3, 4).

C_i = aggregate sectoral private consumption at base year factor cost.

C_{ir} = aggregate sectoral private consumption at current market price.

c_i^a = aggregate sectoral consumption of the non-target group at base year factor cost.

c_i^b = aggregate sectoral consumption of the target group at the base year factor cost.

c_i^m = per capita sectoral consumption of mth group of population at current market price.

D_j = depreciation at current price.

Dd_j = domestic market demand at current market price.

EL_j = total employment in standard person years.

I = gross investment at current market price.

I_i = gross fixed capital investment by origin at base year factor cost.

k_0 = normative rate of (average) annual wage at current price.

M_i = import at base year c.i.f. price.

p_j = producer's price.

p_{rj} = domestic market price for commodities in final use.

p_{ca} = consumer price index for the non-target group.

p_{cb} = consumer price index for the target group.

p^m = total population in mth socio-economic group.

PF = aggregate profit net of depriciation.

PF_r = aggregate profit accruing to private corporate sector.

ρ_j = profit per unit of output.

S = gross savings at current market price.

S_C = corporate savings valued at current market price.

S_F = foreign savings valued at current market price.

S_H = household savings valued at current market price.

S_P = public savings valued at current market price.

S_{0j} = domestic market supply at base year market price.

T_d = total direct tax valued at current market price.

T_x = total indirect tax less subsidy valued at current market price.

Q_b = dependency ratio in the target group.

V_j = gross value-added at current price.

x_j = gross output at base year factor cost.

y_a = aggregate (annual) disposable income of the non-poor at current price.

y_b = aggregate (annual) disposable income of the poor at current price.

Exogenous Variables :

$(\Delta S_i)^*$ = change in stock

E_i^* = export at base year factor cost.

EL_{0j}^* employment at the base year in standard person years.

G_i^* = government consumption at base year factor cost.

Υ = width of wage class.

I_i^* = gross fixed capital investment by origin at base year factor cost.

P^*, P_r^*, P_u^* = total population, rural population, urban population.

p_{mi} = domestic price of imported goods.

π_0 = poverty line at base year market price.

Z_0^* = proportionality factor of the dependency ratio of the target group to that of overall dependency ratio of the economy.

Parameters

a_{ij} = commodity X commodity IO coefficient.

a_{ij}^m = import component of a_{ij}.

a_{ij}^{d} = domestic component of a_{ij}.

(a_i^m, b_i^m) = parameters of sectoral LES demand functions for mth group of population, m=1, 2, 3, 4.

d_i = depreciation rate

e_{ik} = (i, k)th element of employment distribution matrix.

f_r = share of total net profit accruing to private corporate sector.

g_i = import coefficient of government consumption.

h_i = import coefficient of aggregate final demand.

m_i = import coefficient of fixed capital investment.

q_i = import content of private consumption.

r_j = mark-up.

s_c = corporate saving rate.

s_h = savings rate of non-target group households.

t_e, t_d = corporate and direct tax rates.

t_i = indirect tax rate.

t_{ei} = export duty rate.

t_{mi} = import duty rate.

t_{Oi} = base year indirect tax rate. (as per Sixth TN)

t_{coi} = average indirect tax rate at the base year. (as per Sixth TN)

t_{oei} = base year export duty rate. (as per Sixth TN)

t_{omi} = base year import duty rate. (as per Sixth TN)

TRS^* = Net factor income from abroad and other current transfer from rest of the world.

w_k = annual wage rate at current price.

z_a, z_b = ratio of per capita consumption in urban to that of rural area for non-target and target groups respectively.

3.2.2 Output and prices :

The basis of output and price determination has been indicated in the intorductory section. It was argued that an underdeveloped economy like India can not be guided by single rule - either for price formation or for output determination. To make room for this we divide the entire production system into two subsystems denoted by S_1 and S_2. The subsystem S_1 consists of those sectors whose output are mostly unresponsive to demand and the prices, rather than output, respond to change in 'demand-supply' condition of the market. That is, the (domestic) prices of the commodities produced in S_1 are determined by interaction of domestic demand and domestic supply.

Domestic production of the sectors belonging to S_1 are determined in the present model under two alternative assumptions[7]. First we assume that the output of the sectors belonging to S_1 depend upon non-economic factors like rainfall. This assumption is, however, restrictive as output of sectors like foodgrain are found to be responsive to food grain price and the prices of major input like fertilizer. So, alternatively, we assume that the output of foodgrain sector is determined by profit maximising principle under the Cobb-Douglas type neo-classical production function. Finally, we may note that our model can also be used under the assumption that agricultural output is 'demand-determined' -- the assumption which is usually made in the empirical studies on income distribution and growth in input-output framework.

The domestic supply of commodities produced in S_1 consists of import and domestic production net of change in stock and export. (see equation (A.27)

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[7] The subsystem S_1 in the present model consists of only food grain sector.

in the appendix). The market prices of commodities produced in S_1 are determined in such a way that domestic demand (Dd_j, see equation (A.26) in the appendix) and domestic supply (S_{oj}) are equal at the prevailing market price. (see equation (3))[8].

The subsystem S_2, on the other hand, consists of those sectors where output, rather than prices, change with demand and prices are determined by 'mark-up' pricing rule. According to this rule prices are determined by applying mark-up (r_j) over unit cost of production (equation (4)). Sectoral mark-up reflect the state of competitive condition and the nature of market organisation respective industries, and are treated as parameters of the system. Unit prime cost which include both material input and wage input cost are determined by technology and distribution of sectoral employment over different wage classes. Output of sectors belonging to S_2 are determined by final demand using input-output relations as given in equation (2). Sectoral employment are determined by using fixed labour coefficient on sectoral output.

The output and prices of the sectors belonging to the two subsystems are, therefore, determined by the following relations.

<u>Output</u>

$$x_i = x_{ai}/(1-a_{ii}) \quad \forall \; i \; \varepsilon \; S_1 \qquad \ldots\ldots (1)$$

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[8] Several authors (eg. Hicks (1974)) have stressed the role of intermediate traders in the price formation of the commodities produced in S_1 specially in that of agricultural product. We, however, ignore this role in the present model.

$$x_i = \sum_{j=1}^{n} a_{ij} \cdot x_j + C_i + I_i^* + G_i^* + E_i^* + (\Delta S_i)^* - M_i$$

$$\forall \; i \; \varepsilon \; S_2 \qquad \ldots\ldots (2)$$

Price

$$p_{rj} = Dd_j / S_{0j} \qquad \forall \; j \; \varepsilon \; S_1 \qquad \ldots\ldots (3)$$

$$p_j = (1+r_j) \Big[\sum_{i=1}^{n} a_{ij}^{d} \cdot p_i \, (1 + t_i) + \sum_{i=1}^{n} a_{ij}^{m} \cdot p_{mi} \, (1 + t_{mi})$$

$$+ a_j^0 \sum_{k=1}^{s} e_{kj} \cdot w_k \Big], \quad j \; \varepsilon \; S_2 \qquad \ldots\ldots (4)$$

where,

x_{ai} = output of sector i net of self input

x_i = output of sector i

p_i = producer's price of sector i

p_{rj} = market price of sector j

Dd_j = domestic final demand of sector $j \; \varepsilon \; S_1$

S_{0j} = domestic market supply of sector j at constant market price $j \; \varepsilon \; S_1$

r_j = mark-up for sector $j \; \varepsilon \; S_2$

a_j^0 = employment per unit of output in sector j

e_{jk} = proportion of total employment in sector 'j' falling in kth wage class

w_k = average wage rate in kth wage class

a_{ij}^d, a_{ij}^m = input-output coefficient with domestically produced and imported inputs.

As mentioned above x_i in equation (1) is either exogenously specified or determined by (1) using the following supply response function for net output (x_a) of a particular sector (foodgrain) belonging to S_1

$$X_a = D \cdot p_a^{(a+b)/c} \cdot w^{-a/c} \left[p_f \,(1 + t_f) \right]^{-b/c} \qquad \ldots\ldots (5)$$

where

p_a, p_f = producer's price of food grain (sector 1) and fertilizer (sector 19) respectively as determined in the price model.

$$w = \sum_{k=1}^{s} e_{1k} \cdot w_k$$

= average wage rate for the sector 1

t_f = indirect tax/subsidy on fertilizer.

D, a, b and c (=1-a-b) are constants.

It may be noted that the expression (5) above is derived by maximising profit generated in food grain sector using the Cobb-Douglas type production function[9].

$$X_a = A \cdot E_1^a \cdot F_1^b , \qquad a + b < 1 \qquad \ldots\ldots (6)$$

where E_1 and F_1 are labour and fertilizer input and A is constant. The labour and fertilizer input demand by food grain sector are then given by

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9/ That is by maximising $(p_a \cdot x_a - p_f\,(1 + t_f) \cdot F_1 - E_1 \cdot w)$ subject to the condition $x_a = A \cdot E_1^a \cdot F_1^b$ and determining the optimum output.

$$E_1 = x_a \cdot a \cdot p_a / w \qquad \ldots\ldots (7)$$

$$F_1 = x_a \cdot b \cdot p_a / [\, p_f (1 + t_f) \,] \qquad \ldots\ldots (8)$$

The employment estimated by expressions (7) is used in determining employment income of the poor and the non-poor in the income distribution model. Similarly expression (8) appear as demand for fertilizer sector in determining fertilizer output. Further, we may note that the price equation (3) determines the market price for food grain while equation (4) determines producer's price for other sectors. Producer's price (farm harvest price) for food grain output and market price for other sectors are determined from the relation between market price and producer's price as given by equation (A.6) in the Appendix A. Thus the price equations (3) and (4) are to be simultaneously solved with the equation (A.6) for determining producer's and market price for all sectors.

3.2.3 Final demand

Domestic final demand consists of private consumption demand, public consumption demand, gross investment demand and export. Of the different components of final demand, the private consumption demand is endogenous and the remaining components are exogenous in the present model.

The private consumption demand is endogenously obtained by considering production -- income -- price --- consumption relation for the two groups of population. For this we have taken into consideration the following facts. First, production in different sectors generates income to the target and non-target groups via their income linkage with different productive sectors [equations (13) and (14)]. Per capita aggregate consumption of the two groups of population (c_b, c_a) are then obtained from their disposable income using their respective income savings ratios and the percentage of population [equations (9) and (10)]. In order to break down their aggregate per capita consumption into sectoral components we note that the majo determinants of per capita sectoral consumption are per capita aggregate consumption, product (market) prices and consumption pattern as reflected in demand functions.

For this, to reflect the differences in rural urban consumption pattern, the per capita aggregate consumption of the two groups are broken down into their respective rural and urban components ($c^m, m = 1, 2, 3, 4$) by applying the respective ratios (Z_b, Z_a) of per capita consumption in urban to rural population for both target and non-target group (equations (A.17) to (A.20) in the appendix). Finally sectoral consumption of these four groups of population (c_i^m) viz. rural poor, rural non-poor, urban poor and urban non-poor are obtained from their respective LES demand functions and are aggregated to arrive of the sectoral private consumption at market prices (equations (A.14) and (A.15) in the appendix). The aggregate sectoral private consumption at base year factor cost (C_i) are finally obtained after adjusting for sectoral prices and base year tax rates (equations (A.16) in the appendix).

Thus if y_b and y_a are aggregate disposable income of the poor and the non-poor as obtained in the income distribution model (described in section 3.2.5) then their per capita aggregate consumption (c_b, c_a) and aggregate sectoral consumption (C_{ir}) are given by

$$c_b = y_b / \beta \cdot p^* \qquad \ldots\ldots (9)$$

$$c_a = y_a (1 - s_h)/(1 - \beta) \cdot p^* \qquad \ldots\ldots (10)$$

$$C_{ir} = \sum_{m=1}^{4} p^m \left\{ a_i^m \cdot p_{ri} + b_i^m \left(c^m - \Sigma\, a_j^m \cdot p_{rj} \right\} \right. \qquad .....(11)$$

where

(a_i^m, b_i^m) = parameters of LES demand function for mth group of population

c^m = per capita consumption for mth group of population

p^m = population in mth socio-economic group

β = percentage of poor, as determined in the income distribution model.

It may be noted that subsystems are interdependent to each other via sectoral output, prices and demand. This interdependence is reflection of (i) technological interdependence between productive sectors resulting in output and cost interdependence (ii) interdependence of productive sectors and socio-economic groups via income, consumption and commodity trade linkage resulting in demand interdependence. Demand, other hand, depends upon the distribution of income between the target and non-target groups. Thus output and prices of the system depend upon distribution of of income between the target and non-target group.

3.2.4 Import

Import in the present model consists of (i) import for intermediate use and (ii) import for final use. These are estimated by using two sets of coefficients representing (a) the intermediate import use per unit of output as given by the import coefficient matrix, a_{ij}^m and (b) the import use per unit

.../-

of final demand (h_i)[10]. Thus the total sectoral import (M_i) is given by

$$M_i = \sum_{j=1}^{n} a^m_{ij}.x_j + h_i\ (C_i + G^*_i + I^*_i) \qquad \ldots\ldots (12)$$

3.2.5 Distribution of income between the target and non-target group :

In order to identify the target group (the poor) and the non-target group (the non-poor) households and determine their level and share of income it is necessary to calculate the " minimum per capita income" and spot those households whose per capita income is less than or equal to this " minimum income". The " minimum income" is obtained in the model by evaluating the 'poverty line' consumption (π_0) at the consumer price index of the target group (p_{ob}, see equation (A.30) in the appendix). Identification of the target group households and determination of their income, then, are done in the model in two steps.

In the first step we determine the " normative rate of (average) wage" (k_0) which the earning members of a target group household should earn to provide the " minimum per capita income" to all the members (including the earners) of the household. For this we use the concept of dependency ratio defined as the number of dependents (including the earners) per earning member of the household, and make the following assumptions regarding socio-economic characteristics of the target group. :

10/ Import coefficient, h_i, of the aggregate final demand is estimated by using seperate import coefficient for private consumption (q_i), government consumption (g_i) and fixed capital investment (m_i) (See equation (A.29) in the appendix).

(A 1) The earning members of the target group households earn their income through employment either as hired labour or as self-employed.

This assumption is based on the general observation that target group mainly includes households based on income of agricultural labour, small farmers, low paid unskilled workers in urban informal sectors, tenant farmer etc. (see eg. Sinha et al (1979), Chenery and Duloy (1974)).

(A 2) The target group households has a common dependency ratio (Q_b) equal to a constant multiple (Z_0^*) of overall dependency ratio in the economy. This assumption implies that the household size varies proportionally with number of earning members in a household - the constant of proportionality being the common dependency ratio of the target group, and this would reflect the overall population and employment situation in the economy.

(A 3) The net savings of the target group household is zero and they do not pay direct tax.

In the second stage, in order to determine the total income of the target group, we consider only those households of the economy whose income consists of only wage income. Because all the households with positive profit income are by assumption (A 1), excluded from the target group. Moreover the target group consists of members of those household where average wage income is less than or equal to the 'normative rate of average wage'. These households are then grouped in terms of average wage rate (w_k) in such a way that kth group of households have average wage failing in kth wage class. It is also taken that wage classes are arranged in ascending order such that average wage of kth group of household is greater than that of (k-1)th group of households. Finally, to determine the total wage income of the target group of households we consider the distribution of sectoral employment over different wage classes (and implicitly over different groups of households). This distribution as given by sectoral employment distribution matrix (e_{ik}) gives the proportion of sectoral employment in different wage classes and reflect the differences in skill characteristics of different groups of households considered. Given the employment distribution matrix the total income (y_b) and employment generated in the target group are obtained as aggregate income and employment upto normative wage class, $[k_0]/Y$, that is the wage class where the normative wage rate falls. The percentage of population in the target group (β) is then obtained by multiplying the total employment of the target groups by their dependency ratio (Q_b) and expressing it as a percentage of total population (p^*) [equs. (15) and (17)].

Income of the non-target group (y_a) then consists of (i) wage income generated above the normative wage class and (ii) corporate profit income net of corporate savings and corporate tax calculated on the basis of an exogenously given share (f_r) of corporate sector in aggregate net profit (net of depreciation allowances) generated in the economy (equation (14)). Aggregate net profit is obtained from sectoral unit profit, output and depreciation (see equations (A.36) through (A.39) in the appendix).

Thus aggregate income of the poor (y_b), the non-poor (y_a) and the percentage of population below poverty line (β^*) are given by

$$y_b = \sum_{i=1}^{n} \sum_{k=1}^{[k_0]/Y} e_{ik} \cdot w_k \cdot EL_i \qquad \ldots\ldots(13)$$

$$y_a = (1 - t_d) \Big[\sum_{i=1}^{n} \sum_{k=[k_0]/Y+1}^{s} e_{ik} \cdot w_k \cdot EL_i$$

$$+ (1 - t_c)(1 - s_c) \; pF_r + TRS^* \Big] \qquad \ldots\ldots(14)$$

$$\beta = Q_b \left(\sum_{i=1}^{n} \sum_{k=1}^{[k_0]/Y} e_{ik} \cdot EL_i \right) / p^* \qquad .....(15)$$

where, normative wage rate, k_0 and dependency ratio for the poor, Q_b are respectively given by

$$k_0 = Q_b \cdot \pi_0 \cdot p_{cb} \qquad .....(16)$$

$$Q_b = Z_0^* \left(p^* / \sum_{i=1}^{n} EL_i \right) \qquad .....(17)$$

Thus it is seen that distribution of income between target and non-target group depends upon (a) level and structure of output and prices (b) population, given the factor income inequality parameters viz. (i) 'sectoral mark up' which the dividens the unit sectoral income into wage and profit and (ii) employment distribution matrix, which dividens the sectoral unit wage into different wage classes (and implicitly different groups of households). Level and structure of output and prices, as we have already seen, dependent upon distribution of income between target and non-target group. Thus the output, price and income distribution between the target and non-target groups are interdependend and have to be determined simultaneously.

3.3 Savings-Investment Identity of the model

In any economy savings must equal investment at current prices. The question is what adjustments within the system permit this identity? Sen (1963) is perhaps the first to point out explicitly that expected patterns of growth and distribution may depend essentially on how a descriptive model of the economy is made algebraically determinate or closed. One can distinguish two closer rules viz. neo-classical and the neo-keynesian.

The main neo-classical assumption is that something approximating full employment of factors of production is achieved by freely varying prices. Factor payments are determined by their marginal productivity so that with full employment all the earning flows are determined from the side of supply. With earnings given the total amount saved is determined by behaviourial parameters; and investment is assumed to adjust to savings[11].

According to neo-keynesian position investment is determined by espectations, non-market conditions and possibly by rate of interest. It is certainly not affected by the supply of savings generated by marginally determined wages and profit rates in the short run. Rather, prices, factor payments and output levels adjust to permit of savings equal to investment demand.

In our model investment is exogenous and the equality of savings and investment at current prices is established by price adjustment of the commodities produced in S_1 and output adjustments of sectors belonging to S_2. Because of technological interdependence, this change in prices in S_1 and output in S_2 will in turn, change the prices of commodities produced in both S_1 and S_2. The new levels of output and prices will change the distribution of income which, is turn, will change the level of output and prices. This sequence will continue untill the savings investment identity at current prices is established. It should be noted that, although we treat investment

[11] Models of growth and income distribution constructed in neo-classical frame work are by Morley and Williamson (1973), Adelman and Robinson (1973) De Melo and Robinson (1982), Lysy and Taylor (1980) etc. Income distribution in such models show insensivity to different redistributive policies. See Taylor and Lysy (1979).

as exogenous, our closer rules are not strictly keynesian because of our rules of price and output determination. Thus macro savings-investment adjustment in our model is accompanied by numerous sectoral changes in equilibrium solution – that is, shifts in sectocal output, prices, employment, change in income and consumption distribution across socio-economic classes. In the Appendix B we establish savings-investment identity of the present model.

3.4 Limitation of the model :

The policy conclusions which can be derived from a model are determined as much by their structure as by the statistical estimates of the parameters. Thus, to facilitate the exempirical application of the model, one has to curtail the scope of the model by making some simplifying assumptions. Here we shall enumerate some limitations of the model -- the limitations which has been enforced due to lack of information on certain crucial aspect of distributional process in India economy. These limitations should be borne in mind while analysing the policy conclusions drawn from the results of the model.

(1) The model is constructed in IO framework, thus all the limitations inherent in the input-output framework viz. unchanging technology, lack of substitution possibilities among inputs etc. also applies to this model. Moreover, the production oriented models in IO framework were mainly concerned with organised sectors of the economy and this has made a substantial impact on the type of IO data collected so far. Thus the existing input-output table as used in this study though based on both organised and unorganised sectors of the economy contain no information on these sectors separately for organised

and unorganised sectors. Due to this the unorganised small scale sectors of the economy, where presumably most of the self employed poor earn their income, have not been explicitly considered in our model. We also ignore in our model the dualistic nature of production in developing economics, where large scale industries with modern technology coexist side by side with small scale industries with traditional technology[12].

(2) While determining the distribution of income between target and non-target group we mainly consider flow aspects of income distributional process and ignore the role of distribution of productive assests across the socio-economic classes. Distribution of ownership of capital stock in the economy which is more unequal than distribution of income, however, plays a crucial role in shaping the distribution of income across socio-economic classes. Information on the distribution of assets over different socio-economic groups being extremely weak we could not explicitly link the income flow of one socio-economic group with productive assests owned by other socio-economic group[13].

(3) Another important weakness of the model is the absence of explicit modeling of the monetary sector of the economy and its implication for the level and structure of output and prices. Since 'real sector' of the economy is influenced by the level of money supply, rate of interest etc., a more complete analysis of growth, income distribution and poverty requires that

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12/ According to Fei and Ramis (1974) this dualistic nature of production is one of the important causes of income inequality and poverty in developing country.

13/ A theoretical model depicting such linkages has been developed by Ahluwalia and Chenery (1974). This model, however, ~~is~~ ignores the interrelation between distribution of income and level and pattern of demand in an economy.

real sector should be combined with the monetary sector to study the implication of different monetary variables on pattern of growth and income distribution in the economy.

(4) Apart from the above limitations, other limitations of the model follow from different assumptions made while constructing the model. Among them we mention here only assumption (A 3) where we assume that the target groups households has a single dependency ratio. Dependency ratio of households in a particular socio-economic group depends upon the household size and the number of earning members in the household. But information on both the aspects for different socio-economic groups are not available for Indian economy[14]. In absence of any information we assumed the simplest linear relationship between them.

14/ In this context we may mention that household information as contained in NSS consumption data relate only to household size - not to the number of earning members of households. Moreover, the households are classified on the basis of per capita consumption - not on the basis of per capita income as required by our model.

Appendix A

The Equations of the Basic Model

This appendix presents the complete set of equations describing the basic model. Subscripts i, j refer to IO sectors and 'k' refers to wage classes, n, s refer to number of IO sectors and wage classes respectively. γ denotes the width of wage classes.

Equations

Sectoral output and employment[1/]

$$x_i = x_{ai}/(1-a_{ii}), \quad \forall \; i \in S_1 \qquad \ldots\ldots (A.1)$$

$$x_i = \sum_{j=1}^{n} a_{ij}\, x_j + C_i + I_i^* + G_i^* + E_i^* + (\Delta S_i)^* - M_i \qquad \ldots\ldots (A.2)$$

$$\forall \; i \in S_2$$

$$EL_i = a_i^o . x_i \qquad \ldots\ldots (A.3)$$

x_i, $i \in S_1$ is either exogenously specified or determined by equation (A.1) above where the output net of self input (x_{ai}) is determined by the following supply response function

$$x_a = D.p_a^{(a+b)/c} \quad w^{-a/c} \quad [\, p_f . (1+t_f) \,]^{-b/c} \qquad \ldots\ldots (A.3.1)$$

1/ Commodity X commodity matrix used in this model can be obtained from commodity X industry IO matrix under two alternative assumptions viz. commodity technology and industry technology assumptions as given in A system of National Accounts : Studies in Methods Series F, No. 2, UNO. In Chapter 4 we shall examine, using Indian data, the implication of these two assumptions on commodity X commodity IO matrix, and IO analysis based on them, on the basis of which we shall retain one of the assumptions.

Price Equations

$$p_{rj} = Dd_j/S_{0j} \quad , \qquad j \in S_1 \qquad \ldots\ldots (A.4)$$

$$p_j = (1+r_j) \left[\sum_{i=1}^{n} a^d_{ij} \; p_i \, (1 + t_i) + \sum_{i=1}^{n} a^m_{ij} \; p_{mi} \, (1 + t_{mi}) \right.$$

$$\left. + a^o_j \sum_{k=1}^{s} e_{kj} . w_k \right], \qquad j \in S_2 \qquad \ldots\ldots (A.5)$$

p_{rj} $\forall$ $j \in S_2$ and p_j $\forall$ $j \in S_1$ are determined from the following relation connecting sectoral producer's price (p_j) and sectoral market price (p_{rj})

$$p_{rj} = \left[(1 - h_j).p_j.(1 + t_j) + p_{mj}.\,(1 + t_{mj}).\, h_j \right] / (1 + t_{coj}) \ldots (A.6)$$

Sectoral market price index as defined by the relation (A.6) above is the ratio of weighted average of domestic market price and import price inclusive of import duties at the current year to that of base year $(1 + t_{coj})$ — the share of domestic production $(1 - h_i)$ and import (h_i) in the final demand (net of export and change in stock) being taken as weights.

Income distribution and poverty :

$$y_b = \sum_{i=1}^{n} \sum_{k=1}^{[k_0/Y]} e_{ik}.w_k.EL_i \qquad \ldots\ldots (A.7)$$

$$y_a = (1 - t_d) \left[\sum_{i=1}^{n} \sum_{k=[k_0/Y]+1}^{s} e_{ik}.w_k.EL_i + \right.$$

$$\left. (1 - t_c).(1 - s_c)\, PF_r + TRS^* \right] \qquad \ldots\ldots (A.8)$$

$$k_0 = Q_b.\, \pi_0 . p_{cb} \qquad \ldots\ldots (A.9)$$

$$Q_b = Z_0^* \; (P^* / \sum_{i=1}^{n} EL_i) \qquad \text{..... (A.10)}$$

$$\beta = Q_b \; (\sum_{i=1}^{n} \sum_{k=1}^{[k_0/Y]} e_{ik} . EL_i / P^* \qquad \text{..... (A.11)}$$

<u>Aggregate and sectoral consumption</u>

$$c_a = y_a \; (1 - s_h)/(1 - \beta) \; P^* \qquad \text{..... (A.12)}$$

$$c_b = y_b / \beta . P^* \qquad \text{..... (A.13)}$$

$$c_i^m = a_i^m . p_{ri} + b_i^m \; (c^m - \sum_{j=1}^{n} a_j . p_{rj}), \quad m = 1, 2, 3, 4 \qquad \text{..... (A.14)}$$

$$C_{ir} = \sum_{m=1}^{4} p^m . c_i^m = \sum_{m=1}^{4} p^m \left\{ a_i^m . p_{ri} + b_i^m \; (c^m - \sum_{j=1}^{n} a_j . p_{rj}) \right\} \qquad \text{.....(A.15)}$$

$$C_i = C_{ir} / p_{ri} \; (1 + t_{c0i}) \qquad \text{..... (A.16)}$$

$$c^1 = c_b . P^* / (P_r^* + z_b \; P_u^*) \qquad \text{..... (A.17)}$$

$$c^2 = c_a . P^* / (P_r^* + z_a . P_u^*) \qquad \text{..... (A.18)}$$

$$c^3 = z_b . c^1 \qquad \text{..... (A.19)}$$

$$c^4 = z_a . c^2 \qquad \text{..... (A.20)}$$

$$P^1 = \beta . P_r^* \qquad \text{..... (A.21)}$$

$$P^2 = (1 - \beta).P_r^* \qquad \text{..... (A.22)}$$

$$P^3 = \beta . P_u^* \qquad \text{..... (A.23)}$$

$$P^4 = (1 - \beta).P_u^* \qquad \text{..... (A.24)}$$

Import

$$M_i = \Sigma\, a_{ij}^m . x_j + h_i\, (c_i + G_i^* + I_i^*) \qquad \text{..... (A.25)}$$

Expressions for other variables used in the model :

Domestic demand for Commodities produced in S_1 (Dd_i) :

Domestic demand for commodities produced in the subsystem S_1 (that is for foodgrain output in the present model) consists of intermediate input demand, private consumption demand and public consumption demand. Of these components of demand the private consumption demand (C_{ir}) endogenously estimated and is given by equation (A.15). The intermediate demand and the public consumption demand are valued at current market price using the market price index (p_{ri}) and the average indirect tax rate at the base year (t_{c0i}). Thus the domestic demand, at current market price, of output produced in the subsystem S_1 is given by

$$Dd_i = C_{ri} + \left[\sum_j a_{ij}\, x_j + G_i^* \right] p_{ri}.(1 + t_{c0i}) \qquad \text{..... (A.26)}$$

$$i \in S_1$$

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Domestic supply of commodities produced in S_1 (S_{oi})

Domestic supply of commodities produced in S_1 consists of domestic production $[x_i = x_{ai}/(1 - a_{ii})]$, and import (M_i) net of exogenously given export (E_i^*), and change in stock $[(\Delta S_i)^*]$. This is evaluated at constant market price by using average indirect tax rate (t_{coi}) for the base year. Thus the domestic supply, at constant market, of the commodities produced in S_1 is given by

$$S_{0i} = (x_i + M_i - E_i^* - (\Delta S_i)^*) \cdot (1 + t_{coi}), \quad i \in S_1 \qquad \ldots\ldots (A.27)$$

where,

$$t_{coi} = (1 - h_i) \cdot t_{oi} + h_i \cdot t_{moi} \qquad \ldots\ldots (A.28)$$

is defined as the average indirect tax rate at the base year; and

$$h_i = (q_i \cdot C_i + g_i \cdot G_i^* + m_i \cdot I_i^*)/(C_i + G_i^* + I_i^*) \qquad \ldots\ldots (A.29)$$

is the import content of the final demand.

Aggregate Consumer price index for the poor and the non-poor (p_{cb}, p_{ca})

Aggregate consumer price index for the poor and the non-poor (p_{cb}, p_{ca}) are defined as the weighted average of sectoral market price with the sectoral shares in the aggregate consumption of the respective groups being taken as weights. That is,

$$p_{cb} = \Sigma\, p_{ri} \cdot c_i^b / \Sigma\, c_i^b \qquad \ldots\ldots (A.30)$$

$$p_{ca} = \Sigma\, p_{ri} \cdot c_i^a / \Sigma\, c_i^a \qquad \ldots\ldots (A.31)$$

where c_i^a and c_i^b are sectoral consumption of the non-poor and the poor at constant factor cost respectively, given by

$$c_i^a = (1 - \beta)\,(P_r^*\cdot c_i^2 + P_u^*\cdot c_i^4)/p_{ri}\cdot(1 + t_{coi}) \qquad \ldots\ldots (A.32)$$

$$c_i^b = \beta\,(P_r^*\cdot c_i^1 + P_u^*\cdot c_i^3)/p_{ri}\cdot(1 + t_{coi}) \qquad \ldots\ldots (A.33)$$

Sectoral value added (V_j)

Sectoral value added at current factor cost is given by

$$V_j = x_j \left[p_j - \sum_{i=1}^{n} a_{ij}^d\, p_i\,(1 + t_i) - \sum_{i=1}^{n} a_{ij}^m\cdot p_{mi}\,(1 + t_{mi}) \right] \qquad \ldots (A.34)$$

Sectoral value added at constant factor cost is obtained by substituting $p_j=1$ and $p_{mj} = 1 \;\forall\; j$ in the expression (A.34).

Depreciation (D_j) :

Sectoral depreciation is determined by applying an exogenously given depreciation rate (d_j) on the sectoral values added (V_j)

$$D_j = d_j\cdot V_j \qquad \ldots\ldots (A.35)$$

Aggregate net profit (PF)

Sectoral profit generated in sectors belonging to S_2 is calculated by using sectoral mark-up (r_j) over sectoral unit prime cost consisting of (i) domestic material input cost $\left[\Sigma\, a_{ij}^d\, p_i\,(1 + t_i) \right]$, (ii) imported material input cost $\left[\Sigma\, a_{ij}^m \cdot p_{mi}\,(1 + t_{mi}) \right]$, and (iii) wage cost $\left[a_j^o \sum_{k=1}^{s} e_{jk}\cdot w_k \right]$. Unit profit of the sectors belonging to S_1, however, is endogenously estimated in the present model. In case the output of such sectors are exogenously specified, the profit per unit of output is given by equation (A.38). However, when the output is determined by profit maximising principle using Cobb-Douglas type production function the profit is first determined by $(p_a \cdot x_a - p_f \cdot (1 + t_f) F_1 - E_1 \cdot w)$ from which the unit profit is obtained by equation (A.39).

Finally, total net profit accruing to private corporate sector is obtained by equation (A.37) after determining aggregate net profit (PF) by equation (A.36).

$$PF = \sum_{j \varepsilon S_2} r_j \cdot x_j \left\{ \sum_{i=1}^{n} a_{ij}^{d} \cdot p_j \cdot p_i \, (1 + t_i) + \sum_{i=1}^{n} a_{ij}^{m} \cdot p_{mi} \, (1 + t_{mi}) + a_j^0 \sum_{k=1}^{s} e_{jk} \cdot w_k \right\} + \sum_{j \varepsilon S_1} x_{aj} \cdot \rho_j - \sum_{j=1}^{n} D_j \quad \ldots\ldots (A.36)$$

$$PF_r = f_r \cdot PF \quad \ldots\ldots (A.37)$$

$$\rho_j = p_j - \sum_{i=1}^{n} a_{ij}^{d} \cdot p_i \cdot (1 + t_i) - \sum_{i=1}^{n} a_{ij}^{m} \cdot p_{mi} \cdot (1 + t_{mi}) - a_j^0 \sum_{k=1}^{s} e_{jk} \cdot w_k, \quad j \varepsilon S_1 \quad \ldots\ldots (A.38)$$

$$\rho_j = [\, p_a \cdot x_a - p_f \, (1 + t_f) \, F_1 - E_1 \cdot w \,] / x_a \qquad j \varepsilon S_1 \quad \ldots\ldots (A.39)$$

<u>Total indirect tax less subsidy (T_x)</u>

Total indirect tax less subsidy consists of indirect tax on inputs and final demand. Indirect tax on inputs is given by total indirect tax on domestically produced as well as imported material inputs while the same for final demand by indirect taxes on different components of final demand viz. consumption demand (C_i), fixed capital investment demand (I_i^*) and export (E_i^*) met from domestic production ($1 - h_i$) and import (h_i).

$$T_x = \sum_{i=1}^{n} \sum_{j=1}^{n} \left[a_{ij}^{d} \cdot p_i \cdot t_i + a_{ij}^{m} \cdot p_{mi} \cdot t_{mi} \right] x_j + E_j^{*} \cdot p_i^{*} \cdot t_{ei}$$

$$+ \sum_{i} (C_i + G_i^* + I_i^*) \left[(1 - h_i)\, p_i t_i + h_i \cdot p_{mi} \cdot t_{mi} \right] \quad \ldots\ldots (A.40)$$

<u>Total direct tax (T_d)</u>

Total direct tax consists of (a) personal income tax and (b) corporate tax. Given personal income tax rate (t_d) and corporate tax rate (t_c) the total direct tax is obtained from income accruring to the non-poor (y_a) and corporate profite PF_r. Thus total direct tax is given by

$$T_d = \frac{t_d}{1 - t_d} \cdot y_a + t_c \cdot PF_r \quad \ldots\ldots (A.41)$$

<u>Savings (S)</u>

Aggregate savings (S) in the present model is estimated by considering the different components of savings viz. household savings (S_H), public savings (S_p), corporate savings (S_c) and foreign savings (S_F). Household savings is given by total personal disposable income ($y_b + y_a$) less private consumption (C). Public savings is given by government receipts less public (government) consumption. Government receipts consists of direct tax (T_d), indirect tax less subsidies (T_x) and income from government owned corporate production

$[(1 - f_r) \cdot PF]$. Corporate savings is obtained by applying corporate savings rate (S_c) on private corporate profit net of corporate tax $[(1 - t_c) \cdot f_r \cdot PF_r]$. Finally, foreign savings is given by total import less total export less other current transfer from rest of the world. The expressions for S_H, S_P, S_c and S_F, are, therefore, given by

$$S_H = y_a + y_b - C \qquad \text{..... (A.42)}$$

$$S_P = [T_d + T_x + (1 - f_r) \cdot PF - \Sigma\, G_i^* \cdot p_{ir} (1 + t_{c0i})] \qquad \text{..... (A.43)}$$

$$S_c = s_c (1 - t_c) \cdot f_r \cdot PF \qquad \text{..... (A.44)}$$

$$S_F = \sum_i M_i - \sum_i E_i^* \cdot p_i (1 + t_{ei}) - TRS^* \qquad \text{..... (A.45)}$$

Appendix B

Savings - Investment Identity

Macro-economic savings investment identity can be established considering the dual decomposition of total value-added into factor income and final use. For this we consider input-output accounting system in value terms for commodity sector 'i' as follows :

$$p_i x_i = \sum_{j=1}^{n} p_i \, a_{ij}^{d} \cdot x_j + (1 - h_i)(C_i + I_i^* + G_i^*) \, p_i$$
$$+ (\Delta \, S_i)^* \cdot p_i + E_i^* \, p_i \qquad \ldots\ldots (B.1)$$

and

$$p_{mi} \, M_i = \sum_{j=1}^{n} a_{ij}^{m} \cdot p_{mi} \cdot x_j + h_i \, (C_i + I_i^* + G_i^*) \cdot p_{mi} \qquad \ldots\ldots (B.2)$$

combining (B.1) and (B.2) we get

$$p_i x_i + p_{mi} \cdot M_i = \sum_{j=1}^{n} p_i \cdot a_{ij}^{d} \cdot x_j + \sum_{j=1}^{n} p_{mi} \cdot a_{ij}^{m} \cdot x_j + p_{if} \, (C_i + I_i^* + G_i^*)$$
$$+ E_i^* \cdot p_i + (\Delta \, S_i)^* \cdot p_i \qquad \ldots\ldots (B.3)$$

where

$$p_{if} = p_i \cdot (1 - h_i) + p_{mi} \cdot h_i \qquad \ldots\ldots (B.4)$$

Summing over i and rearranging terms we get,

$$\sum_{i=1}^{n} p_i x_i - \sum_{i=1}^{n} \sum_{j=1}^{n} p_i \cdot a_{ij}^{d} \cdot x_i - \sum_{i} \sum_{j} p_{mi} \cdot a_{ij}^{m} \cdot x_j = \Sigma \, p_{if} \, (C_i + I_i^* + G_i^*)$$
$$+ \sum_{i} E_i^* \cdot p_i + \sum_{i} (\Delta \, S_i)^* \cdot p_i - \Sigma \, M_i \cdot p_{mi} \qquad \ldots\ldots (B.5)$$

Now substracting total indirect tax less subsidies on inputs, that is,

$$T_{inp} = \sum_i \sum_j x_j \, (a^d_{ij} \, p_i \, t_i + a^m_{ij} \cdot p_{mi} \cdot t_{mi}) \qquad \ldots\ldots (B.6)$$

from both sides of (B.5), we get

$$\sum_j \left[p_j - \sum_i p_i \, a^d_{ij} \, (1 + t_i) - \sum_i p_{mi} \, a^m_{ij} \, (1 + t_{mi}) \right] x_j$$

$$= \sum_i p_{if} \, (C_i + I^*_i + G^*_i) + \sum E^*_i \cdot p_i + \sum \, (\Delta \, S_i)^* \cdot p_i$$

$$- \sum M_i \cdot p_{mi} - T_{inp} \qquad \ldots\ldots (B.7)$$

or

$$\sum V_j = \sum p_{if} \, (C_i + I^*_i + G^*_i) + \sum E^*_i \cdot p_i + \sum \, (\Delta \, S_i)^* \, p_i$$

$$+ \sum M_i \cdot p_{mi} - T_{inp} \qquad \ldots\ldots (B.8)$$

Now, total private consumption at current market prices, C, can be obtained after simplication from equations (A.12), (A.13), (A.14), (A.15) and (A.16) of Appendix A and is given by

$$C = \left[(1 - \beta) \, c_a + \beta \cdot c_b \right] p^* = \sum_i C_i \cdot p_{ri} \, (1 + t_{c0i}) \qquad \ldots\ldots (B.9)$$

Substituting p_{ri} from equation (A.6) of Appendix A we get

$$\sum_i C_i \cdot p_{if} = C - T_{pc0n} \qquad \ldots\ldots (B.10)$$

where T_{pc0n} is total indirect tax less subsidy on private consumption is given by

$$T_{pc0n} = \sum_i C_i \left[h_i \, p_{mi} \cdot t_{mi} + (1 - h_i) \, p_i \cdot t_i \right] \qquad \ldots\ldots (B.11)$$

Similarly,

$$\sum_i I_i^* \cdot p_{if} = \sum_i I_i^* \cdot p_{ri} \; (1 + t_{c0i}) - T_{inv}. \qquad \ldots\ldots (B.12)$$

where T_{inv} is total indirect tax less subsidy on gross fixed capital investment, given by

$$T_{inv} = \sum_i I_i^* \; [\, h_i \cdot p_{mi} t_{mi} + (1 - h_i) \cdot p_i \cdot t_i \,], \qquad \ldots\ldots (B.13)$$

$$\sum_i G_i^* \cdot p_{if} = \sum_i G_i^* \cdot p_{ri} \; (1 + t_{coi}) - T_{gc0n} \qquad \ldots\ldots (B.14)$$

where T_{gc0n} is total indirect tax less subsidy on government consumption, given by

$$T_{gc0n} = \sum_i G_i^* \; [\, h_i \; p_{mi} \; t_{mi} + (1 - h_i) \;\; p_i t_i \,] \qquad \ldots\ldots (B.15)$$

$$\sum E_i^* \cdot p_i = \sum_i E_i^* \; (1 + t_{ei}) \cdot p_i - T_{exp}. \qquad \ldots\ldots (B.16)$$

where T_{exp} is total export duty, given by

$$T_{exp} = \sum_i E_i^* \cdot t_{ei} \cdot p_i \qquad \ldots\ldots (B.17)$$

Substituting equations (B.10), (B.12), (B.14), (B.16) in (B.8) we get

$$\sum V_j = C + \sum_i (I_i^* + G_i^*) \; p_{ri} \; (1 + t_{c0i}) + \sum_i (\Delta S_i)^* \; p_i$$
$$+ \sum_i E_i^* \; (1 + t_{ei}) \; p_i + \sum_i M_i \; p_{mi} - T_x \qquad \ldots\ldots (B.18)$$

where T_x is total indirect tax less subsidy given

$$T_x = T_{inp} + T_{pc0n} + T_{inv} + T_{gc0n} + T_{exp} \qquad \ldots\ldots (B.19)$$

Now left hand side of (B.18) can be decomposed into two types of factor income viz. profit and wage income where profit includes interest, rent and depreciation so that

$$\Sigma V_j = \text{Profit} + \text{Wage} + \Sigma D_j \qquad \ldots\ldots (B.20)$$

Now,

$$\begin{aligned} \text{Profit} &= PF \\ &= (1 - f_r)\, PF + f_r \cdot PF \\ &= (1 - f_r)\, PF + t_e \cdot f_r \cdot PF + s_c \cdot (1 - t_c) \cdot f_r \cdot PF \\ &\quad + t_d \cdot (1 - s_c)\,(1 - t_c) \cdot f_r \cdot PF \\ &\quad + (1 - t_d)\,(1 - s_c)\,(1 - t_c)\, f_r \cdot PF \end{aligned} \qquad \ldots\ldots (B.21)$$

and

$$\begin{aligned} \text{Wage} &= \sum_{j=1}^{n} \sum_{k=1}^{n} e_{jk} \cdot w_k \cdot EL_j \\ &= y_b + (1 - t_d) \sum_{j=1}^{n} \sum_{k=[k_0/\gamma]+1}^{s} e_{jk} \cdot w_k \cdot EL_j + \\ &\quad t_d \sum_{j=1}^{n} \sum_{k=[k_0/\gamma]+1}^{s} e_{jk} \cdot w_k \cdot EL_j \end{aligned} \qquad \ldots\ldots (B.22)$$

Adding (B.21) and (B.22) both sides and using equations (A.7), (A.8) and (A.41) of Appendix A, we get

$$\begin{aligned} \text{Profit} + \text{Wage} &= y_b + y_a + T_d + (1 - f_r)\, PF \\ &\quad + s_c\,(1 - t_c)\, f_r \cdot PF - TRS^{*} \end{aligned} \qquad \ldots\ldots (B.23)$$

Substituting (B.23) in (B.20) and using the identify of (B.18) and (B.2) we get

$$(y_b + y_a - C) + \left[T_d + T_x + (1 - f_r).PF - \sum_i G_i^*.p_{ri} (1 + t_{c0i}) \right]$$

$$+ s_c (t - t_c) f_r.PF + \left[\Sigma M_i.p_{mi} - \Sigma E_i^* (1 + t_{ei}).p_i - TRS^* \right] + \Sigma D_j$$

$$= \Sigma I_i^* p_{ri} (1 + t_{c0i}) + \Sigma (\Delta S_i)^* p_i \qquad \ldots\ldots (B.24)$$

Using equations (A.41) through (A.45) of Appendix A in (B.24) above we get

$$S_H + S_P + S_C + S_F + \Sigma D_j = \Sigma I_i^* .p_{ri} (1 + t_{c0i}) + \Sigma (\Delta S_i)^* p_i$$

or

$$S = I$$

Thus gross saving is equal to gross investment at current market price.

CHAPTER 4

Data Base

4.1 Introduction

Paucity of information on the income linkage of different socio economic groups is one of the major problems in constructing operational income distributional models. This problem becomes much more severe as one moves from aggregative to multisectoral framework. In such a situation the model builder has to draw on disperate sources to get a complete data set. Our approach for developing the data base of the model is to find a complete and consistent data set for the base year by best possible use of available informations. This is then used in the model to reproduce the pre-specified sectoral and macro information for the base year. Comparision of the base year solution of the model with these pre-specified values then provides a check on the reliability of data base as well as the workability of the model. Below we describe how the complete data base for the model has been developed using information from different sources.

4.2 Inter-industry flow data

The analytical framework of this study is built around input-output accounting system. The information on the inter-industry flow coefficients, total as well as its imported components, are taken from 'Technical Note on Sixth Plan of India, 1980-85' (hereafter referred as Sixth TN). The original table has 89 sectors which are aggregated into 32 sectors according to our aggregation scheme as given in Table 4.1. The main consideration behind this aggregation scheme was the availability of information on sectoral employment distribution. However, while aggregating we have tried to give better representation to sectors on which poor rely more for their income and consumption. Moreover, the basic industries have also been located separately. Thus the present aggregation scheme can be considered as a compromise between distributional data availability and importance of individual sectors for analysis of growth income-distribution and poverty.

4.3 Employment distribution matrix

Distribution of sectoral employment over different wage earning classes as represented by the employment distribution matrix is a crucial parameter of the basic model. Firstly, it provides the income linkage of the poverty group with different productive sectors of the economy. Secondly, the sectoral unit wage cost which is one of the major determinants of sectoral prices and profit, is determined by the structure of this matrix. The estimate of the wage distribution matrix has been obtained by integrating informations from publications of National Sample Survey Organisation (NSSO), Labour Bureau, Central Statistical Organisation (CSO), National Council of Applied Economic Research (NCAER) and other related publications. In the present study this matrix is estimated by two stage consistency approach. In the first stage we obtain an 'initial estimate' of the matrix by integrating informations obtained from different sources. In the second stage this 'initial estimates' are updated consistently with exogenous sectoral as well as macro economic informations on wage, consumption and poverty.

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4.3.1 Initial estimates

4.3.1.1 Agriculture

Agriculture is the largest source of employment and income in India and substantial informations on different aspects of Indian agriculture are available from Farm Management Surveys (FMS). However, FMS data do not contain any information on the distribution of employment over different earning classes. The only survey, to our knowledge, which was concerned with this aspect was conducted by NSS (1965). In absence of any such information for recent years we have used this information as a starting point for estimating the structure of wage earnings in agriculture. The information on average daily earning presented in this report relates to average per day earning of agriculture labourer for the year 1958-59. The initial estimate of the employment distribution for the year 1977-80 is obtained after adjusting the earning classes by the consumer price index for agricultural labourers.

4.3.1.2 Manufacturing Sectors

Main source of information on the distribution of employment for the manufacturing sectors is the report on occupational wage survey, 1963-65 by Labour Bureau (1973). This report furnishes information on distribution of employment by average daily earning in 45 manufacturing industries for the period 1963-65. This information is aggregated to our classification of industries using sectoral output and employment as given in this report. Finally to arrive at the initial estimate for the year 1979-80 the distribution was corrected to price change using consumer price index for industrial workers.

4.3.1.3 Other Sectors

Information for plantation, Mining and Electricity was also taken from Labour Bureau (1973). As to the sector construction such information was not available and its distribution was taken as weighted distribution of the sectors, electricity, mining and machine building. Employment distribution of service sector was also obtained as the weighted average of the distribution as reported in NSS (1965), NCEAR (1962) and Roy (1979).

4.3.2 Final estimate

The initial estimate of the employment distribution matrix thus obtained, however, may not be consistent with various exogenous sectoral and macro-economic aggregates for the base year that is, for the year 1979-80. Because the sectoral total wage as implied by this employment distribution matrix need not be equal to the independently given sectoral wage for the base year. Moreover, the percentage of people below poverty line and their mean consumption determined from this matrix need not also agree with their given base year values.

The final estimate of the employment distribution matrix is obtained by balancing the 'initial estimates' with the following base year elements : (a) Sectoral wages for the base year as estimated from National Accounts Statistics, 1979-80, CSO and Annual Survey of Industries, 1979-80. (b) Percentage of people below poverty line and their mean per capita consumption estimated from informations provided in Sixth TN.

The balancing is done through an iterative procedure which uses the equations of income distribution submodel for prorata adjustment of the elements of employment distribution matrix with above mentioned elements. Starting with initial values for normative wage rate, k_o (daily wage rate corresponding to the poverty line) the procedure adjust the elements of employment distribution matrix first to satisfy the sectoral wages and then to wage earning of the poor (which is also equal to their total consumption) and non-poor. Next the normative wage rate is recalculated in such way that the percentage of people below poverty line based on the elements of adjusted matrix is equal to the given base year value. The process is repeated untill the values of the normative wage rate and the employment distribution matrix becomes stable, in which case the process converges and all the base year conditions are satisfied simultaneously. It can be noted that the iterative procedure, which is very similar to RAS method and whose convergence is already established by Bacharach (1970), does not lead to a unique solution but only provides one of the estimates consistent with exogenously given elements. The mathematical basis of this procedure is discussed below.

4.3.2.1 Methodology for estimating employment distribution matrix

(a) Methodology

The objective here is to develope the mathematical basis to recast and balance the initial estimate of employment distribution matrix to match the exogenously given sectoral and macro economic information for the base year. The given exogenous elements are :

(i) Mean monthly private consumption of the people below poverty line and their percentage in total population.

(ii) Total wages (wages and salaries plus earning of the self employed) of each sector of the economy.

Let, $E = (e_{ik})$ be the updated employment distribution matrix, where e_{ik} is the percentage of total employment in ith sector of the economy falling kth wage class. $(i = 1, \ldots n, k = 1, \ldots s)$ (uniform wage classes of fixed interval for all sectors have been considered).

Let E_i be employment of sector i in the base year, w_k be average daily wage in kth wage class and W_i be total wage in sector 'i' in the base year. Then the updated employment distribution matrix should satisfy the following conditions.

$$365 \sum_{k=1}^{s} e_{ik}.w_k.E_i = W_i \qquad \ldots\ldots (1)$$

$$365 \sum_{i=1}^{n} \sum_{k=1}^{k_0} e_{ik}.w_k.E_i. = C_b \qquad \ldots\ldots (2)$$

$$365 \sum_{i=1}^{n} \sum_{k=k_0+1}^{n} e_{ik}.w_k.E_i = \left(\sum_{i=1}^{n} W_i^* - C_b\right) \qquad \ldots\ldots (3)$$

$$k_0 = \theta_b \, \pi_0 / 365 \qquad \ldots\ldots (4)$$

$$\theta_b = \beta.P^*/\left(\sum_{i=1}^{n} \sum_{k=1}^{k_0} e_{ik}.E_i\right) \qquad \ldots\ldots (5)$$

where,

C_b = annual aggregate income of the target group,

k_0 = normative rate of daily earning corresponding to the poverty line income,

θ_b = dependency ratio of the people below poverty line,

π_0 = poverty line at the base year prices,

β = percentage of people below poverty line,

P^* = base year population

Equation (1) gives the relation between sectoral total wage and the employment distribution matrix. Equation (2) states our assumption that total consumption below poverty line is <u>exactly</u> equal to total (wage) income generated below poverty line. Equation (3) gives the relation between total wage above poverty line and the employment distribution matrix. Equation (4) and (5) determine the normative rate of daily earning and dependency ratio below poverty line (see the income distribution model in Chapter 3). Using (4) and (5) k_0 is determined from the following equation :

$$k_0 = \sum_{i=1}^{n} \sum_{k=1}^{k_0} e_{ik} . E_i = \beta . P^* . \pi_0 \; / \; 365 \qquad \ldots\ldots (6)$$

Thus, the equations which the updated employment distribution matrix should satisfy are (1), (2), (3) and (6). It can be seen that the elements of the employment distribution matrix (e_{ik}) and normative rate of daily earning (k_0) are required to be estimated simultaneously satisfying the equations (1), (2), (3) and (6). Having determined all e_{ik} and k_0 the estimate of θ_b is obtained from (5).

(b) <u>Estimation Procedure</u>

<u>Adjustment of employment distribution matrix to given sectoral wage</u>

At first we shift the initial employment distribution of each sector of the economy such that there is no proportion of employment below the wage class corresponding to the official minimum wage rate. Then the initial employment distribution matrix is adjusted to match the given sectoral wages, that is to satisfy condition (1). For this purpose we adjust the elements of initial employment distribution matrix, E^* (e^*_{ik}), prorata by a scalar, f_i given by (7) below :

$$W_i = \sum_{k=1}^{s} e^*_{ik} \cdot f_i \cdot w_k \cdot E_i \qquad \ldots\ldots (7)$$

Since f_i may be different for different sectors and may be greater or less than unity, adjustment of average wage by adjusting wage class limits would no longer lead to uniform wage classes of fixed interval for all sectors. Keeping the original wage class interval unaltered we, therefore, distribute e^*_{ik} over different wage classes such that

$$e^*_{ik} = \sum_r B_{ir} \qquad \ldots\ldots (8)$$

and $$e^*_{ik} \cdot f_i \cdot w_k = \sum_r B_{ir} \cdot w_r \qquad \ldots\ldots (9)$$

where, r (≥ 1) denotes the wage classes affected by such adjustment , and will, in general, be a function of f_i and average wage of the class which is adjusted;

B_{ir} denotes the elements of the employment distribution matrix after such adjustment, which are required to be estimated.

Thus the distribution of e^*_{ik} essentially consists of (a) determining the range over which r varies, and (b) distributing e^*_{ik} uniformly over the affected classes such that (8) and (9) are satisfied.

Let the average wage of jth class (class limits (j-1) to j) be adjusted by f_i such that

$$(j-1)\, f_i = k - \delta_k, \quad 0 < \delta_k \leq 1 \qquad \ldots\ldots (10)$$

$$j \cdot f_i = p - \delta_p, \quad 0 \leq \delta_p < 1 \qquad \ldots\ldots (11)$$

In (11) j is to be taken as $(2w_s - s + 1)$ for the highest wage limit instead of j=s. Then e^*_{ij} of jth class is to be distributed over n_c unit wage classes in the wage interval k to p, where $n_o = (p - k + 1)$. The new proportion in these wage classes, B_{ir}, are given by

$$B_{ir} = d_{ir} \cdot e^*_{ij}, \quad r = k, \ldots p \qquad \ldots\ldots (13)$$

where d_{ir} is the proportion of e^*_{ij} alloted to rth affected wage class and is obtained as follows so that (8) and (9) are satisfied.

$$d_{ir} = 1/f_i \quad \text{for } r = k + 1, \ldots p-1 \qquad \ldots\ldots (14)$$

and d_{ik} and d_{ip} are determined from (15) and (16) below.

$$d_{ik} \cdot w_k + d_{ip} \cdot w_p = w_j \cdot f_i - \theta_r \qquad \ldots\ldots (15)$$

$$d_{ik} + d_{ip} = 1 - \theta_o \qquad \ldots\ldots (16)$$

In order to determine d_{ir}'s from (14), (15) and (16) one should note that :

(i) If $n_o \leq 2$ then equation (14) is redundant and $\theta_r = \theta_o = 0$

(ii) If $n_c > 2$ then $\theta_r = \sum_{r=k+1}^{p-1} w_r/f_i$, $\theta_o = (n_o - 2)/f_i$ ..... (17)

(iii) For unit wage classes $w_k = k - \frac{1}{2}$, $w_p = p - \frac{1}{2}$, $w_j = j - \frac{1}{2}$, $w_r = r - \frac{1}{2}$, but if $k < s$ (highest wage class) and $p \geq s$, then $W_N = w_p = (s - 1 + j \cdot f_i)/2$ is to be used in (15). Similarly if $k < m$ (minimum wage class) and $p \geq m$, then $w_k = w_m = [(j - 1) \cdot f_i + m]/2$ is to be used in (15) for $n_o > 2$

(iv) If both k and p are greater than or equal to s, then e^*_{ij} is alloted only to sth wage class with $w_s = w_j \cdot f_i$

(v) For $n_o = 1$, the following additional considerations has to be taken into account :

(a) If $k = m$ then e^*_{ij} is alloted to mth class with $w_m = w_j \cdot f_i$

(b) If $m < k < s$ then e^*_{ij} is alloted to two classes according to (15) and (16) with $\theta_r = \theta_o = 0$ the two classes being

k-1 and k if $w_j \cdot f_i < w_k$

and k and k+1 if $w_j \cdot f_i > w_k$.

In case $w_j \cdot f_i = w_k$ the entire e^*_{ij} is alloted only to kth class.

(c) No transfer of e^*_{ij} is required if $f_i = 1$.

In the above we have maintained a uniformity of unit wage classes for all IO sectors except for the two open ended classes to simply further calculations.

<u>Adjustment of employment distribution matrix to wages below and above poverty line</u>

The employment distribution matrix which has been balanced to sectoral wages in the previous section is now again balanced with conditions (2) and (3) above. In this case there are only two adjustment factors for all input-output sectors - one for total consumption of people below poverty line (f_b) and the other for total wages of the people above poverty line (f_a), which are obtained by the following relations.

$$f_b = C_b / \sum_{i=1}^{n} E_i \left\{ \sum_{k=1}^{\bar{k}_0} B_{ik} \cdot w_k + \Delta \sum_{k=\bar{k}_0}^{(\bar{k}_0+1)} w_k \cdot B_{ik} \right\} 365 \qquad \ldots\ldots(18)$$

$$f_a = (\sum_{i=1}^{n} W_i - C_b) / \sum_{i=1}^{n} E_i \left\{ \sum_{k=\bar{k}_0+1}^{s} B_{ik} \cdot w_k + (1-\Delta) \sum_{k=\bar{k}_0}^{\bar{k}_0+1} B_{ik} \right\} 365 \quad \ldots(19)$$

where,

C_b = total consumption of people below line

$$\Delta = \delta_1 / (\delta_1 + \delta_2) \qquad \ldots\ldots(20)$$

$$\delta_1 = C_b - \sum_{i=1}^{n} \sum_{k=1}^{\bar{k}_0} (B_{ik} \cdot E_i \cdot w_k)\, 365 \qquad \ldots\ldots(21)$$

$$\delta_2 = \sum_{i=1}^{n} \sum_{k=1}^{\bar{k}_0+1} 365 . (B_{ik} \cdot E_i \cdot w_k) - C_b \qquad \ldots\ldots(22)$$

and $\bar{k}_0$ is the integral part of k_0 and is determined to satisfy the following :

$$\bar{K}_0 \sum_{i=1}^{n} \sum_{k=1}^{\bar{k}_0} B_{ik} \cdot E_i \leq P_x \leq (\bar{k}_0 + 1) \sum_{i=1}^{n} \sum_{k=1}^{\bar{k}_0} B_{ik} \cdot E_i \qquad \ldots\ldots(23)$$

where,

$$P_x = (\beta . P^* . \pi_b)/365$$

B_{ik} obtained in the previous section are adjusted here using the same adjustment procedure explained therein, but using the factor f_b upto the wage class $\bar{k}_0$ and using the factor f_a from wage class $(\bar{k}_0+1)$ to s for all sectors of the economy. These adjustments of B_{ik} will satisfy the condition (2) and

(3) and will yield new estimate of the employment distribution matrix. Using this newly estimated elements of the employment distribution matrix $\bar{k}_0$ is estimated by (23) which will ensure that condition (6) is satisfied.

If the newly estimated employment distribution matrix does not satisfy given sectoral wages, it is again readjusted to satisfy condition (1) and the process is repeated till k_0 and B_{ik}'s reach stable values - when all the conditions are satisfied. Thus base year conditions (1), (2), (3) and (6) are simultaneously satisfied through an iterative process, which is very similar to RAS method; its condition for convergence is already established by Bacharach (1970).

4.3.2.2 Analysis of employment distribution

Final estimate of the employment distribution matrix is presented in Table 4.2. Although the matrix has been estimated with 97 daily wage classes we have presented the distribution upto the daily wage class Rs. 20 and above. This is because in any variant of policy analysis, the normative rate of daily earning (NRE) which determines the distribution of income between target (poor) and non-target groups, does not go beyond Rs. 20. It may be noted that NRE for the base year is Rs. 10 per day.

In absence of any comparable estimate of sectoral employment distribution for the year 1979-80 we will analyse the structure of the matrix in terms of its implication for (a) sources of income and (b) poverty and inequality profile of the target group.

(a) Source of income of the target group

Since the main focus of attention in this study is on the economic position of the target group it is imperative to describe the sources of

Table 4.1 : Sector classification

Sector No.	Name of Sector	Sixth Plan Technical Note Sector No.
(1)	(2)	(3)
1	Foodgrain	1-6
2	Other crops	7-11
3	Allied agriculture	12-15
4	Food manufacturing	20-25
5	Beverages and tobacco	26-27
6	Coal and lignite	16
7	Crude petrolium and natural gas	17
8	Other minerals	18-19
9	Cotton textiles (other than handloom and khadi)	28, 30 & 31
10	Cotton textiles (handloom)	29
11	Jute textiles	32
12	Misc. textiles product	33-35
13	Wood products	36
14	Paper and printing	37 & 38
15	Leather and Leather products	39 & 40
16	Plastic and rubber product	41 & 42
17	Petrolium and coal products	43 & 44
18	Heavy chemicals	45 & 46
19	Chemical fertilizers	47 & 48
20	Other chemicals	49-53
21	Cement	55
22	Other non-metallic mineral products	54 & 56
23	Basic metal and alloy industry	57-60
24	Metal products	61
25	Machinery and machine tools	62-65
26	Elec. machine tools	66-71
27	Transport equipment	72-76
28	Other manufacturing industry	77 & 78
29	Construction	79
30	Electricity, gas etc.	80
31	Transport services	81 & 82
32	Other services	83-89

Table 4.2 : Sectoral Wage Distribution

Sector No.	Daily wage class in rupees at 1979-80 price 0-3	3-4	4-5	5-6	6-7	7-8
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	0.0	0.0	.02243	.05922	.13792	.21278
2	0.0	0.0	.00100	.00969	.03970	.07666
3	0.0	.18254	.28709	.25889	.15008	.06653
4	0.0	.15916	.21671	.20371	.15034	.09958
5	0.0	.30737	.28250	.20046	.11123	.04657
6	0.0	0.0	0.0	.00008	.00027	.00050
7	0.0	0.0	0.0	.00001	.00005	.00017
8	0.0	0.0	0.0	.00452	.01717	.04041
9	0.0	0.0	0.0	.02537	.06814	.12395
10	0.0	0.0	.06746	.09344	.13133	.15553
11	0.0	0.0	0.0	.09242	.15258	.14653
12	0.0	0.0	0.0	.13025	.10664	.12287
13	0.0	0.0	.01397	.02450	.04304	.05911
14	0.0	0.0	0.0	.00817	.01006	.01370
15	0.0	0.0	.07631	.14607	.18118	.16519
16	0.0	0.0	0.0	.04648	.03295	.03192
17	0.0	0.0	0.0	.00044	.00087	.00135
18	0.0	0.0	0.0	.00003	.00011	.00024
19	0.0	0.0	0.0	.00912	.01578	.01889
20	0.0	0.0	0.0	.03638	.04064	.05410
21	0.0	0.0	0.0	.00201	.00862	.02258
22	0.0	0.0	0.0	.12897	.13612	.15347
23	0.0	0.0	0.0	.00394	.00931	.01109
24	0.0	0.0	0.0	.08347	.04662	.03081
25	0.0	0.0	0.0	.01384	.01569	.01790
26	0.0	0.0	0.0	.05710	.03086	.02760
27	0.0	0.0	.01559	.02540	.04118	.04509
28	0.0	0.0	0.0	.00570	.01863	.03197
29	0.0	0.0	0.0	.09537	.09352	.12402
30	0.0	0.0	0.0	.00347	.00987	.01830
31	0.0	0.0	.03881	.06614	.11032	.15141
32	0.0	0.0	.00917	.01699	.02851	.03550

contd......./-

Table 4.2 : Sectoral Wage Distribution (Contd.)

Daily wage class in rupees at 1979-80 price

Sector No.	8-9	9-10	10-11	11-12	12-13
(1)	(8)	(9)	(10)	(11)	(12)
1	.21166	.11139	.06884	.05132	.02954
2	.06316	.03557	.10369	.10213	.07563
3	.02652	.00883	.00353	.00312	.00320
4	.06085	.02772	.01572	.01532	.01522
5	.01660	.00538	.00350	.00447	.00500
6	.00050	.00030	.00076	.00178	.00371
7	.00031	.00029	.00089	.00182	.00293
8	.04952	.03282	.07118	.06774	.06234
9	.12817	.04538	.08447	.10457	.08749
10	.13251	.05665	.06545	.08427	.07653
11	.08577	.02839	.04719	.03286	.02081
12	.09788	.02876	.04787	.06832	.06612
13	.05086	.02039	.02399	.01728	.01689
14	.01712	.01408	.03053	.03102	.02514
15	.11720	.04986	.04262	.04729	.03917
16	.02291	.00921	.01179	.01160	.01357
17	.00217	.00331	.00862	.00623	.00396
18	.00028	.00022	.00064	.00135	.00199
19	.01409	.00730	.01427	.02031	.02434
20	.04736	.02206	.04550	.05504	.04586
21	.03190	.02627	.06966	.09261	.08366
22	.14475	.05927	.07799	.09130	.06803
23	.00661	.00293	.00571	.00855	.01271
24	.01212	.00377	.00750	.00984	.00974
25	.01064	.00562	.01640	.01859	.01639
26	.01705	.00788	.01745	.02771	.02811
27	.04173	.02173	.03504	.04897	.04802
28	.02654	.01781	.05094	.06370	.05775
29	.11155	.03598	.06611	.07475	.06226
30	.01784	.00917	.01643	.02304	.02627
31	.14190	.05693	.08487	.09712	.06804
32	.03021	.01635	.03523	.05060	.05988

contd......../-

Table 4.2 : Sectoral Wage Distribution (Contd.)

Daily wage class in rupees at 1979-80 price

Sector No.	13-14	14-15	15-16	16-17
(1)	(13)	(14)	(15)	(16)
1	.01434	.00843	.00665	.00612
2	.05634	.03729	.03312	.02933
3	.00269	.00195	.00130	.00090
4	.01245	.00861	.00512	.00336
5	.00460	.00376	.00277	.00187
6	.00521	.00549	.00544	.00572
7	.00370	.00341	.00330	.00368
8	.06515	.06147	.04932	.04115
9	.07337	.06332	.05159	.03850
10	.04886	.02872	.01983	.01381
11	.02235	.02876	.04780	.04619
12	.06613	.05668	.04064	.02950
13	.02294	.02579	.02815	.03345
14	.02133	.02153	.02643	.02785
15	.02791	.01967	.01466	.01152
16	.01904	.02352	.02548	.02509
17	.00334	.00306	.00345	.00387
18	.00251	.00376	.00448	.00460
19	.02259	.02149	.02723	.03280
20	.03492	.02727	.03121	.03261
21	.06886	.06004	.05677	.05425
22	.04275	.02671	.01756	.01440
23	.01748	.02018	.01971	.01886
24	.00898	.00802	.00868	.01512
25	.01300	.01008	.00903	.00922
26	.02303	.02342	.02807	.03313
27	.04121	.03498	.02949	.02489
28	.07325	.07652	.06344	.06285
29	.05700	.04967	.04454	.04096
30	.02788	.02929	.03042	.03262
31	.04187	.02561	.01574	.01031
32	.06894	.07185	.06251	.04521

contd......./-

Table 4.2 : Sectoral Wage Distribution (Contd.)

Daily wage in rupees at 1979-80 price

Sector No.	17-18	18-19	19-20	20 and above	Total
(1)	(17)	(18)	(19)	(20)	(21)
1	.00615	.00645	.00655	.04022	1.0
2	.02250	.01689	.01095	.28576	1.0
3	.00054	.00038	.00035	.00158	1.0
4	.00213	.00133	.00085	.00152	1.0
5	.00128	.00096	.00071	.00100	1.0
6	.00774	.01400	.02382	.92469	1.0
7	.00386	.00387	.00396	.96775	1.0
8	.03923	.04006	.04231	.31562	1.0
9	.02713	.02085	.01606	.04164	1.0
10	.00948	.00648	.00382	.00583	1.0
11	.05381	.05949	.04408	.08096	1.0
12	.02229	.01763	.01569	.08392	1.0
13	.04303	.05664	.05942	.46065	1.0
14	.02478	.02487	.02461	.67880	1.0
15	.00962	.00809	.00655	.03708	1.0
16	.02489	.02982	.03800	.63370	1.0
17	.00379	.00341	.00280	.94935	1.0
18	.00461	.00461	.00461	.96596	1.0
19	.03408	.03289	.02857	.67624	1.0
20	.03015	.02813	.02593	.44284	1.0
21	.04988	.04504	.04134	.28658	1.0
22	.01324	.00926	.00446	.01173	1.0
23	.01845	.01803	.01715	.80928	1.0
24	.02960	.04711	.05911	.61950	1.0
25	.00900	.00821	.00904	.81735	1.0
26	.03573	.03721	.03665	.56810	1.0
27	.02835	.03070	.02921	.45842	1.0
28	.05725	.04400	.03968	.30995	1.0
29	.03824	.03328	.02963	.04512	1.0
30	.03778	.04399	.04646	.62717	1.0
31	.00811	.00756	.00726	.06802	1.0
32	.02752	.01604	.01127	.41421	1.0

'able 4.3 : Sectoral sources of income of target group and consumption pattern target and non-target group (in percentage)

ector No.	Income source (target group)	Consumption	
		Target group	Non-target group
(1)	(2)	(3)	(4)
1	36.9015	31.969	17.580
2	5.6940	10.384	9.036
3	26.5355	8.330	12.200
4	4.3800	12.570	10.972
5	1.8250	2.548	2.566
6	0.0	0.057	0.117
7	0.0	0.0	0.0
8	0.0365	0.0	0.0
9	1.5695	1.655	6.089
10	0.8760	4.621	1.170
11	0.3285	0.091	0.051
12	0.6935	0.742	1.111
13	0.2190	1.274	0.117
14	0.0365	0.171	0.197
15	0.5475	0.323	0.621
16	0.0365	0.114	0.278
17	0.0	3.233	1.637
18	0.0	0.0	0.0
19	0.0365	0.006	0.015
20	0.1460	0.342	1.184
21	0.0365	0.0	0.0
22	1.4235	1.293	0.577
23	0.0365	0.0	0.0
24	0.1460	0.685	0.424
25	0.0365	0.019	0.475
26	0.0730	0.076	0.680
27	0.1825	0.076	0.629
28	0.3285	0.628	2.361
29	5.7305	0.0	0.0
30	0.0730	0.437	0.665
31	0.7160	0.969	3.589
32	5.4020	11.588	25.658
tal	100.0	100.0	100.0

income of the target group. It may be recalled that only source of income of the target group, in our model, is employment income which includes wage income as well as income from self employment. The employment distribution matrix, which provide income linkage of the target group with different productive section of the economy, also determine sectoral pattern of income of the target group. The sectoral pattern of income source of the target group as estimated from the employment distribution matrix is given in Table 4.3. It is seen that agriculture provides about 71% of the income of the target group. Next in order comes services and manufacturing sectors whose percentage contribution towards income of target group are respectively 12.11 and 10.96. It should, however, be pointed out that contribution of individual manufacturing sectors are very less - varying from 0 to 1.7%. By contrast, construction sector alone account for 5.7% of the income of the target group. It can be noted that our estimates of sectoral sources of income of the poor are not widely different from those provided by Sinha, Pearson et al (1979), although their data base and method of estimation is quiet different from ours.

b) Poverty and inequality profile of the target group

The poverty and inequality profile of the target group as estimated from the employment distribution matrix is presented in Table 4.4.

Sen's index (20.54) and percentage of people below poverty line (48.35) show high incidence of poverty in the target group. However, extent of inequality within the target group (Lorenz ratio : 0.139) is low as compared with the overall inequality in the structure of employment earnings

Table 4.4 : Poverty profile by broad groups of sectors, 1979-80

Sectors Name	Sen's index of poverty	Percentage of people below P.L.	Inequality in the poverty group (Gini)	Percapita income of people below P.L.
(1)	(2)	(3)	(4)	(5)
Agriculture	15.2398	34.11002	0.14423	50.91478
Mining and Quarring	0.4768	0.01922	0.06820	63.55954
Manufacture	3.1565	6.67133	0.14713	48.65358
Electricity and etc.	0.7032	0.02520	0.07403	61.32210
Construction	0.8603	2.52231	0.08984	56.99823
Transport	1.0101	2.93200	0.09877	57.28297
Other services	0.8225	2.36734	0.10149	57.19910
Total	20.5419	48.35	0.13931	52.63

Note : P.L. = poverty line = Rs. 78.76 (monthly percapita in 1979-80 prices).

(L.R. 0.389). Analysis of sectoral incidence of poverty reveals that agriculture has highest incidence of poverty (Sen's index : 15.24, percentage of people below poverty line : 34.11, per capita consumption of the poor : Rs. 50.91) followed by manufacturing, services and construction sectors. Mining and Electricity sectors, on the other hand, have least incidence of poverty (Sen's index : 0.477, 0.703) with per capita consumption of the poor about 20% more than that in agriculture and manufacturing industries. To compare our estimates with other estimates of inequality and poverty, aggregate as well as sectoral, it should be pointed out that most of other estimates are based on consumption data provided by NSSO. The only estimates of inequality based on personal distribution of income are provided by NCAER (1976), Ahmed and Bhattacharya (1974), and Roy (1979).

Roy (1979) used the same data source for estimating wage inequality in Indian manufacturing industries for the years 1958-59 and 1963-65. Our estimate which are obtained after recasting and balancing the same data for the year 1979-89, show marginal increase in overall as well sectoral inequality.

Estimates of inequality provided by NCAER (1975) and Bhattyacharya and Ahmed (1974) are based on distribution of personal income. However, so far as employment income forms a major portion of personal income, at least in the lower part of the distribution, we may compare our estimate with these estimates. It is seen our estimate of wage earning inequality (LR : 0.39) comes in between Bhattyacharya and Ahmed (LR : 0.36) and NCAER (L.R. : 0.45).

4.4 Parameters of consumer demand functions

The impact of income redistributive policies on different economic variables depends upon the differences in the consumption pattern associated with the income classes. Thus the choice of the consumer expenditure functions may have important implication for the estimate and policy conclusions drawn from the model. Use of different forms of Engel functions for estimating the consumption pattern of the different socio-economic groups, is quite prevalent in the literature. But, as it is well known most of them do not satisfy additivity condition and total expenditure is adjusted with arbitarily chosen 'residual sector' or on prorata basis. Moreover, use of these functions do not allow analysis of impact of prices on the expenditure level and pattern of different socio-economic classes which may have substantial impact on the distribution of income.

4.4.1 Estimation of parameters of LES demand functions

The present study uses Linear Expenditure System (LES) of demand functions proposed by Stone (1954) for estimating commodity consumption expenditure of the target and non-target groups.

Parameters of LES demand functions for four groups of population, as used in the consumption sub-model of Sixth TN, have been derived from those of 13 broad commodity sectors provided in 'Report of the Task force on the Projections of minimum needs and effective consumption' by Planning Commission (1979). For our study the 13 sector LES parameters are first disaggregated into 32 sectors using weights representing share in consumption of our individual commodity sector in 13 broad commodity sectors. These shares have been calculated using engel functions for 71 commodities along with their estimated parameters as given in the above mentioned Task Force report. The methodology adopted for this disaggregation is discussed in the next section.

The LES parameters thus obtained need not yield the base year private consumption vector. So the 32 sectors LES parameters of the four consumer groups are next adjusted simultaneously by an iterative scheme so that the aggregated sectoral consumption implied by them is equal to the given base year aggregate sectoral consumption. This iterative scheme is described in section 4.4.1.2.

Finally, sectoral trade and transport margin as provided by Majumdar and Panda (1982) are seperated out from LES parameters and are accounted in the parameters of their respective sectors as discussed in section 4.4.1.3. Thus the LES demand functions thus obtained would provide consumption at current market price that is, inclusive of indirect tax less subsidy.

4.4.1.1 Determination of LES parameters for IO sectors from LES parameters of broad commodity groups

In this section we describe a method of estimating LES parameters for input-output (IO) sectors from those of 13 broad groups of commodities. The method consists of disaggregating LES parameters for broad commodity groups into corresponding parameters for IO sectors using engal functions for individual commodities within the broad group.

Let (A_i, B_i) denote the given LES parameters (expressed at constant prices) for ith broad group of commodities for i= 1, 2, ... 13. Then the aggregate per-capita consumption of ith group can be determined from LES demand functions as

$$C_i = A_i + B_i \left(c - \sum_k A_k\right) \qquad \ldots\ldots (24)$$

$$i = 1, 2, \ldots 13$$

where c is the known aggregate per-capita consumption.

Let q_{ij} be the consumption of jth individual commodity belonging to ith broad commodity group, j=1, 2, ... n_i and $f_j(c)$ be the engal function of jth individual commodity. Then

$$q_{ij} = f_j(c) \qquad i=1, \ldots\ldots 13 \qquad \ldots\ldots (25)$$
$$j=1, 2, \ldots\ldots n_i$$

The q_{ij}'s obtained by (25) are adjusted prorata such that

$$\sum_{j=1}^{n_i} q_{ij} = C_i \qquad \text{..... (26)}$$

Let (a_k, b_k) be LES parameters for kth IO sector and S_k be the set of commodities belonging to kth IO sector then estimates of a_k and b_k for $k=1 \ldots\ldots n$ are given by,

$$a_k = \sum_{i=1}^{13} \sum_{j=1}^{n_i} A_i . W_{ij} . \delta_{ij} \qquad \text{..... (27)}$$

$$b_k = \sum_{i=1}^{13} \sum_{j=1}^{n_i} B_i . W_{ij} . \delta_{ij} \qquad \text{..... (28)}$$

where, $W_{ij} = \dfrac{q_{ij}}{C_i}$, $i=1, 2, \ldots\ldots 13$, $j=1, 2, \ldots\ldots n_i$,

$$\delta_{ij} = \begin{cases} 0 \text{ if } j \notin S_k \\ 1 \text{ if } j \in S_k \end{cases} \qquad \forall \; i=1, 2, \ldots\ldots 13$$

and n is the number of IO sectors.

It can be easily verified that $\sum_{k=1}^{n} b_k = 1$ as $\sum_{i=1}^{13} B_i = 1$

The parameters a_{kr} and b_{kr} ($k=1, 2, \ldots\ldots n$; $r=1, 2, \ldots\ldots 4$) for 4 classes of population (below and above poverty line for rural and urban) have been estimated using the above method.

4.4.1.2 <u>Adjustment of LES parameters of different classes of population when only aggregate consumption vector is given</u>

If C_{ij} is per-capita consumption of ith commodity by the jth class population with aggregate per-capita consumption μ_j, then according to LES demand function

$$C_{ij} = a_{ij} + b_{ij} \left(\mu_j - \sum_{k=1}^{n} a_{kj} \right) \qquad \ldots\ldots (29)$$

$$i=1, 2, \ldots n, \quad j= 1, 2, 3, 4,$$

where a_{ij} and b_{ij} are LES parameters for ith commodity and jth group of population as estimated in the previous section. For the given sectoral consumptions $\bar{C}_{ij}$ for jth group of population the LES parameters can be adjusted so that LES demand functions yield the same given sectoral consumption for individual groups of population. The adjusted LES parameters are

$$\bar{a}_{ij} = (\bar{C}_{ij}/C_{ij}) \quad a_{ij} \qquad \ldots\ldots (30)$$

$$\bar{b}_{ij} = (\bar{C}_{ij} - \bar{a}_{ij})/(\mu_j - \sum_{k=1}^{n} \bar{a}_{kj}) \qquad \ldots\ldots (31)$$

which will satisfy

$$\bar{C}_{ij} = \bar{a}_{ij} + \bar{b}_{ij} \left(\mu_j - \sum_{k=1}^{n} \bar{a}_{kj} \right) \qquad \ldots\ldots (32)$$

In our case $\bar{C}_{ij}$ for seperate groups are unknown, while only aggregate private consumption (at market price) of the individual classes combined is known. In such a situation the above method fails and we have to adjust C_{ij}, a_{ij} and b_{ij} simultaneously. Below we present an iterative method for adjusting sectoral LES parameters and consumption of individual groups of population such that they yield the given aggregate sectoral consumption.

Let C^{*}_{pi} be the aggregate consumption of commodity sector 'i' by the four groups of populations combined. Let C_{ij}, a_{ij} and b_{ij} be initial estimates of sectoral consumption and LES parameters by jth group of population such that (29) is satisfied. The problem is to adjust C_{ij}, a_{ij} and b_{ij} such that their adjusted values $\bar{C}_{ij}$, A_{ij} and B_{ij} satisfy

$$12 \sum_{j=1}^{4} \beta_j^* \cdot P_j^* \cdot \bar{C}_{ij} = C_{pi}^* \qquad \ldots\ldots (33)$$

$$\bar{C}_{ij} = A_{ij} + B_{ij} \left(\mu_j - \sum_{k=1}^{n} A_{kj} \right) \qquad \ldots\ldots (34)$$

$$\sum_{i=1}^{n} B_{ij} = 1 \qquad \forall \; j = 1, 2, 3, 4 \qquad \ldots\ldots (35)$$

and
$$\sum_{i=1}^{n} \bar{C}_{ij} = \mu_j \qquad \forall \; j = 1, 2, 3, 4 \qquad \ldots\ldots (36)$$

where β_j^* = proportion of population in jth class (exogenously given)

and P_j^* = population of jth class (exogenously given).

Let the adjustment factor for ith sector and jth group of population be r_{ij} and

$$A_{ij} = r_{ij} \cdot a_{ij} \qquad \ldots\ldots (37)$$

$$\bar{C}_{ij} = r_{ij} \cdot C_{ij} \qquad \ldots\ldots (38)$$

Then substituting A_{ij} in (34) and $\bar{C}_{ij}$ in (36) from (37) and (38) we get

$$B_{ij} = r_{ij} \left(C_{ij} - a_{ij} \right) / \left(\mu_j - \sum_{k=1}^{n} r_{kj} \cdot a_{kj} \right) \qquad \ldots\ldots (39)$$

$$\sum_{i=1}^{n} \bar{C}_{ij} = \sum_{i=1}^{n} r_{ij} \cdot C_{ij} = \mu_j \qquad \ldots\ldots (40)$$

Now if we choose

$$r_{ij} = \rho_i \cdot \mu_j / \sum_{k=1}^{n} \rho_k \; C_{kj} \qquad \ldots\ldots (41)$$

where ρ's are unknown parameters to be estimated then (40) and hence (36) is satisfied.

Again, by virtue of (40) along with (38) and (39) it is obvious that (35) is satisfied. Moreover, substituting $\overline{C}_{ij}$ from (34) in (33) and using (37) and (39) we get

$$\sum_{j=1}^{4} \beta_j^*.P_j^*.r_{ij}.C_{ij} = C_{pi}^*/12$$ and hence (33) is also satisfied.

Finally estimates of B_{ij} by (39) satisfy (34).

Now substituting (41) in (42) we get

$$= C_{pi}^*/\left[12 \sum_{j=1}^{4} (\beta_j^* P_j^*. \mu_j .C_{ij}/ \sum_{k=1}^{n} \rho_k C_k)\right] \quad ..... (42)$$

ρ_i's are then determined iteratively by (43).

$$\rho_i^t = C_{pi}^*/\left[12 \sum_{j=1}^{4} \beta_j^* P_j^* \mu_j C_{ij}/ \sum_{k=1}^{n} \rho_k^{t-1} C_{kj}\right] \quad ..... (43)$$

When ρ_i^0 is obtained from (34) using C_{ij} given by (29). r_{ij}'s are then obtained from (41) and A_{ij}, B_{ij} by (37) and (40). With these A_{ij} and B_{ij} we finally estimate $\overline{C}_{ij}$ by (34).

4.4.1.3. Estimation of LES parameters at market price

Sectoral LES parameters as obtained in previous section are at purchaser's price; that is inclusive of trade and transport margins and indirect taxes less subsidies. To calculate LES parameters at market price involving only indirect taxes and subsidies we have to remove trade and transport margins from these LES parameters and account them in respective parameters of trade and transport sectors. Trade and transport margins at purchasers' price are given by Majumdar and Panda (1982) for 89 IO sectors from which the corresponding rates for 32 IO sectors are calculated after appropriate aggregation.

Let the trade and transport margins for ith IO sector be denoted by d_i and r_i respectively. Let ($\bar{a}_k$, $\bar{b}_k$) denote LES parameters for kth IO sector at market price and (a_k, b_k) be the same at purchaser's price. Then $\bar{a}_k$ and $\bar{b}_k$ are given by

$$\bar{a}_k = a_k (1 - d_k - r_k) \quad \forall \quad k \neq \alpha, \beta$$

$$\bar{a}_d = a_\alpha + \sum_k a_k d_k$$

$$\bar{a}_\beta = a_\beta + \sum_k a_k r_k$$

and

$$\bar{b}_k = b_k (1 - d_k - r_k) \quad \forall \quad k \neq \alpha, \beta$$

$$\bar{b}_\alpha = b_\alpha + \sum_k b_k d_k$$

$$\bar{b}_\beta = b_\beta + \sum_k b_k r_k$$

where subscripts α and β refer to trade and transport sectors respectively. It can easily be verified that

$$\sum_{k=1}^{32} \bar{a}_k = \sum_{i=1}^{32} a_i$$

and

$$\sum_{k=1}^{32} \bar{b}_k = \sum_{i=1}^{32} b_i$$

/-

4.4.2 Analysis

Estimates of sectoral LES parameters for the target and non-target groups, rural and urban, as estimated by above mentioned method are given in table 4.5. Consumption pattern as obtained by these demand functions show wide variation between target and non-target groups. It is seen that while target group spends about 66% of their total consumption expenditure on 'food and beverage' the non-target group spends about 52%. Moreover, share of agriculture sector (50.9%) in total consumption of target group is about 12% more than that of non-target group. However, share of manufacturing sector in the total consumption of these two groups are more or less same. But the non-target group spends about 1.5 times more than target group on services, the share of which in target and non-target group being 18.5 and 29.2 percent respectively. Thus we see that difference in consumption pattern between target and non-target group is mainly due to their difference in consumption of agricultural products and services.

4.4.2.1 Employment coefficient and employment elasticities

Estimates of sectoral employment coefficient and employment elasticities used in this study are built up from informations provided in Sixth TN, and supplementary information available from Planning Commission for 71 sectors which have been aggregated into 32 sectors using information on sectoral gross output and employment. Employment figures according to these estimates are expressed in 'standard person year' which is equivalent to 273 working days in a year working 8 hours a day. This unit, however, has its demerits in measuring employment in agriculture and services which

Table 4.5 : Parameters of ~~Les~~ LES demand functions

Sector No.	Rural				Urban			
	Below poverty line		Above poverty line		Below poverty line		Above poverty line	
	A_1	B_1	A_2	B_2	A_3	B_3	A_4	B_4
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1	6.370980	0.303932	22.122040	0.055418	3.680449	0.137273	10.668451	0.003811
2	1.730094	0.100744	4.967855	0.070981	0.435908	0.073586	3.436519	0.070147
3	0.146363	0.099802	0.272940	0.100924	-0.849475	0.109989	6.142059	0.058830
4	1.159278	0.112229	5.729572	0.071373	0.808045	0.165540	9.117150	0.094650
5	0.421576	0.020991	1.560260	0.020617	0.238550	0.024816	0.626700	0.017658
6	0.005564	0.000119	0.069149	0.000216	0.029359	0.001171	0.256132	0.001101
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	-0.053411	0.025243	-1.834733	0.105347	-0.213825	0.014909	-1.824300	0.064379
10	-0.136670	0.059022	0.0	0.0	-1.107536	0.077285	-1.734502	0.061281
11	-0.000558	0.000241	-0.017476	0.001004	-0.001373	0.000096	-0.002861	0.000100
12	-0.025593	0.011066	-0.390504	0.022421	-0.111703	0.007792	-0.116785	0.004120
13	-0.147787	0.021845	-0.291350	0.003564	-0.235594	0.013219	-0.917102	0.009681
14	0.011077	0.002104	-0.008458	0.003512	-0.004144	0.001031	-0.005388	0.000395
15	-0.041097	0.006065	-4.828847	0.059036	-0.034480	0.001942	-0.850309	0.008953
16	0.001008	0.001514	-0.079910	0.004702	-0.003744	0.000850	-0.037529	0.002637
17	1.217262	0.022431	1.733423	0.005393	0.094732	0.003774	1.309400	0.005646
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	0.000302	0.000058	-0.000417	0.000173	-0.000191	0.000047	-0.003559	0.000260
20	0.017148	0.003259	-0.028800	0.011959	-0.022529	0.005604	-0.337636	0.024739
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	-0.162307	0.023955	-1.820307	0.022252	-0.143906	0.008103	-4.126953	0.043465
23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	-0.067554	0.009961	-3.691133	0.045151	-0.014976	0.008527	-0.080969	0.000860
25	-0.002990	0.000442	-0.070375	0.008906	-0.004765	0.000268	-0.173768	0.001830
26	-0.008650	0.001277	-0.513951	0.016751	-0.014459	0.000813	-0.406423	0.004281
27	-0.008884	0.001313	-0.000417	0.011047	-0.014164	0.000797	-0.060047	0.000633
28	-0.020655	0.009892	-0.072597	0.038291	-0.017719	0.003479	-0.226242	0.012283
29	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	0.055288	0.001018	-0.005159	0.001179	0.219749	0.008759	2.318441	0.009995
31	0.867975	0.073646	-0.022503	0.053102	0.193589	0.054092	-0.294850	0.028394
32	0.369443	0.087836	-0.003706	0.266681	-2.033398	0.276239	-2.470208	0.469869

Table 4.6 : Sectoral paramactors

Sector No.	Employment coefficient(1)	Employment Elasticity	(1+Mark-up)(2)	Wage inequality (Gini)(3)
(1)	(2)	(3)	(4)	(5)
1	191.13	0.3319	1.1052	0.1026
2	101.30	0.5145	1.1575	0.1483
3	260.04	1.3252	1.0361	0.1543
4	44.86	1.4075	1.0258	0.1610
5	131.86	3.4297	1.0674	0.1652
6	46.14	0.3704	1.2927	0.1798
7	6.56	0.3102	1.5061	0.1946
8	46.95	0.4418	1.3422	0.1960
9	51.36	1.3729	1.4554	0.1963
10	51.36	0.4557	1.4888	0.2064
11	42.36	1.1233	1.2630	0.2134
12	56.41	0.2751	1.3054	0.2228
13	44.28	0.1595	1.1615	0.2258
14	20.49	-1.0990	1.1158	0.2266
15	53.88	0.8817	1.0506	0.2333
16	11.69	0.7330	1.1677	0.2377
17	1.79	0.5979	1.1120	0.2402
18	11.69	0.4938	1.4199	0.2566
19	11.69	0.4339	1.2326	0.2584
20	11.69	0.5719	1.1629	0.2656
21	28.49	0.3109	1.0857	0.2718
22	61.34	0.8293	1.1256	0.2726
23	10.43	0.4307	1.1790	0.2859
24	29.69	0.6617	1.1727	0.2885
25	14.12	0.3216	1.1674	0.2891
26	25.24	0.3222	1.1216	0.2941
27	24.13	-0.0375	1.1386	0.3053
28	58.46	0.5147	1.1819	0.3177
29	60.12	0.5778	1.0637	0.3205
30	18.87	0.4663	1.3254	0.3509
31	.88.34	0.5228	1.1631	0.3572
32	60.37	0.6003	1.1938	0.3700

(1) Million standard person year per million Rs. of output.

(2) Mark up for agricultural sector is endogenously determined in the fix-flex price version of the model. The figure reported here for agriculture sectors refer to base year. Aggregate mark-up for the economy for 1979-80 is 0.1383.

(3) Aggregate wage inequality (Lorentz Ratio) is 0.3889 and the same for the poverty group is 0.1393.

should be kept in mind in subsequent discussion of employment implication of alternative policies. The estimates of employment coefficient and elasticities thus obtained are given in Table 4.6.

Comparision of sectoral labour coefficients shows great sectoral variation in labour intensity (employment per output). First of all agriculture and industry have remarkable difference in, labout intensity - labour intensity in agriculture is almost four times greater than that of manufacturing industries. In order of intensity the sectors can be divided into the following groups. Agriculture and allied industries like beverage and tabacco are most labour intensive sectors of the economy (labour coefficient: 101-192). Next most labour intensive sectors are construction and services (labour Coeff. : 60-90). Mining and manufacturing industries, on the other hand, show wide spectrum of labour intensity (2-60). In terms of intensity of their labour use these industries can further be sub-divided into three groups. The first group consists of Mining (except the sector 'other minerals'), Textile, Paper, Wood, Leather and Transport equipment industries which have labour coefficients in the range 40 to 60. In the second group mainly non-metalic and machine tools industries (labour Coeff. : 20-40). Finally, the plastic and chemical industries which have labour coefficients of 15 or less forms the third group.

Comparision of sectoral employment elasticities also show that most of the sectors are employment inelastic with elasticities varying in between 0.3 and 0.6. The only sectors which have employment elasticities greater than one are 'allied agriculture', 'food manufacturing', and 'cotton textiles'.. In view of inelastic labour requirement of the major industries it can be said that input-output projections with fixed labour coefficient will generally overestimate employment.

4.5 Poverty line and percentage of people below it

Various estimates have been made of the poverty line in India.)ne of the earliest of the kind is by a Study Group of Planning Commission. \ccording to this study Rs. 20 per month at 1960-61 prices was taken as)overty line. Subsequently, Bardhan (1974), Dandekar and Rath (1971) inde-)endently estimated the same figure for the rural population but slightly igher figure (Rs. 22.1 at 1960-61 prices) for urban population. Planning ommission in their Task Force report has come out with poverty line at 973-74 prices separately for rural and urban areas, which were considered or Sixth Plan. These studies follow a common methodology. First, the nutritionally' balanced diet for an 'average' person is identified and osted. The figure so obtained is then blown up by a ratio of food to total xpenditure in order to account for necessary minimum expenditure for non-od expenditure. Planning Commission's 1979-80 figures are, however, based actual consumption pattern of the expenditure class which correspond to e average calorie requirement. This methodology, however, has been criti-sed by Sukhatme (1977) on the ground that the recommended requirement is verage' and not minimum and also ignore inter as well as intra individual iation of calories requirement.

For our study we have used the Sixth Plan estimates of 'poverty e' and the percentage of people below it as provided in Sixth TN. These ures are given respectively for rural and urban population. All India estimates of percentage of people below poverty line has been calculated using rural and urban population figures. To arrive at the all India estimate of poverty line, as required by our model, we have utilised the information regarding the distribution of per capita consumption of rural and urban population assumed to be lognormal in Sixth TN. This can be done if one assumes that per-capita aggregate consumption for the country also follow two parameter lognormal distribution as discussed in the next section.

The all India estimate of poverty line and the percentage of population below poverty line are estimated -- as Rs. 78.76 per month at 1979-80 prices) and 48.35% respectively.

4.5.1 Estimation of 'All India poverty line'

In this section we describe a method of estimating all India poverty line from the distributions of per capita expenditure in rural and urban India. For rural and urban India the respective per capita expenditure are generally assumed to be log normaly distributed. This is also supported by the data of National Sample Surveys on household consumer expenditure. To estimate the all India poverty line we integrate these distributions under the assumption that per capita consumption for the country as a whole also follow two parameter lognormal distribution.

Let the all India poverty line to be estimated be x_α. Let F_r and F_u be distribution functions of percapita expenditure in rural and urban India. Then proportion of total population, p_j, having percapita expenditure x_j or less is given by

$$p_j = [P_r \cdot F_r(x_j) + P_u \cdot F_u(x_j)] / (P_r + P_u) \qquad \ldots\ldots (44)$$

where, P_r and P_u are rural and urban populations. Now, if F_r and F_u follow two parameter lognormal distribution with respective parameters ($\bar{x}_r$, λ_r) and ($\bar{x}_u$, λ_u) then

$$p_j = p_r \cdot \varphi\,(y_{jr}) + p_u \cdot \varphi\,(y_{ju}) \qquad \ldots\ldots (45)$$

where,
$$y_{jr} = (1/\lambda_r) \cdot \log\,(x_j / \bar{x}_r) + \lambda_r/2, \qquad \ldots\ldots (46)$$

$$y_{ju} = (1/\lambda_u) \cdot \log\,(x_j / \bar{x}_u) + \lambda_u/2, \qquad \ldots\ldots (47)$$

$$p_r = P_r/(P_r + P_u), \quad p_u = P_u/(P_r + P_u),$$

and φ (.) is the normal distribution function with zero mean and unit variance. Then by using (45) one can obtain p_j for different values of x_j. Now, let Q_j be the aggregate share of percapita consumption up to x_j for the country as a whole. Then,

$$Q_j = (P_r \cdot \int_0^{x_j} x \cdot \delta\, F_r(x) + P_u \cdot \int_0^{x_j} x \cdot \delta\, F_u(x))/P\bar{x}$$

$$= [\,P_r \cdot \bar{x}_r \cdot \varphi\,(y_{rj} - \lambda_r) + P_u \bar{x}_u \cdot \varphi(y_{ju} - \lambda_u)\,]/P \cdot \bar{x} \qquad \ldots\ldots (48)$$

where $\bar{x}$ is the given average percapita consumption expenditure for the country as a whole and $P = P_r + P_u$.

Lorenz ratio for the country as a whole, L, is given by

$$L = 1 - \sum_{j=1}^{n} (p_j - p_{j-1})\,(Q_{j-1} + Q_j) \qquad \ldots\ldots (49)$$

where n is the total number of expenditure class limits considered. It can be noted that $p_0 = 0$, $Q_0 = 0$, and $Q_n = 1$

Now, if we assume that all India per capita expenditure follow two parameter lognormal distribution with parameter $\overline{x}$ (known) and λ^2 (unknown) then

$$L = 2 \cdot \varphi(\lambda / \sqrt{2}) - 1 \qquad \ldots\ldots (50)$$

Finally, using (49) and (50) we can estimate λ uniquely. The all India poverty line, x_α, then can be estimated by using the following equation, given the all India percentage α of people poverty line.

$$\alpha = \varphi(y_\alpha) \qquad \ldots\ldots (51)$$

$$y_\alpha = (1/\lambda) \log (x_\alpha / \overline{x}) + \lambda/2 \qquad \ldots\ldots (52)$$

4.6 Estimate of aggregate production function :

As stated in the previous chapter, the foodgrain output in the basic model is determined under two alternative assumptions viz. (a) that food grain output is exogenously specified or (b) that it is determined under profit maximising principle using Cobb-Douglas production function. The exogenously specified food grain output, as used in the present study, is taken to be same as that obtained in the basic solutions of the basic and the plan models. The food grain output so obtained are Rs. 182022 million and Rs. 223479 million at 1979-80 prices. For the second assumption we need an estimate of aggregate production function for the entire food grain sector of Indian economy. Agricultural production function which are available for Indian economy are generally estimated for individual crops and individual regions using cross-section and/or time series data.[1] These estimates, which are generally used for

[1] See Askari and Cummings (1976), Hopper (1965) etc. Also see Rudra (1982) for methodological criticism of these estimates and their use for economic analysis.

testing hypotheses relating to return to scale, allocative efficiency and supply response behaviour in Indian agriculture, show wide variation over time, region and types of crops. In the present study we, however, need an estimate of aggregate production function for the entire food grain sector of the Indian economy. Data requirement, specifically relating to inputs, for estimating such an aggregate production function on all India basis pose an enormous problem and it is beyond the scope of the present study to provide an independent estimate of such an aggregate production function. Moreover, the available literature on agricultural production function, to the best of our knowledge, does not provide any estimate of all India aggregate production function, based on recent data, for food grain sector. In absence of any such readily available estimate, we have used an estimate of agricultural production function, by Kawageo, Hayami et al (1985), estimated for a group of LDC including India. The production function estimated in this study is of Cobb-Douglas type with labour, land, livestock, fertilizer, machinery, general education, technical education, time dummy as independent variables and net agricultural output (agricultural output net of self-input) as dependent variable. The basic data used in this study were collected from publications by FAO, ILO, UNESCO etc. and the government of member countries. The production function was estimated from the cross country information on above mentioned variables averaged over the years 1970, 1975, and 1980. For estimating the production function from the cross country data two methods of estimation were used viz. Ordinary Least Square (OLS) and Principal Component Regression (PCR) method. In the present study we use the estimate obtained by PCR [estimate Q14, see Kawageo et al (1985)], as in this method of estimation the problem of multicollinearity can be mostly avoided.

Table 4.7 : Parameters of agricultural production function

Parameters	Production function used in The Basic Model	The Plan Model
(1)	(2)	(3)
Constant ferm (A)	5357.4	5838.9
Elasticity of labour input (a)	0.534	0.534
Elasticity of fertilizer input (b)	0.162	0.162

Table 4.8 : Parameters of supply response function

Parameters	Supply response function used in The Basic Model	The Plan Model
(1)	(2)	(3)
Constant term (D)	2.8733 x 10"	3.8045 x 10"
Own price elasticity [(a+b)/(1-a-b)]	2.2895	2.2895
Fertilizer price elasticity [-b/(1-a-b)]	-0.5329	-0.5329
Wage elasticity [-a/(1-a-b)]	-1.7566	-1.7566

In order to use this production function in the present study we, however, express the production function in terms of two main inputs viz. labour and fertilizer input and absorbe the effect of the remaining inputs in the constant term of the production function. The constant terms of the production and response functions are determined in such a way that output of food grain sector as obtained by these functions, using the basic solution values of the independent variables, are same as those under the basic solutions of the Basic and Plan models. The parameters of the production and supply response few functions so obtained are presented in Tables 4.7 and 4.8 respectively. These estimates should be treated as first order appoximations of aggregate production function for Indian economy and can be improved on the basis of recent data on Indian economy. The policy analysis based upon these estimates should, therefore, be considered as demonstration exercises for highlighting mainly the differences in policy conclusions arising out of different assumptions regarding the supply of agricultural output.

4.7 Other estimates

Estimates of the other sectoral and macro-economic parameters used in the model are mainly taken from Sixth TN. National Accounts Statistics CSO (NAS) and Annual Survey of Industries (ASI), 1979-80 (see Table 4.11). Share of wage (wage and Salaries plus earning of self employed) in different sectors of the economy for the year 1979-80 are calculated using informations from CSO and ASI. For calculating sectoral mark-up, sectoral gross profit is first calculated by applying sectoral wage share on sectoral gross value added. Next, sectoral gross profit per unit of output is expressed as proportion ~~percen-tage~~ of unit material as well as wage cost to arrive at sectoral mark-up (table 4.6). Sectoral mark-up so estimated show that mark-up in manufacturing industries (0.134), on the average is almost three times that of agriculture and twice that of service sectors. Rates of indirect tax ~~rate~~, export and import duties are ~~and~~ calculated from those given in Sixth TN and are presented in Table 4.9. Sectoral import contents of the different components at final

Table 4.9 : Indirect Tax Rates

Sector No.	Indirect tax rates[1]		Import duty rates[2]		Export duty rates[3]	
	1979-80	1984-85	1979-80	1984-85	1979-80	1984-85
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0115	0.0071	0.0	0.0	0.0585	0.0476
3	0.0	0.0	0.2437	0.2893	0.1621	0.2294
4	0.0402	0.0603	0.0959	0.1210	0.0623	0.0488
5	0.4719	1.0805	4.3000	4.9400	0.0	0.0
6	0.0469	0.0586	0.0	0.0	0.0	0.0
7	0.1611	0.2029	0.0	0.0	0.0	0.0
8	0.0042	0.0060	0.0433	0.0486	0.1819	0.1232
9	0.1783	0.3357	0.0242	0.0754	0.0	0.0062
10	0.0038	0.0052	0.0	0.0	0.0054	0.0
11	0.0673	0.1141	0.0	0.0	0.0	0.0
12	0.0012	0.0012	0.0	0.0	0.0	0.0001
13	0.0088	0.0115	0.0	0.0	0.0	0.0
14	0.0826	0.1062	0.2178	0.2432	0.0	0.0
15	0.0048	0.0060	0.0	0.0	0.0	0.0
16	0.1645	0.2258	1.1163	1.2121	0.0	0.0
17	0.5768	0.6367	0.2092	0.3824	0.0	0.0
18	0.1082	0.1163	0.7740	0.7097	0.0319	0.0248
19	0.1140	0.1496	0.1331	0.2260	0.0	0.0
20	0.0574	0.0711	1.1295	0.8705	0.0	0.0
21	0.2515	0.3257	0.0	0.0	0.0	0.0
22	0.0267	0.0324	0.5147	0.5401	0.0	0.0
23	0.0910	0.1435	0.5330	0.6088	0.0	0.0
24	0.0105	0.0139	0.4445	0.2895	0.0	0.0
25	0.0300	0.0388	0.9038	0.8163	0.0	0.0
26	0.1820	0.2283	1.0820	0.7778	0.0	0.0
27	0.0551	0.0747	0.4222	0.3663	0.0	0.0
28	0.3309	0.3776	0.6064	1.0593	0.0041	0.0990
29	0.0	0.0	0.0	0.0	0.0	0.0
30	0.0933	0.1165	0.0	0.0	0.0	0.0
31	0.1117	0.1340	0.0	0.0	0.0	0.0
32	0.0007	0.0009	0.0	0.0	0.0	0.0

1/ Per rupee of sectoral gross value of output at factor cost less export less changes in stock.

2/ Per rupee of sectoral import at c.i.f. prices.

3/ Per rupee of sectoral export at factor cost.

Table 4.10 : Import content of different components of final demand, 1979-80 and 1984-85

Sector No.	1979-80 Private consumption	Public consumption	Investment	1984-85 Private consumption	Public consumption	Investment
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	0.0018	0.0	0.0	0.0010	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0047	0.0	0.0	0.0054	0.0007	0.0
4	0.0645	0.0051	0.0	0.0521	0.0019	0.0
5	0.0003	0.0	0.0	0.0003	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0069	0.0	0.0	0.0032	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0123	0.0016	0.0	0.0084	0.0016	0.0
13	0.0011	0.0022	0.0	0.0010	0.0012	0.0
14	0.2261	0.2027	0.0	0.2173	0.2023	0.0
15	0.0002	0.0	0.0	0.0003	0.0	0.0
16	0.0082	0.1145	0.0106	0.0058	0.0	0.0153
17	0.2778	0.0	0.0	0.8145	0.9018	0.0
18	0.0	0.0	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	0.0	0.0
20	0.0168	0.1160	0.0	0.0143	0.1228	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0
22	0.0063	0.0	0.0062	0.0060	0.0	0.0063
23	0.0	0.0	0.1575	0.0	0.0	0.0751
24	0.0233	0.0	0.0312	0.0476	0.0312	0.0677
25	0.0032	0.0252	0.2131	0.0029	0.0	0.1873
26	0.1256	0.0128	0.1173	0.1731	0.0146	0.1908
27	0.0099	0.0511	0.0957	0.0326	0.0906	0.1371
28	0.1306	0.0753	0.0754	0.0974	0.1234	0.1441
29	0.0	0.0	0.0	0.0	0.0	0.0
30	0.0	0.0	0.0	0.0	0.0	0.0
31	0.0	0.0	0.0	0.0	0.0	0.0
32	0.0	0.0	0.0	0.0	0.0	0.0

Table 4.11 : Population and Other Parameters used in the Study

Item		Year	
	1979-80	1984-85	1994-95
(1)	(2)	(3)	(4)
1. Population (million)	654.1	717.2	843.0
1.1 Rural	512.0	653.4	631.0
1.2 Urban	142.1	163.8	212.0
2. Ratio of per capita consumption in urban to that of rural area			
2.1 below poverty line	1.1654	1.1484	1.1250
2.2 above poverty line	1.3204	1.3079	1.2850
3. Transfer (Rs. million)	30540.0	75200.0	140950.0
4. Net factor income from abroad (Rs. million)	-2010.0	-2480.0	-4950.0
5. Other current transfer from rest of the world (Rs. million)	15200.0	8430.0	16500.0
6. Corporate tax rate	0.10	0.10	*
7. Corporate savings rate	0.0755	0.076	*
8. Direct tax rate	0.029	0.03	*
9. Propensity to save for the non-poor	0.2024	0.202	*
10. Share of profit going to public sector	0.1492	0.1492	*
11. Proportion of public sector accruing to household sector	0.5057	0.51	*

* These are not required in the Plan model for the perspective years, 1994-95.

demand viz. private consumption demand, public consumption demand and fixed capital investment demand, for the years 1979-80 and 1984-85 are also calculated from those given in Sixth TN and presented in Table 4.10. Finally estimates of population and other parameters for the years 1979-80, 1984-85 and 1994-95 as presented in Table 4.11 are taken from NAS, ASI, Sixth TN and other related publications.

4.8 Conclusion

From the point of view of policies aimed at improving the economic position of the target group, the following general conclusions emerge from the analysis of the base year data. Firstly, our analysis of pattern of sources of income and their consumption at the target group show that agriculture and service sectors are the two most important sectors as the target group depend heavily on these sectors both for their income and consumption. Moreover, these are the most labour intensive sectors and generate maximum employment among 'target group'. This observation also supports the hypothesis that the poor produced most of the goods on which they spent a high portion of their income. In other words it is seen that " basic goods which are widely purchased by those on low income ..." are precisely the goods which are produced with more labour intensive techniques" (see ILO : 1970, pp. 147). Secondly, agriculture and service sectors are the two sectors where inequality in earning and incidence of poverty are highest in the economy. Thus any attempt to tackle the problems of poverty in the short run should be directed at generating more income and output in these two dominant sectors.

CHAPTER 5

Input-Output Analysis Under Commodity Technology and Industry Technology Assumptions : A Comparision for Indian Economy

5.1 Introduction

In practice it is seen that for a given classification of commodities and industries, commodities are produced not only as characteristic or principal products but also as industrial by products and/or commodity joint products. In other words, industries produce, along with its principal products, principal products of other industries; and output matrix, instead of being diagonal, becomes rectangular with non-zero off-diagonal elements. On the other hand, input-output (IO) information is available not for individual commodities produced in the economy but for individual industries. Presence of product mix in the industry output matrix thus deprives us of information on input cost structure of individual commodities. Models for estimating input cost structure of individual commodities when there is product mix in output matrix were first constructed by Stone et al (1963). Basically two models, known as 'commodity technology model' and 'industry technology model' have been developed under two alternative assumptions regarding technology of commodities produced in the economy.

In this chapter our purpose is to examine empirically the impact of these two alternative assumption on the commodity X commodity IO matrix for the Indian economy 1979-80 and the IO analysis based upon it. For this we first examine the nature and extent of product mix in the output matrix of the Indian economy 1979-80 and next we examine its impact on input cost structure of individual commodities estimated under two alternative assumptions. This chapter is organised as follows. In the next section we develop the tools required for analysis of product mix and their impact on the commodity cost structure. In the third section we carry out the analysis with information made available for Indian economy, 1979-80 by Planning Commission (1981). The final section is devoted to conclusion.

5.2 Indices for measuring the nature and extent of product mix

In this section we shall develop tools to examine the nature and extent of product mix in the output matrix V. Following notations are used.

Prime indicates transposition of vectors and matrices, column vectors are unprimed.

n = number of industries.

m = number of commodities.

S_I = set of industries.

S_c = set of commodities.

$U = (U_{ij})$ = commodity X industry matrix of values of intermediate inputs to industries.

$V = (v_{ij})$ = industry X commodity matrix of values of output of industries.

$f = (f_i)$ = column vector of values of final purchases of commodities.

$q = (q_i)$ = column vector of values of commodity output.

$g = (g_j)$ = column vector of values of industry output.

$\hat{x}$ = diagonal matrix with elements of vector x

$x'y$ = scalar product of two vectors x and y

.../-

$D = V.\hat{q}^{-1} = (d_{ij}) =$ matrix of share of industries in different commodity markets.

$C = V . \hat{g}^{-1} = (C_{ij}) =$ matrix of shares of commodities in output of different industries.

5.2.1 Indices for measuring product mix

Presence of product mix in the output matrix results from the fact that a commodity or a group of commodities, for a given classification of commodities and industries, is produced by more than one industry; and/or an industry producers more than one commodity. Starting from this observation we proceed to define two relations, one between industries and the other between commodities.

Relation 1 (between industries, through commodities, called R1) :

Any two industries $(i, j) \varepsilon S_I$ are said to be related if there exists a commodity $\alpha \ \varepsilon \ S_c$ such that both i and j produces the commodity 'α'.

Relation 2 (between commodities, through industries, called R2) :

Any two commodities $(\alpha , \beta) \varepsilon S_c$ are said to be related if there exists an industry $i \ \varepsilon \ S_I$ such that both α and β are produced by the industry 'i'.

It can be noted that any pair of commodities and industries are unrelated in the above sense when there is no product mix in the output matrix. Moreover, the mutual unrelatedness of commodities does not imply mutual unrelatedness of industries and vice-versa.

A quantitative index of relatedness between two industries i and j, called I_{ij}, as defined by R1 can be constructed from the following considerations :

(i) Extent of relatedness between two industries through a commodity should depend upon the relative shares of industries in the market of the commodities <u>commonly</u> produced by them.

(ii) If these relative shares are equal then the measure should be unity representing perfect relatedness between the concerned industries.

(iii) If there is no commodity commonly produced by them the measure should be zero representing complete unrelatedness between the concerned industries.

Thus relatedness between industry i and j through a commodity can be measured by $I_{ij}(\alpha)$ as

$$I_{ij}(\alpha) = 1 - \frac{|x_{i\alpha} - x_{j\alpha}|}{x_{i\alpha} + x_{j\alpha}}, \quad 0 < I_{ij}(\alpha) < 1 \qquad \ldots. (1)$$

where

$x_{i\alpha}$ = ith industry's share in αth commodity market.

$x_{j\alpha}$ = jth industry's share in αth commodity market.

In case a number of commodities are jointly produced by industry i and j then a measure of relatedness between i and j can be given by I_{ij} as

.../-

$$I_{ij} = \frac{\sum_{\alpha \in S_c} I_{ij}(\alpha) . \left\{ d_{i\alpha} . d_{j\alpha} \right\}^{\frac{1}{2}}}{\sum_{\alpha \in S_c} \left\{ d_{i\alpha} \; d_{j\alpha} \right\}^{\frac{1}{2}}} . \frac{n_c^{ij}}{n_{max}^{ij}}, \quad 0 \leq I_{ij} \leq 1 \quad \ldots\ldots (2)$$

where

$$I_{ij}(\alpha) = 1 - \frac{\left| d_{i\alpha} - d_{j\alpha} \right|}{d_{i\alpha} + d_{j\alpha}}$$, $d_{i\alpha}$'s are elements of matrix D and,

n_c^{ij} = number of commodities commonly produced by industry i and j,

n_{max}^{ij} = maximum number of commodities produced by either of them.

It can be noted that I_{ij} as given by (2) is a weighted average of $I_{ij}(\alpha)$, weights being geometric mean of αth market share of industry i and j. The factor n_c^{ij} / n_{max}^{ij} represent the nature of relatedness as a proportion of common number (n_c) of commodities produced by industries to the maximum number (n_{max}) of commodities produced in either of these industries. Correspondingly a measure of relatedness of industry 'i' with rest of industries is given by

$$I_i = \frac{\sum_{\alpha \in S_c} w_\alpha^i \left\{ d_{i\alpha} (1 - d_{i\alpha}) \right\}^{\frac{1}{2}}}{\sum_{\alpha \in S_c} \left\{ d_{i\alpha} (1 - d_{i\alpha}) \right\}^{\frac{1}{2}}} . \frac{n_c^i}{n_{max}^i}, \quad i \in S_I \quad \ldots.(3)$$

where $w_\alpha^i = 1 - \left| 2 d_{i\alpha} - 1 \right|$

From similar considerations we can construct an index of relatedness between two commodities α and β, as defined by relation R_2, as

$$K_{\alpha\beta} = \frac{\sum_{i \varepsilon S_I} K_{\alpha\beta}(i) \left\{ C_{\alpha i} \cdot C_{\beta i} \right\}^{\frac{1}{2}}}{\sum_{i \varepsilon S_I} \left\{ C_{\alpha i} \cdot C_{\beta i} \right\}^{\frac{1}{2}}}, \quad 0 \leq K_{\beta} \leq 1 \qquad \ldots\ldots(4)$$

where $K_{\alpha\beta}(i) = 1 - \dfrac{|C_{\alpha i} - C_{\beta i}|}{(C_{\alpha i} + C_{\beta i})}$ and $C_{\alpha i}$'s are elements of matrix C.

Relatedness of a particular commodity with rest of the commodities is given by

$$K_{\alpha} = \frac{\sum_{i \varepsilon S_I} w_i^{\alpha} \left\{ C_{\alpha i} (1 - C_{\alpha i}) \right\}^{\frac{1}{2}}}{\sum_{i \varepsilon S_I} \left\{ C_{\alpha i} (1 - C_{\alpha i}) \right\}^{\frac{1}{2}}} \cdot \frac{n_o^{\alpha}}{n_{max}^{\alpha}} \qquad \ldots\ldots(5)$$

where $w_i^{\alpha} = 1 - |2 . C_{\alpha i} - 1|$

It can be noted that both I_{ij} and $K_{\alpha\beta}$ satisfy the following :

(a) $I_{ij} = I_{ji}, \; \forall (i, j) \; \varepsilon \; S_I, \; K_{\alpha\beta} = K_{\beta\alpha}, \; \forall (\alpha, \beta) \; \varepsilon \; S_o$

(b) $I_{ii} = 1 \; \forall \; i \; \varepsilon \; S_I, \; K_{\alpha\alpha} = 1, \; \forall \; \alpha \; \varepsilon \; S_o$

(c) $0 \leq I_{ij}, \; K_{\alpha\beta} \leq 1$

(d) $I_{ij} > 0, \; I_{j\alpha} > 0 \not\Rightarrow I_{i\alpha} > 0$, and $K_{\alpha\beta} > 0, \; K_{\beta\gamma} > 0 \not\Rightarrow K_{\alpha\gamma} > 0$

Finally a measure of product mix for the system as a whole, as exhibited by the output matrix V, is given by

.../-

$$PM\,(V) = \max \left\{ I\,(V),\, K(V) \right\}, \quad 0 \leq PM\,(V) \leq 1 \qquad \ldots\ldots (6)$$

where

$$I\,(V) = \frac{1}{n} \sum_{i \,\varepsilon\, S_I} I_i \quad \text{and } K\,(V) = \frac{1}{m} \sum_{\alpha \,\varepsilon\, S_c} K_\alpha$$

$I(V)$ measures the extent of product mix as it is caught through industry relatedness and $K(V)$ measures the extent of product mix as it is caught through commodity relatedness. The maximum of the two is taken as a measure of product mix in the output matrix V. In case $I\,(V) = 0$ and $K(V) > 0$ then it is possible to split the set of industries S_I into a number of n unrelated industries. Similarly, if $K(V) = 0$ and $I(V) > 0$ then it is possible to split S_c into m unrelated commodities. $PM(V) = 0$ means that there is no product mix in the output matrix, and all the commodities and industries are unrelated in the above sense. $PM(V) = 1$ means that there is perfect relatedness between industries and commodities (note that $I\,(V) = 1 \iff K\,(V) = 1$) and it is impossible to split S_I and S_c into number of unrelated subsets.

5.2.2 Input cost structure under different technological assumptions

Presence of product mix in the output matrix affects the input cost structures of individual commodities and the input-output analysis based upon them. In this section we briefly describe the models used to estimate input cost structures of commodities and the types of analysis carried with them.

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Models for estimating input cost structures of individual commodities when there is product mix in the output matrix were first constructed by Stone et al (1963) and have been recently adopted by U.N.O.[1] Basically two models, known as 'commodity technology model' and 'industry technology model' based on two alternative assumptions regarding technology for commodity production have been developed. In commodity technology model it is assumed that each commodity is produced by one and only one (unknown) technology irrespective of industries where it is produced. Thus input cost structure of an industry is a linear combination of (unknown) input cost structures of the commodities produced by that industry.

In industry technology model it is assumed that a commodity is produced by the technology of the industry (given by the input cost structure of the industry) where it is produced. Thus a particular commodity is produced by as many technology as the number of industries where it is produced. The estimated cost structure of the commodity concerned is the weighted average of input cost structures of the different industries in which it is produced, the weights being the share of different industries in the total output of that commodity. Thus, according to our notations, the commodity input-output matrix by commodity technology and industry technology models are respectively given by[2]

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[1] a cogent representation of these models and the new system of national accounts adopted by U.N.O., can be found in Aidenoff (1970).

[2] Commodity technology model requires that B and C are square matrices and equal in dimension to the number of industries. The inverse of the matrix C will always exists provided that in any column of C the diagonal element is larger than sum of other elements. Experience with calculation of commodity technology model has shown that some elements of matrix A_C may be negative. In practice, however, these negative elements turn out to be very small and can be eliminated following a method by Stone et al (1963).

$$A_C = B \cdot C^{-1} \qquad \ldots\ldots (7)$$

$$A_I = B \cdot D \qquad \ldots\ldots (8)$$

where

$$B = V \cdot \hat{g}^{-1}$$

It can be noted that in industry technology model it is implicitly assumed that input cost structures of industries as given by matrix B is independent of commodity composition of industry output. The stability of commodity input coefficient matrix as estimated by industry technology model A_I depends upon the stability of the matrix D as well as B. On the otherhand in commodity technology model, stability of commodity input coefficient matrix A_c does not depend upon the stability of B and C. If C changes, B correspondingly changes, A_C remaining unchanged. Thus by changing the product mix in the output matrix one can compute B keeping A_C unchanged, but this is not possible in industry technology model[3/].

Finally, we consider another model which we shall call the 'base model' by assuming that there is no product mix is the output matrix. In this the commodity input cost structure will be given by

$$A_O = B \qquad \ldots\ldots (9)$$

3/ A number of mixed technology models, by appropriately mixing these two basic assumptions have been developed by U.N.O. (1968) and Gigantics (1970). Possibilities of producing commodities as joint product of other commodities, under the assumption that output of each joint product will be proportional to the linear combination of output of commodities of which that particular commodity is a joint product, is given in Bandyopadhyay and Majumdar (1983).

Thus we get this model by putting $C = D = I$, the identify matrix, in the above two models. It is evident that any difference in cost structure estimated by A_I and A_C from A_0 will be due to presence of product mix in output matrix. On the otherhand any difference between A_C and A_I will be due to difference in technological assumptions underlying these two models.

5.2.3 Index for comparison of input cost structure of commodities

For direct comparison of input cost structure estimated by different models we use the following index developed by Chenery (1958) used for international comparision of structure of production. The index, known as absolute column measure, measures the absolute difference between technique 'j' as estimated by two models, say α and β, and is given by

$$\lambda_j^{\alpha\beta} = \frac{\sum_i \left| a_{ij}^{\alpha} - a_{ij}^{\beta} \right|}{\frac{1}{2} \sum_i (a_{ij}^{\alpha} + a_{ij}^{\beta})}, \quad 0 \leq \lambda_{ij}^{\alpha\beta} \leq 2 \qquad \ldots\ldots(10)$$

where a_{ij}^{α} = input-output coefficient under model α and a_{ij}^{β} = input-output coefficient under model β.

5.2.4 Index for measuring structural interdependence

Interdepence is the central theme of input-output analysis. In an input-output model production is conceived as a system of interdependent parts -- the so called sectors of production. Given an input-output model one can find two types of interdependence between sectors of production. The first one, which is called the technological interdependence, shows how the different sectors of the economy hang together as interdependent parts of the system as one sector uses as inputs the output of other sectors. Secondly, one can think of interdependence between sectors in so far as one sector creates, through income generation, the demand for output for other sectors. This second type of interdependence is essentially inspired by Keynesian problem of 'effective demand' and advocates synchronous expansion of industries through simultaneous expansion of effective demand of each other. Here we will consider only the first type of interdependence, that is, technological interdependence.

A number of measures have been developed to measure the extent of technological interdependence as exhibited by an input-output model. The most popular among them is one suggested by Chenery and Watanbe (1958), known as 'forward linkages' and 'backward linkages'. These indices, however, do not give distribution of inputs or deliveries among various sectors[4]. Rasmussen (1956) has given a more modified version of these linkages considering the matrix $(I - A)^{-1}$ for a given input-output matrix A. He defines 'sensitivity of dispersion', which is analogues to forward linkage, for sector j as

$$S_{j0} = \left(\frac{1}{n} \quad Z_{j0} \right) / \left(\frac{1}{n^2} \cdot \sum_i Z_{i0} \right) \qquad .....(11)$$

and power of dispersion, which is analogues to backward linkage, as

$$P_{0j} = \left(\frac{1}{n} \; Z_{0j} \right) / \left(\frac{1}{n^2} \; \sum_j Z_{0j} \right) \qquad .....(12)$$

4/ Bharadwaj (1966) criticises the use of these indices as a basis for setting up investment priorities.

where $Z_{i0} = \sum_j Z_{ij}$, $Z_{0j} = \sum_i Z_{ij}$, and $Z = (Z_{ij}) = (I - A)^{-1}$

To measure the <u>nature</u> of technological interdependence under different models we use the index given by Yan and Ames (1965). For a given input-output matrix A, Yan and Ames first constructed an order matrix $R = (r_{ij})$ as follows :

$$r_{ij} = \begin{cases} K \text{ if } a_{ij}^{(k)} \text{ is the first non-zero element in the sequency} \\ \quad a_{ij}^{(1)},\ a_{ij}^{(2)},\ \ldots \\ \infty \text{ if there does not exist any finite k such that} \\ \quad a_{ij}^{(k)} \neq 0 \end{cases}$$

where $a_{ij}^{(k)}$ is (i, j) the element of A^k. Next from the order matrix R, they define an interrelatedness function F as follows :

$$F\left(R\begin{pmatrix} i_1 \ldots\ldots i_r \\ j_1 \ldots\ldots j_s \end{pmatrix}\right) = \frac{1}{r.S} \sum_{Y=1}^{r} \sum_{w=1}^{s} \frac{1}{r_{Y,\ j_w}} \quad 0 \leq F \leq 1.$$

where $R\begin{pmatrix} i_1 \ldots\ldots i_r \\ j_1 \ldots\ldots j_s \end{pmatrix}$ is an arbitary sub matrix

of order matrix R consisting of rows $i_1 \ldots\ldots i_r$ and columns $j_1 \ldots\ldots j_s$. If n_1, n_2 .... denote the number of elements of the submatrix of the order matrix whose values are 1, 2, ... then F can be written as

$$F\begin{pmatrix} i_1 \ldots\ldots i_r \\ j_1 \ldots\ldots j_s \end{pmatrix} = \frac{n_1}{r.s} + \sum_{k \neq 1} \frac{n_k}{k.r.s} \qquad \ldots\ldots (13)$$

The first right hand side term of the above expression, referred as index of diversification, represents the proportion of industries to which a given industry sells, in case the sub-matrix in question is of order 1 x n. In case the sub matrix is at order n x 1 this term represents the proportion of industries from which a given sector buys. The second right hand side term of the above expression is referred as 'index of indirect interdependence' and the expression given in (13) as 'index' of interdependence. When the submatrix is of order (1 x n) then (13) is called 'index of forward interdependence' and when the submatrix is (n+1) then (13) is called the index of 'backward interdependence'. In our analysis we shall use both measures of forward and backward interdependence.

5.3 Empirical analysis for Indian economy, 1979-80 :

In this section we first examine the nature and extent of product mix in the output matrix of Indian economy, 1979-80. Next we estimate its impact on the commodity cost structure as obtained by different models and the input-output analysis based upon them.

Although the information on output matrix is provided for 89 sectors of Indian economy we carry out the analysis after suitably aggregating them into 32 sectors. It should be noted that the estimates of product mix, cost structures and different indices of economic interdependence are bound to be affected by particular scheme of aggregation. However, for our analysis we first examine the nature and extent of product mix for 89 sectors and see how this gets changed under different schemes of aggregations. In the light of this exercise we choose our scheme of aggregation with which we carry out the input-output analysis.

5.3.1 Nature and extent of product mix for Indian economy :

Out of 89 industries 28 are not related through commodities that is, each of these industries produces a set of commodities not produced by any other industry. These industries mainly come under non-manufacturing sectors of the economy. Ranking of industries in terms of I_i show that industries belonging to manufacturing sectors have comparatively high 'industry relatedness'. On the other hand, 31 out of 89 commodity sectors are not related, that is, there does not exist any common industry producing two or more from this set of commodities. Commodities which show comparatively high 'industry relatedness' mainly come under manufacturing sectors of the economy. They accounts for 96 per cent of total commodity relatedness in the economy. This extent of product mix in non-manufacturing sectors is greater than that of manufacturing sectors. The extent of product for the economy as a whole is small [PM (V) = .0065, I (V) = .0065, K (V) = .0050]. Structure of matrices (I_{ij}) and (K_{ij}) reveal that manufacturing industries are mainly related through commodities produced by them and commodities are mainly related through manufacturing industries.

Nature and extent of product mix under the 32 sector aggregation (as given in Chapter 4) show an increase in the product mix in the 32 sector output matrix (see Table 5.1). This is mainly because the industries and commodities which were unrelated in original 89 x 89 output matrix get related in the aggregated output matrix of 32 sectors.

5.3.2 Comparision of commodity cost structure :

Comparison of input cost structures of commodities as estimated by industry technology model A_I and commodity technology model A_c with that of B , by Chenery index (see Table 5.2) show that overall difference is small in both cases - the difference of A_I is marginally greater than that of A_c. Moreover, it is also seen that the difference between B and A_I is higher in these sectors which have high 'industry relatedness' and the difference between B and A_c is higher for these sectors which have commodity relatedness. The spearman's rank correlation coefficient between sectoral ranks in terms of I_i with sectoral ranks in terms of Chenery index for comparing B and A_I is 0.99. The corresponding figure between K and (B, A_c) is 0.98.

5.3.3 Input-Output Analysis :

Input-output analysis based upon different models show that 'index of interrelatedness' (both forward and backward) as estimated by equation (13) for the model B is slightly higher than that of A_c and A_I. But models A_c and A_I do not differ much in this respect.

Overall interdependence	B	A_C	A_I
Direct	0.84	0.69	0.68
Indirect	.082	.15	.16
Total	.92	.82	.84

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At the sectoral level it is seen that (Table 5.3) A_I dominates both A_c and B in terms of forward and backward interdependence. Moreover, for all sectors forward direct interdependence is greater than indirect interdependence.

Extent of interdependence as estimated by Rasmuseen's indices of forward and backward linkages do not differ much for all the three models (see Table 5.4).

5.4 Conclusion :

The main conclusion regarding extent of product mix in the output matrix of Indian economy 1979-80 can be enumerated as follows :

(a) The analysis of output matrix of Indian Economy 1979-80 show that over all extent of product mix is very small. Product mix in manufacturing sectors, which is mainly due to output relatedness among themselves was found to be comparatively higher than that of non-manufacturing sectors.

(b) Empirical results obtained in the second stage of analysis show that presence of product mix in the output matrix of Indian economy has no appreciable effect on the estimates of input cost structure and also on nature and extent of economic interrelatedness as estimated under different models[5].

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[5] Commodity x commodity IO matrix as used in the present study is estimated under industry technology assumption.

Table 5.1 : Sectoral Industry and Commodity Relatedness

Sector No.	I_i	k_i
(1)	(2)	(3)
1	.0002(27)	.0004(27)
2	.0130(13)	0.0160(14)
3	0.0^c (28)*	0.0 (30)
4	.0026(21)	0.0120(16)
5	0.0^c (32)	0.0 (30)
6	0.0016(24)	0.0260(10)
7	0.0470(5)	0.0056(22)
8	0.0038(20)	0.0018(24)
9	0.0086(15)	0.0074(21)
10	0.0300(7)	0.0690(4)
11	0.0100(14)	0.0050(23)
12	0.1300(1)	0.0410(7)
13	0.0130(12)	0.0410(7)
14	0.0059(16)	0.0160(13)
15	0.0900(2)	0.1200(1)
16	0.0340(6)	0.0700(3)
17	0.0019(22)	0.0009(25)
18	0.0280(8)	0.0075(20)
19	0.0014(25)	0.0100(18)
20	0.0630(4)	0.0380(8)
21	0.0052(18)	0.0100(17)
22	0.0043(19)	0.0170(12)
23	0.0170(10)	0.0290(9)
24	0.0150(11)	0.0570(5)
25	0.0740(3)	0.0740(2)
26	0.0170(8)	0.0008(26)
27	0.0003(26)	0.0250(11)
28	0.0017(23)	0.0096(19)
29	0.0052(17)	0.0120(15)
30	0.0^c (31)	0.0^c (29)
31	0.0^c (28)	0.0 (30)
32	0.0^c (28)	0.0^c (28)

* 'c' indicates approximated values : I(V) = 0.0190, K(V) = 0.023,
PM(V) = 0.023.

Table 5.2 : Comparison of Cost Structure under Different Models by Chenery Index

Sector No.	$(B, A_I)^*$	$(B \cdot A_c)$
(1)	(2)	(3)
1	.0003(27)	0.0037(25)
2	0.0140(16)	0.0130(19)
3	0.0 (29)	0.0 (29)
4	0.0055(25)	0.0320(14)
5	0.0 (29)	0.0 (31)
6	0.0099(21)	0.1100(2)
7	0.1100(4)	0.0120(20)
8	0.0130(18)	0.0037(24)
9	0.0240(13)	0.2220(17)
10	0.0450(7)	0.0720(4)
11	0.0300(11)	0.0004(28)
12	0.1600(2)	0.0260(15)
13	0.0120(19)	0.0520(8)
14	0.0180(14)	0.0330(12)
15	0.1700(1)	0.1600(1)
16	0.0540(6)	0.0620(5)
17	0.0063(23)	0.0023(26)
18	0.0320(10)	0.0053(22)
19	0.0062(24)	0.0390(10)
20	0.0390(8)	0.0094(21)
21	0.0250(12)	0.0049(9)
22	0.0100(20)	0.0320(13)
23	0.0380(9)	0.0350(11)
24	0.0170(15)	0.0540(7)
25	0.1200(3)	0.0720(3)
26	0.1000(5)	0.0046(23)
27	0.0083(26)	0.0540(6)
28	0.0082(22)	0.0240(16)
29	0.0130(17)	0.0190(18)
30	0.0 (29)	0.00 (31)
31	0.0 (29)	0.00 (30)
32	0.0 (29)	0.0 (27)

Notes : B = Commodity x commodity input-output matrix assuming no product mix.

A_I = Commodity x commodity input-output matrix under industry technology assumption.

A_c = Commodity x commodity input-output matrix under commodity technology assumption.

* = Figures within the bracket denote ranks.

Table 5.3 : Nature of Sectoral Interdependence under Different Models

Sector No.	Forward			Backward		
	B	A_I	A_c	B	A_I	A_c
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	.98(6)	.99(6)	.92(11)	.87(8)	.94(16)	.81(25)
2	.81(21)	.92(23)	.81(19)	.89(4)	.97(5)	.90(6)
3	1.0 (1)	1.0 (1)	.95(6)	.63(32)	.64(32)	.63(32)
4	.80(23)	.95(15)	.76(23)	.85(16)	.96(5)	.83(21)
5	.50(32)	.69(30)	.63(29)	.73(29)	.73(29)	.73(29)
6	.94(14)	.97(8)	.89(13)	.87(8)	.89(27)	.78(28)
7	.92(16)	.97(8)	.86(17)	.87(8)	.95(12)	.95(1)
8	.96(8)	.97(8)	.94(9)	.86(16)	.97(5)	.91(6)
9	.72(24)	.95(15)	.72(27)	.85(19)	.92(22)	.86(14)
10	.92(10)	.94(21)	.92(11)	.87(8)	.98(4)	.86(14)
11	1.0 (1)	1.0 (1)	1.0 (1)	.80(26)	1.0 (1)	.85(17)
12	.95(11)	.95(15)	.87(14)	.84(20)	.94(16)	.84(17)
13	.62(28)	.84(27)	.69(29)	.87(8)	.92(22)	.83(21)
14	.64(26)	.30(29)	.72(27)	.87(8)	.92(22)	.91(6)
15	.84(19)	.92(23)	.72(22)	.84(20)	.97(5)	.84(17)
16	1.0 (1)	1.0 (1)	.98(4)	.89(4)	.97(5)	.87(11)
17	.81(21)	.94(21)	.76(23)	.81(25)	.94(16)	.83(21)
18	.95(11)	.97(8)	.87(14)	.93(2)	.97(5)	.94(3)
19	.92(16)	.95(15)	.87(14)	.78(28)	.89(27)	.81(25)
20	.97(8)	.97(8)	.95(6)	.89(4)	1.0 (1)	.91(6)
21	.55(30)	.66(30)	.73(25)	.83(24)	.91(26)	.81(25)
22	.64(26)	.89(26)	.73(25)	.86(16)	.92(22)	.92(5)
23	.94(14)	.97(8)	.86(17)	.89(4)	1.0 (1)	.86(14)
24	.72(24)	.93(23)	.80(20)	.87(8)	.94(16)	.84(17)
25	.82(20)	.95(15)	.80(20)	.86(5)	.97(5)	.87(11)
26	.53(31)	.61(32)	.67(31)	.80(26)	.94(16)	.89(10)
27	.95(11)	.95(15)	.95(6)	.84(20)	.94(16)	.83(21)
28	.56(29)	.81(28)	.67(31)	.84(20)	.95(12)	.87(11)
29	.94(8)	.97(8)	.94(9)	.93(2)	.95(12)	.94(3)
30	.98(6)	.98(6)	.98(4)	.68(23)	.69(31)	.68(31)
31	1.0 (1)	1.0 (1)	1.0 (1)	.73(29)	.73(29)	.73(29)
32	1.0 (1)	1.0 (1)	1.0 (1)	.95(1)	.95(1)	.95(1)

Note : Figures within the bracket denote rank.

Table 5.4 : Extent of Sectoral Interdependence under Different Models

Sector No.	Forward			Backward		
	B	A_I	A_c	B	A_I	A_c
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	1.80(4)	1.84(3)	1.79(4)	0.66(32)	0.65(32)	0.66(32)
2	0.72(16)	0.71(16)	0.72(16)	1.09(6)	1.09(6)	1.09(6)
3	2.10(2)	2.09(2)	2.09(2)	0.68(31)	0.68(31)	0.67(31)
4	0.69(18)	0.70(18)	0.68(18)	1.02(14)	1.02(14)	1.02(13)
5	0.51(32)	0.49(32)	0.50(32)	1.11(5)	1.12(4)	1.11(5)
6	0.74(15)	0.77(14)	0.75(14)	1.13(3)	1.13(3)	1.19(3)
7	0.64(20)	0.64(20)	0.63(20)	0.94(25)	0.95(25)	0.93(25)
8	0.71(17)	0.70(17)	0.70(17)	1.01(15)	1.02(15)	1.00(16)
9	0.57(24)	0.56(24)	0.57(24)	1.12(4)	1.11(5)	1.12(4)
10	0.79(11)	0.82(11)	0.80(11)	1.04(11)	1.03(11)	1.05(10)
11	1.11(8)	1.10(8)	1.10(8)	1.05(9)	1.05(9)	1.04(12)
12	0.84(10)	0.83(10)	0.84(10)	0.85(28)	0.89(27)	0.84(28)
13	0.65(19)	0.67(19)	0.65(19)	0.99(18)	0.99(18)	1.00(18)
14	0.76(12)	0.77(12)	0.76(12)	1.08(7)	1.09(7)	1.08(7)
15	0.56(25)	0.54(27)	0.57(27)	1.18(2)	1.16(2)	1.22(7)
16	0.74(14)	0.73(15)	0.75(15)	1.04(12)	1.03(12)	1.04(11)
17	0.58(23)	0.58(23)	0.58(23)	0.98(20)	0.97(21)	0.97(19)
18	0.86(9)	0.85(9)	0.86(9)	0.92(26)	0.92(26)	0.92(26)
19	1.12(7)	1.10(7)	1.11(7)	1.07(8)	1.06(8)	1.07(8)
20	1.82(3)	1.81(4)	1.82(4)	0.94(24)	0.95(24)	0.94(24)
21	0.54(28)	0.54(28)	0.54(28)	1.00(17)	1.00(17)	1.00(17)
22	0.52(30)	0.51(30)	0.51(30)	0.98(19)	0.97(19)	0.97(20)
23	0.75(13)	0.76(13)	0.75(13)	0.97(21)	0.97(20)	0.97(21)
24	0.61(21)	0.60(22)	0.61(22)	1.05(10)	1.04(10)	1.06(9)
25	0.51(31)	0.51(31)	0.51(31)	0.96(23)	0.97(22)	0.95(23)
26	0.56(26)	0.55(26)	0.56(26)	1.21(1)	1.18(1)	1.21(2)
27	0.56(27)	0.56(25)	0.56(25)	1.01(16)	1.01(16)	1.01(15)
28	0.52(29)	0.52(29)	0.52(29)	0.97(22)	0.97(23)	0.96(22)
29	0.60(22)	0.61(21)	0.60(21)	0.80(29)	0.80(29)	0.79(29)
30	1.17(6)	1.17(6)	1.17(6)	1.02(13)	1.02(13)	1.02(14)
31	1.38(5)	1.38(5)	1.38(5)	0.88(27)	0.88(28)	0.87(27)
32	5.44(1)	5.44(1)	5.44(1)	0.74(30)	0.74(30)	0.74(30)

Note : Figures within the bracket denote rank.

CHAPTER 6

Redistributive Policy Analysis with the Basic Model

6.1 Introduction

The operational feasibility of income redistributive policies depends on the availability of policy instruments to redistribute income in favour of particular socio-economic group or groups. Effective income redistribution, therefore, calls for a wide range of policy instruments to achive distributional objective. Since the level and growth of income of different socio-economic groups are determined as a part of general equilibrium of the economy, the government has a wide choice in alternative types of policy interventions.

Intervention in commodity market to influence level and pattern of output and prices is one of important ways to achive income redistribution objective. Such intervention generally can be made in the form of tax-subsidy schemes, reallocation of investment, promotion of export and substitution of imports by domestic production. Use of these instruments for achieving distributional and poverty objective, however, will depend upon income-distributional and poverty characteristics of different sector of production and also on the consumption characteristics of the different groups of population. This is because the pattern of factor income generated in different productive sectors are different, and some productive sectors, because of their strong income and consumption linkage with the poor, tend to favour the income distributional objective. Such sectors are agriculture, services and construction where large proportion of the poor earn their income. It is, therefore, expected that stimulating production in such sectors will help in allevialing poverty.

Viability of this approach on the other hand, depends upon the flexibility of demand to absorbe the new product mix. Among various types of demand, switching of private consumption is more difficult than other types of demand, because of strong preference of different groups of population for certain types of commodities. Thus, it is generally observed, that consumption demand pattern of high income group favour the capital - intensive consumer goods. Inspite of this the government can make an attempt to switch away demand from such goods by designing suitable indirect tax - subsidy schemes.

Reallocation of investment, on the other hand, provides an alternative way to change the level and pattern of output in the economy. Level of pattern of investment demand, because of its somewhat autonomous character, can be used to change the level and pattern of output (and implicitly the relative prices) for achiving the distributional objective. Similarly, promotion of exports of labour intensive goods and substitution of imports in capital intensive sectors are useful instruments for changing the level and pattern of output and prices in favour of the poor. This is particularly so when the possibilities of changing the level and pattern of domestic demand are limited. Finally controlling the production and prices of certain types of goods in the economy is an extreme form of intervention in commodity market, and has been used in many developing countries for achiving the distributional objective.

An alternative way of reducing poverty and income inequality consists of transfering income from the non-poor to the poor. In this policy a certain proportion of income, say profit income, of the non-poor can be taxed and may be transfered to the poor through certain institutional mechanism. Income can also be redistributed through intervention in labour market. Thus increase in minimum wage is considered to be one of the instruments for reducing poverty and income inequality. Distributional impact of such policies will, however, depend upon the way the labour market operates. In a labour surplus economy, where poor are mostly employed in unorganised sectors of the economy, any increase in minimum wage may lead to fall in aggregate employment of the poor. Increase in nominal wage of the non ~~non~~-poor employed in organised sector of the economy, on the otherhand, generally lead to familiar wage-price spiral and redistribute income from the ~~non~~-poor to the non-poor. In this context we may point out that the problem with implementing such redistributive policies arise from absence of any viable mechanism for financing such policies over time. As a result most of the developing countries are not in a position to continue such redistributive policies as they put severe pressure on the budgetary resources of the economy.

In this part of the study our purpose is to use the basic model for analysing the impact of the different redistributive policies on the level of income of the poor and the non-poor, and other important macro-economic variables. The types of income redistributive policy instruments considered for the analysis is are (i) indirect tax - subsidy, (ii) export - promotion and import - substitution, (iii) investment reallocation by changing the level and pattern of investment, (iv) change in level of agricultural output, (v) income transfer from the non-poor to the poor and (vi) changes in nominal wages of the poor and the non-poor. Moreover, we also examine the effectiveness of the different income redistributive policies under three alternative assumptions regarding the supply of agricultural output in the economy, viz. (a) foodgrain output is demand determined which is usually assumed in the literature (b) foodgrain output is exogenously specified and finally (c) foodgrain output is determined by profit maximising principle with neoclassical production function.

This is mainly to demonstrate the differences in policy conclusion which arise out of the different assumptions one make regarding the supply of agricultural output in Indian economy.

In simulating the impact of different policy instrument our approach is essentially that of comparative static. Thus a change in the basic model is introduced by changing the different policy parameters; and consequently the different endogenous variables of the model change successively as the model adapts itself to the changed policy configuration. This process continues untill the values of the endogenous variables become self repeating at the new level which are taken as equilibrium solution of the model under changed parametric condition. This equilibrium solution is then compared with the basic solution of the basic model, viz. the solution for the year 1979-80, for analysing the impact of different redistributive policy instruments.

6.2 The Basic Solution

In order to obtain the basic solution we have solved the basic model for the year 1979-80 using the data base as developed in Chapter 4. In this section we shall describe the basic solution in some detail as this will serve as a point of reference for the variational exercises considered in this chapter. Moreover, as promised in Chapter 4, we shall also compare the basic solution with the official sectoral as well as macro-economic information for the year 1979-80 to examine the reliability of data base and workability of the model.

Macro-economic aggregates for the year 1979-80 as given by the basic solution and the corresponding official estimates are presented in Table 6.1.

Table 6.1 : Macro-Economic Aggregates under Basic Solution[1/]

	Item	Official estimates	Model estimates
	(1)	(2)	(3)
1.	NDP at factor cost	909020.0	924362.5
2.	Depreciation	61490.0	52079.5
3.	GDP at factor cost (1+2)	9705010.0	976442.0
4.	Indirect tax less subsidy	114950.0	113997.4
5.	GDP at market price	1085460.0	1090439.0
*6.	Met factor income from abroad	-2010.0	-2010.0
7.	GNP (5+6)	1083450.0	1088429.0
*8.	Other current transfer from the rest of the world	15200.0	15200.0
9.	Gross disposable in come (7+8)	1098650.0	1103628.0
10.	Wages		
	10.1 Total	739356	744278.0
	10.2 Target group	200753.6	199735.5
	10.3 Non-target group	538602.4	544542.5
11.	Gross Profit	231154.0	232164
12.	Private consumption	750530.0	753243.1
	12.1 Private (target group)	200753.6	199735.9
	12.2 " (non-target group)	549776.4	553507.2
*13.	Government consumption	117570.0	117734.0
*14.	Export	69080.0	69080.0
15.	Import	87900.0	84780.0
16.	Gross Fixed capital investment	210370.0	209348.3
17.	Changes in stock	27610.0	25810.0
18.	Gross investment (16+17)	237980.0	235158.3
19.	Gross domestic savings	230550.0	232641.2
20.	Net domestic savings	163060	180561.0
21.	Foreign aid	5630.0	2510.0
22.	Savings rate (%)[2/]	21.2	21.3
23.	Investment rate (%)[2/]	21.9	21.6
24.	Per capita GNP (Rs.)	1656.4	1664.01
25.	Per capita consumption (Rs.)	1147.4	1151.6

[1/] in million rupees at 1979-80 prices unless otherwise stated.

[2/] expressed as percentage of GDP at market price.

* exogenously given.

It can be seen from this table that most of the macro-economic aggregates estimated by the base model are in the close range of the official estimates, the percentage difference varying between 10.45% and 0.85%. This difference may be attributed to the tolerance limit used for solving the model. The estimates which differ significantly from their corresponding official estimates are depreciation, change in stock and import. Estimates of change in stock and depreciation differ by 6% from their official estimates which may be due to our somewhat arbitary nature of the estimates of depreciation rate and stock coefficients. This difference is also reflected in the difference of NDP (1.6%), gross investment (1.2%) and net domestic savings (10%) from their official estimates. Estimates of import by the model is about 3.6% less than its official estimate and has reduced our estimates of foreign aid to almost half of its official figure. This discrepancy may be attributed to high degree of aggregation in import coefficients and partly to our endogenous treatment of private consumption in the basic model.

GDP at factor cost and at market prices estimated for the base year are Rs. 976442.0 million and Rs. 1090439.0 million respectively. Share of agriculture (34.95%), services (33.48%) and manufacturing sectors (18.30%) in GDP at factor cost show that economy is highly dependent upon primary and tertiary sectors where, as we have already seen, the incidence of poverty is highest. Distribution of GDP (at market price) over major expenditure items, on the other hand, show that private consumption (69.10%) account for most of its use. Gross investment (21.6%) is the next major use of GDP of which about 99% goes for creation and maintenance of fixed capital of the economy. Sectoral distribution of investment, however, reaveals its lopsided structure in the base year. It is seen that while manufacturing (26%) and services (27%) together get about 53% of investment, agriculture, whose share in GDP is highest, gets only 20%. Share of export (7.11%) in GDP is about 1.9% less than that of import (9.0%) and therefore, foreign savings account show a deficit of Rs. 2510.0 million.

Gross domestic savings estimated for the base year is Rs. 232641 million of which about 60% comes from household sector. Tax revenue of the government for the base year is Rs. 146841 in which share of direct tax is only 22%. Indirect tax which is about 10.5% of GDP at market prices is major source of government revenues.

Economic profile of the target and non-target group, as presented in Table 6.2 show that per capita disposable income of the non-target group is almost 3.25 times that of the target group. It is because of lower share of target group (26.8%) in the aggregate wage and high degree of inequality in the structure of wage earning (Gini Coefficient : 0.389). Share of target group (54%) in the total employment is slightly more than that of non-target group and the dependency ratio (3.82) of the target group is less than that of the non-target group. This is because more members of the poor family work at a very low rate of wage. Discrepancy in the income of target and non-target group is also reflected in their consumption - the per capita consumption of the non-target group being about 2.5 times that of the target group. Sen's index of poverty is 20.54 while income and consumption inequality between the poor and the non-poor are 0.259 and 0.217 respectively.

Aggregate wage generated in the economy is about 76% of GDP (at factor cost) of which only 26.6% goes to the target group. Analysis of sectoral wage generated in the base year (see Table 6.3) show that about 77% of the wage is generated in agriculture (39.8%) and services (37.79%). Wages

Table 6.2 : Economic Profile of the Poor and the Non-poor under Basic Solution

Economic indicators	Target group	Non-target group
(1)	(2)	(3)
1. Population (million)	316.26	337.84
2. Employment (million standard person year)	82.91	68.82
3. Monthly per capita income (Rs.)		
3.1 Total	52.63	176.35
3.2 Disposable	52.63	171.17
4. Monthly per capita consumption (Rs.)	52.63	136.53
5. Dependancy ratio	3.814	4.909
6. Percentage of population	48.35	51.35
7. Savings rate (%)	0.0	20.245

in manufacturing and construction sectors are only 13.2% and 5.15% respectively. Among manufacturing industries non-metalic and machine tools industries (4.36%) has maximum wage share followed by Textile (2.98%) and chemical industries (1.2%). Out of the total wage generated in the target group (see Table 6.3) about 70% comes from agriculture and 12.12% from services. Share of manufacturing sectors taken together in the total wage in the target group is 6-7% which is near to the share of construction (5.74%). Thus agriculture, services and construction account for the most of the wage income generated in the target group.

Table 6.3 : Sectoral Wage and Employment under Basic Solution

Sector No.	Employment 1/	Wage (Rs. million)	Wage accruing to target group (Rs. million)	Wage share 2/
(1)	(2)	(3)	(4)	(5)
1	34.8485	118486.30	73816.50	87.2350
2	17.2124	121858.90	11363.18	54.0595
3	28.2757	55881.50	53046.54	93.6690
4	4.6369	10548.50	8738.83	80.2270
5	2.1322	3993.10	3669.71	79.6065
6	0.5626	6263.40	2.55	69.4230
7	0.0301	689.85	0.0	19.9655
8	0.2185	1485.55	95.63	55.6260
9	2.8200	12030.40	3155.42	83.4390
10	1.0430	3529.55	1723.53	78.9860
11	0.4705	2014.80	635.46	87.6000
12	1.1152	4653.75	1404.52	50.1510
13	0.7358	5434.85	417.92	70.1895
14	0.3195	3449.25	58.76	68.0725
15	0.5840	1908.95	1076.38	78.5715
16	0.2427	1956.40	88.33	39.6025
17	0.0585	1084.05	1.46	24.7470
18	0.0747	1241.00	0.365	39.6755
19	0.3173	3489.40	56.57	40.4420
20	0.5166	4285.10	282.87	40.9165
21	0.1316	843.15	37.59	69.7880
22	1.6996	5898.40	2834.22	65.6270
23	0.5207	7894.95	47.81	51.0270
24	0.7479	5697.65	309.88	60.5535
25	0.5099	8143.15	86.14	61.1375
26	0.4814	3985.80	166.44	65.3460
27	0.7809	6044.40	396.39	60.8040
28	2.1338	14760.60	628.53	72.4160
29	9.3132	38558.60	11483.63	80.5585
30	0.7276	7359.85	123.73	43.3985
31	8.7988	33594.60	13395.13	70.6275
32	29.3219	247313.05	10832.47	75.805
Aggregate	151.73	744278.80	199736.56	76.40

1/ Expressed in million standard person year.

2/ Expressed as percentage of sectoral gross value added.

It is seen that share of wage in gross value-added in agriculture (84%) is highest, followed by services (70%) and manufacturing sectors (60%). It can be noted that pattern of variation in labour intensity among manufacturing sectors is also reflected in share of wages.

Analysis of sectoral mark-up show that mark-up in manufacturing industries (0.134) on the average, is almost three times that of agriculture and twice that of service sectors.

Table 6.4 : Per capita import for consumption by different groups of population under Basic Solution

(in Rs.)

Socio-economic groups	Intermediate use	Final consumption use	Total
(1)	(2)	(3)	(4)
Rural poor	12.55	35.40	47.95
Rural non-poor	26.93	68.93	95.86
Urban poor	11.13	30.90	42.03
Urban non-poor	30.86	83.23	114.09

Total import in the basic model is endogenously estimated on the basis of import coefficient for final as well as intermediate use of commodities. The per capita import for consumption and intermediate inputs, for producing consumption goods, by different groups of population at the year 1979-80 is presented in Table 6.4. It can be seen that per capita import for consumption use by the rural poor is almost half of the same for the rural non-poor while per capita import of urban non-poor is almost 2.7 times that of the urban poor. It is interesting to note that per capita import for rural poor is slightly above than that of the urban poor. This may be due to higher share of foodgrain, a part of which was imported at the year 1979-80, in the aggregate consumption of the rural poor than the urban poor. Finally one may note that import for final consumption use is almost 2.5 times the import for intermediate inputs for producing consumption goods of the different groups of population.

6.3 Indirect tax-subsidy

Use of indirect taxation as instrument for plan maneuverability is as old as planning. In a mixed economy it plays a dual role. On one hand, indirect taxation provides a means of directly raising resources which can be transferred to the poor through subsidy and different expenditure schemes; on the other hand, it also provides a mechanism for changing the distribution of factor income by influencing the level and pattern of output and prices in the economy. In Indian economy indirect taxation has been used for both the purposes. Thus, in 1979-80, indirect taxes and subsidy were Rs. 14,594 crores and Rs. 2426 crores, that is, respectively about 13.75% and 2.28% of the GDP at market price. Again, the indirect taxes in Indian economy constitute the major source of government revenue, and much of this falls on intermediate inputs. For example, CSO estimated that 58.17% of indirect taxes in 1979-80 came from intermediate goods.

In this section we shall use the basic model to estimate the effect of indirect taxes and subsidies on income distribution, poverty and other macro-economic variables. In this content we may mention the theoretical-empirical studies on impact of indirect tax subsidies in IO framework. At the theoretical level Metezler (1951) was first to discuss the inter-industrial price effect of tax-subsidy. He demonstrated that the price of taxed commodity rises and price of subsidized commodity falls : the primary effect of tax-subsidy exceeds the secondary effect by changing the imput cost-structure of the taxed and subsidized industry. However, one of the important assumptions in Metezler's analysis was that commodity composition of demand and output remains unchanged under alternative tax-subsidy schemes. Subsequently Atsumi (1981) proved Metzler's result under less stringent conditions.

At the empirical level one may mention the works of Chelliah and Lal (1981) and Ahmed and Stern (1981) on the analysis of Indian indirect-tax-subsidy systems. Chelliah and Lal (1981) examine the progressivity of Indian indirect tax system using NSS consumption data. They unambiguously concluded that indirect tax rate in Indian economy for the year 1973-74 were progressive for rural and urban areas. Ahmed and Stern (1981) however, found that they are not invariably so if one considers the 'effective rate' of indirect taxation on commodities. Ahmed and Stern (1981) carried out detailed analysis of different types of indirect tax-subsidy schemes in IO frame work. Their analysis were mainly concerned with the effects of indirect tax-subsidy, both on inter mediate and final goods, on consumer prices, welfare and government revenue. For this, they estimated the effective tax element taking into consideration direct and indirect impact of indirect taxes both on output and imputs, and decomposed them into different components arising from different tax bases. They found major differences between nominal tax rates, where only taxes on output one considered and effective tax rates, where taxes on both output and inputs one considered. This difference was often found in the region of 10.0 to 15.0 percent of the value of output.

However, none of these studies examine the impact of indirect tax subsidy schemes on the level and share of income of the different groups of population considering the interrelation between output, price and income distribution. The basic model, where such interrelations has been considered, therefore, provides a framework for estimating the economic impact of different indirect tax-subsidy schemes on output, price, income distribution and poverty, taking into consideration the interactions between them.

Indirect tax system in India is complicated with several types of taxes with responsibilities of their collection divided between the centre and the states. Therefore, analysis of indirect tax-subsidy should ideally consider the different types of indirect tax viz. excises, import duties, sales and other taxes and their corresponding base. This involves detailed estimates of revenue collection for different taxes and estimates of gross output of commodities[1/]. In the present analysis we, however, do not consider such detailed classification of indirect taxes and their bases. Instead, we mainly use the tax rates provided in sixth plan technical note (Sixth TN) and simulate the model with different indirect tax and subsidy rates taking the Sixth TN rates as 'bench mark' rates. The sixth TN provides the indirect taxes for three broad categories viz. import duties, export duties and remaining indirect taxes. Thus excises, sales tax and other types of indirect taxes have been grouped together under " the remaining indirect taxes" and as such we shall also treat them alike. This, however, is a major limitation of our analysis as impact of indirect tax-subsidy schemes are examined in terms of

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[1/] Ahmed and Stern (1981) considers the detailed classification of Indian indirect taxes while estimating the different tax components of 'effective taxes'.

average rates of different indirect taxes - not in terms of individual types of indirect taxes. Thus the data set on the indirect taxes in the present study do not go beyond those provided in sixth TN. Moreover, as the present analysis considers 32 broad sectors, the Sixth TN informations on indirect taxes for 89 sectors were aggregated into 32 sectors from which the sectoral ~~normal~~ nominal tax rates for 32 sectors were calculated using appropriate levels of commodity output. The nominal tax rates thus calculated are presented in Table 4.9 of Chapter 4. These nominal tax-rates, when applied in price equation of the basic model along with other technological and income distribution parameters for the year 1979-80, will make the sectoral prices unity. These nominal tax rates, therefore, are taken as 'bench mark' rates in terms of which the alternative tax-subsidy schemes are defined for our analysis.

6.3.1 Economic impact of indirect tax-subsidy

In order to study the effect of indirect tax subsidy on different macro economic variables we have simulated the basic model with alternative rates of indirect taxes and subsidies imposed on imputs and outputs of different sectors of production. The description of alternative tax-subsidy schemes are given in Table 6.5. For simulating the basic model we change the level and pattern of base year tax rates for which sectoral prices are unity. The subsidies are treated as negative tax rates and are considered by reducing the base year tax rates by certain stipulated amount.

It may be noted that, in our model, any change in level and pattern of base year indirect tax rates will disturb the base year equilibrium and yield a new equilibrium solution through a process of interaction between output, prices and income distribution. This process starts with the changed level and structure of sectoral prices due to change in cost structure at the new indirect tax rates.

The empirical results as presented in Table 6.6 show that indirect taxation, in general, have negative impact on GDP, private consumption, employment. Thus we see that increase in indirect tax rate on imputs of all sectors by 0.05 reduces the GDP by 5.16%, employment by 2.70% and the private consumption by 4.02% (see alternative case 1). Moreover, comparision of results of alternative 1 and 4 show that adverse effect of indirect tax on inputs on GDP, employment and private consumption is more than that on the final goods. Increase in aggregate price level due to increase in indirect tax rates, as estimated by our model, show that increase in indirect tax rate by 0.05 results in about 3.0% increase in aggregate price index. Moreover the price raising effect of indirect taxation is more on manufacturing commodities than on the agricultural commodities. This is understandable as the incidence of indirect taxation on manufacturing sector is higher than on agricultural sector. Thus we see that while the increase in price of manufactured commodities is 4.36% the same for agricultural commodities is 1.50%. As a result of this increase in price level the aggregate private consumption demand in the economy decreases and consequently GDP, employment etc. falls. It is interesting to note the adverse effect of indirect taxation on GDP and employment are more in case the foodgrain output is determined by supply response function (see alternative case 3). In this case the level of agricultural output falls below the basic solution level due to negative impact of increased fertilizer price on foodgrain production. Thus we see that in this case the GDP, private consumption and employment fall by 6.58%, 5.12% and 7.58% respectively ~~to~~ as the indirect tax rate is increased by 0.05. However, the adverse effect of indirect taxation is much reduced if indirect taxation is accompanied with increased foodgrain production. Thus we if the food grain output is fixed at the basic solution level, which is higher than the food grain output level as obtained in case 3, the reduction in GDP, private consumption and employment are 4.54%, 3.25% and 1.99% respectively. Further, it is found that indirect taxation, in general, reduces the share of industry in gross value added. It is found that increase in indirect tax rate by 0.05 reduces the share of manufacturing industry by 5.67% and increases that of agriculture by 4.36%. This is because of the share of agricultural products in aggregate consumption increase at higher price level due to indirect taxation.

Indirect taxation, in general, reduces the import requirement of the economy by reducing both intermediate as well as private consumption use of import. This is because total import requirement, in our model, depends on private consumption and output both of which fall at higher rates of indirect taxation. Moreover, the pattern of output also shifts toward agricultural sector where intermediate use of import is less than that of the manufacturing sectors. Thus it may be seen that increase in indirect tax rate by 0.05 reduces the import requirement by 2.14% over the basic solution level (see alternative case 1).

Subsidy on agricultural products and/or on the major imputs for production of agricultural ~~to~~ goods are primarily aimed at reducing prices of the agricultural commodities. Thus if the agricultural production can be increased by subsidizing fertilizer imputs, it is expected to reduce the prices of agricultural commodities in the economy as found in case 7. Similarly direct subsidization of agricultural goods has been a government policy to achive the real income transfer to the poor. These policies are particularly important for their impact on the urban poor who generally receive the money income and whose real income are sensitive to prices of agricultural commodities. The alternatives 6, 7 and 8 are mainly concerned with impact of subsidy on agricultural output and imputs. The results show that subsidy on agricultural output or imput have favourable impact on GDP, private consumption and employment, this positive impact is more for subsidy on agricultural input than the subsidy on agricultural output. This is because subsidy on agricultural input increase employment and reduces market price via its positive impact on foodgrain production. Thus it can be seen from the results of alternatives 6 and 7 that GDP, private consumption and employment increase by 1.98%, 2.01% and 2.03% respectively when the rate of subsidy on fertilizer input is increased by 0.05 (alternative 7) while corresponding increase in GDP, private consumption and employment when the rate of subsidy on foodgrain output is increased by 0.05 are 1.65%, 1.40%, 1.81% respectively (alternative 6). Finally the result of alternative 8 indicate that subsidy on both agricultural input and output have substantial positive impact on GDP, private consumption and employment. It can be seen that GDP, private consumption and employment increase respectively by 2.25%, 2.75% and 3.15% when the rate of subsidy on both agricultural input and output are increased by 0.05.

Comparision of aggregate savings rate (aggregate savings as a percentage of GDP at current market price) under alternative rates of indirect taxation shows that aggregate saving rate of the economy increases with the increase in indirect tax rate. It can be seen from the Table 6.6 that aggregate savings rate increases by 3.52% over the 'basic solution level' when the indirect tax rate is increased by 0.05. This increase in savings rate is mainly due to increase in government tax revenues and consequent rise in public savings, government consumption, being held fixed in real terms. Moreover, as import requirement decreases due to indirect taxation and the export is also held fixed in real terms, foreign savings also falls due to increase in indirect tax rates. However, both household savings and corporate savings reduced due to fall in the disposable income as a result of increase in indirect taxation. But the reduction in household and corporate savings is more than compensated by the increase in public savings and consequently aggregate domestic savings rate of the economy rises due to increase in indirect taxation.

Aggregate savings rate, however, falls substantially due to subsidies on agricultural sector. This is mainly because of substantial reduction in public savings due to subsidies. Moreover, due to increased GDP the import requirement of the economy rises and consequently foreign savings increases. This reduction in public savings is not compensated by rise in household and corporate savings resulting from subsidies on agricultural sector.

Economic profile of the poor and the non-poor as presented in Table 6.7 show the change in the economic position of the poor and the non-poor under different indirect tax-subsidy schemes. It may be noted, that indirect taxation has an adverse effect on the income, consumption and dependency ratio of the poor as well as the non-poor. An increase in indirect tax rates on imputs by 0.05 reduces the income of the poor by 2.62% and increase their consumer price index and dependency ratio by 2.54% and 3.40% respectively. It can be further noted that the unfavourable economic impact of indirect taxation is more on the poor than on the non-poor. Thus we see that income of the poor falls by 0.78% and the same for the non-poor falls only by 0.21% when indirect tax rate on mass consumption goods like food, textile and leather products are increased by 0.05. " However, this adverse impact of indirect taxation on the poor is much reduced if agricultural output is increased with increase in indirect taxation as can be seen from results of alternatives 2 and 3. This is because the increased agricultural production dampens the prices raising effect of indirect taxation by reducing the prices of agricultural output. Moreover, it can be seen that indirect taxation on imputs has more detrimental effect on the economic position of the poor than the indirect taxation on final goods. Finally it can be seen from the results of alternatives 6, 7 and 8 that income and consumption of both the poor and the non-poor increase due to increase in subsidy on agricultural output and agricultural input. However the increase in income is more for subsidy on agricultural input than the subsidy on agricultural output. It can also be noted from the result of alternatives 6 and 7 that the non-poor benefit more than the poor from subsidy on agricultural input.

Impact of indirect tax-subsidy on income distribution is estimated by changes in income/consumption inequantity as measured by Lorentz Ratio while the impact on poverty is measured by changes in the proportion of poor and Sen's index of poverty. These indices show that indirect taxation has substantial negative impact on the inequality and poverty situation of the economy (see Table 6.6). For example, increase in indirect tax rates by 0.05 increases income inequality by 4.30% and Sen's index by 11.17% over their respective basic solution level. The increases in Sen's index is due to increase in proportion of the poor and decrease in the level of percapita of consumption. Income and consumption inequality, on the otherhand, increases

Table 6.5 : Description of Indirect Tax-Subsidy Alternatives

Case no.	Description of alternative cases
(1)	(2)
1	Increase in indirect tax rates on inputs by 0.05 in all taxable sectors.
2	Case 1 with output of sector 1 (foodgrain) fixed at basic solution level.
3	Case 1 with output of sector 1 determined by supply response function.
4	Increase in indirect tax rates on final use by 0.05 in all taxable sectors.
5	Increase in indirect tax rates by 0.05 on final demand of some of mass consumption goods (sectors 4, 5, 9, 10 and 15).
6	Subsidy of 0.05 on foodgrain output.
7	Input subsidy of 0.05 on fertilizer with output of sector 1 determined by supply response function.
8	Subsidy of 0.05 on foodgrain output and fertilizer input with output of sector 1 determined by supply response function.

as the fall in nominal income and rise in consumer price index due to indirect taxation is more for the poor than the non-poor. As a result the real income is shifted against the poor due to indirect taxation. Impact of subsidy on poverty and inequality as estimated under alternatives 6, 7 and 8 clearly show that subsidy on agricultural sector have favourable impact on poverty but increase income and consumption inequality. Thus it may be seen that increase in rate of subsidy on agricultural input and output reduces poverty. (Sen's index) by 5.87% but increase income and consumption inequality by 2.80% and 2.10% respectively (alternative 8).

Table 6.6 : Macro-Economic Aggregates under Alternative Indirect, Tax-subsidy Schemes : Comparision with Basic Solution[(a)]

Case nos.	GDP at Factor Cost	Indirect tax less subsidy	Private consumption	Import	Employment	Savings ratio
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	94.94	118.42	95.98	97.86	97.30	103.52
2	95.46	118.80	96.75	98.18	98.01	102.86
3	93.42	119.52	94.18	97.99	92.42	104.83
4	96.21	122.81	97.05	97.00	96.46	103.80
5	99.16	104.79	99.54	99.22	99.13	100.56
6	101.65	94.15	101.40	101.27	101.81	98.68
7	101.98	95.35	102.01	101.35	102.03	99.23
8	102.25	93.98	102.75	101.84	103.15	98.65

(a) As percentage of basic solution.

Contd.../-

Table 6.6 : Macro-Economic Aggregates under Alternative Indirect, Tax-subsidy Schemes : Comparision with Basic Solution

(Continued)

Case nos.	Poverty (Sen's index)	Inequality (Lorentz ratio)		Price level		
		Income	Consumption	Aggregate	Agriculture	Manufacturing
(1)	(8)	(9)	(10)	(11)	(12)	(13)
1	111.17	104.30	103.96	102.92	101.50	104.36
2	107.43	102.19	102.10	102.23	99.48	104.29
3	120.00	108.26	108.69	102.86	101.35	104.35
4	113.60	104.19	103.71	102.90	101.11	104.11
5	103.88	101.65	101.35	101.20	100.80	102.20
6	95.77	100.01	99.87	99.21	97.45	100.00
7	95.01	103.75	103.01	99.64	98.97	99.89
8	94.13	102.80	102.10	99.02	96.06	99.90

Table 6.7 : Economic Profile of Target and Non-target Groups under Alternative Indirect Tax-subsidy Schemes : Comparision with Basic Solution@

Case nos.	Percentage of population		Dependency ratio		Monthly per-capita income		Consumer Price Index	
	Target group	Non-target group	Target group	Non-target group	Target group	Non-target group	Target group	Non-target group
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1	106.03	94.34	103.40	103.72	97.38	98.95	102.54	102.70
2	104.25	96.01	102.64	102.44	98.40	98.61	101.20	101.90
3	109.00	91.55	108.85	110.17	94.42	99.44	102.40	102.63
4	105.41	95.04	103.00	103.26	98.04	99.21	102.65	103.16
5	102.83	97.81	101.49	100.77	99.22	99.79	100.40	100.59
6	98.47	101.43	98.79	97.13	101.82	101.85	98.37	99.13
7	97.24	102.16	97.65	105.97	102.75	104.15	98.10	99.45
8	96.73	103.54	96.98	104.21	103.10	105.12	97.32	97.45

@ As percentage of Basic solution.

6.3.2 Welfare evaluation of alternative indirect tax-subsidy policies

Welfare evaluation of alternative redistributive policies has been done by using a social welfare function of semilogarithmic type where social utility is written as a function of per-capita consumption of the poor and the non-poor. Thus if c_b and c_a denote the per capita consumption of the poor and the non-poor then social utility function is given by

$$u = N_1 \beta_1 \log c_b + N_2 \beta_2 \log c_a \qquad \ldots\ldots (1)$$

where N_1 and N_2 are the number of the poor and the non-poor; and β_1 and β_2 are weights.

Using the social utility function given by (1) we define two alternative measures of per capita social utility, U_e and U_p, from (a) "equal weights" form of social utility function and (b) "poverty weights" form of social utility function. The 'equal weights' social utility index can be shown to be a measure of the increase in welfare if we assume that utility function is symmetric, that is, $\beta_1 = \beta_2$. The 'poverty weights' social utility index, on the otherhand, provides a measure of welfare improvement when β's are different for different classes. Thus per capita utility indices for "equal weights" and "poverty weights" form of social utility function are respectively given by[2/]

$$U_e = [N_1 \log c_b + N_2 \log c_a] / N \qquad \ldots\ldots (2)$$

$$U_p = [N_1 \beta_1 \log c_b + N_2 \beta_2 \log c_a] / N \qquad \ldots\ldots (3)$$

where N is total population and the weights β_1 and β_2 in (3) are determined in such a way that they yield poverty weights 0.6 and 0.4 for the target and the non-target groups of populations. It may be noted that per capita consumption of each group of population under different policy alternatives can be aggregated into single utility stream using U_e and U_p and can be used for comparing welfare gain or loss under alternative redistributive policies. The per capita utility for the basic solution under 'equal weights' and "poverty weights", as calculated by expressions (2) and (3), are 4.45 and 5.60 respectively.

2/ See Ahluwalia (1974) for method of deriving weights for 'equal weights' and "poverty weights" form of utility indices.

Table 6.8 : Per capita Utility and its change over Basic Solution Level under Alternative Tax-subsidy Schemes

Alternative case number	Per capita utility		Change in per capita utility	
	Equal weight	Poverty weight	Equal weight	Poverty weight
(1)	(2)	(3)	(4)	(5)
1	4.41	5.27	99.10	94.11
2	4.42	5.34	99.30	95.36
3	4.38	5.09	98.43	90.89
4	4.42	5.31	99.32	94.82
5	4.44	5.45	99.77	97.32
6	4.48	5.71	100.67	101.96
7	4.50	5.79	101.12	103.39
8	4.55	5.83	101.35	104.11

Per capita utility and its percentage change over the basic solution per capita utility level, under alternative indirect tax-subsidy schemes are presented in Table 6.8. Comparision of per capita utility change under different indirect tax-subsidy schemes show unfavourable impact of indirect taxation on social welfare. It can be seen that reduction in per capita utility under 'poverty weights' social utility function can be as much as 9.11 percent when the indirect tax rate is increased by 0.05. Further it is seen that unfavourable welfare impact is more for indirect taxation of inputs than that of output. Subsidy on agricultural output and input, however, yeild per capita utility higher than the corresponding Basic solution values. The results indicate that welfare improvement under agricultural input subsidy is more than that of agricultural output subsidy. Finally it can also be noted that subsidies on both agricultural inputs and output yeilds significant improvement in the per capita utility level.

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6.4 Profit income transfer from the non-poor to the poor

In this section our purpose is to simulate the economic impact of profit income transfer from the non-poor to the poor. This, however, requires certain modifications of the income determining equations for the poor and the non-poor in the basic model. It may be recalled that the income of the non-poor in the basic model consists of wage and profit income while that of the poor consists of only wage income. Moreover the income of the poor from the distribution of wage earning on the basis of normative wage rate. In case a portion of profit income is transferred to the poor the normative wage rate should be adjusted accordingly taking into consideration the impact of extra income gain of the poor on the normative wage rate. For this we assume that income transferred is equally distributed among the poor. In this situation, the normative wage rate, will be that rate of wage which, along with minimum (percapita) non-wage income, provides poverty line normative consumption.

Thus if TRS is the amount of profit income transferred from the non-poor to the poor then the aggregate income of the poor and the non-poor may be modified as follows :

$$\bar{y}_b = y_b + TRS \qquad \ldots\ldots (4)$$

$$\bar{y}_a = y_a - TRS \qquad \ldots\ldots (5)$$

where

$\bar{y}_b$ = aggregate income of the poor after transfer

$\bar{y}_a$ = aggregate income of the non-poor after transfer

y_b = aggregate income of the poor before transfer

y_a = aggregate income of the non-poor before transfer

and y_b and y_a are determined from the equations of the basic model using the following normative wage rate (K_0)

$$K_o = \theta_b \, (\pi_0 . p_{cb} - \bar{u}) \qquad \text{..... (6)}$$

where $\bar{u}$ is per capita non-wage income of the poor after transfer and is given by

$$\bar{u} = TRS/\beta . P^* \qquad \text{..... (7)}$$

TRS, when expressed as a percentage (δ_r) of disposable profit income of the non-poor will be :

$$TRS = \delta_r . (1 - t_d) \, PF_r \qquad \text{..... (8)}$$

where PF_r is the aggregate non-wage income of the non-poor.

It may be noted that β and θ_b in the above equations are determined in the same way as in basic model. Further, from the above equations it can be seen that economic impact of income transfer in our model is estimated by considering the direct and indirect impact of transfer on the level and pattern of output. The transfer of income from the non-poor to the poor; thus, increases the aggregate consumption demand, and hence output, in the economy, as this extra income will be entirely consumed by the poor. Moreover, since consumption pattern of the poor is different from that of the non-poor, the income transfer will also change the pattern of output in the economy. The changed level and pattern of output will, in turn, have indirect effect on the economic position of the poor and the non-poor.

In this section we study the impact of transfering Rs. 7,000 million from the non-poor to the poor. This amount is about 5.4% of the profit income and about 1% of the aggregate income of the non-poor as obtained in the 'basic solution'. It can be seen that, due to this income transfer, the per-capita income of the poor increases by 2.72% while that of the non-poor decreases by 0.75% over their respective basic solution level. Moreover change in dependency ratio and percentage of population in the target and non-target groups reveal that employment gain, due to income transfer, of the target group is more than that of the non-target group.

This favourable impact of income redistribution from the non-poor to the poor may be explained as follows : Redistribution of income from the non-poor to the poor through income transfer increase the aggregate consumption and also change demand pattern in the economy. Consequently aggregate output increases and pattern of output is shifted towards labour intensive sectors. It is found that increase in agricultural output (0.56%) due to income redistribution is more than that of manufacturing industries (0.10%). As a result the share of agriculture in gross value - added increase (0.37%) while that of industry falls (0.22%). This shift of pattern of output towards agriculture increase the labour intensity of production in the economy and consequently employment income of the poor increases. Further, it is interesting to note that 1% transfer of base year income of the non-poor decreases the income of the non-poor by less than 1%. Finally it may be noted that income transfer from the non-poor to the poor reduces, both poverty and income inequalityin the economy. However, aggregate savings rate falls by 0.24% due to income redistribution from the poor to the non-poor. This fall in aggregate savings rate is mainly due to fall in household savings by 0.29% in the economy because redistribution of income from the non-poor to the poor. It is also interesting to note that aggregate as well as share of import (in GDP) falls due to redistribution and consequently foreign savings falls. Moreover, public savings slightly increase because of higher output resulting from income redistribution while corporate savings remain more or less unaffected. This increase in public savings and decrease in foreign savings, however, do not offset the decrease in household savings and consequently aggregate savings rate in the economy falls due to income redistribution. Finally it was found that per capita utility level under equal weights and 'poverty weights' social utility function increased by 0.44% and 1.61% respectively over their corresponding basic solution level.

6.5 Changes in nominal wage of the poor and the non-poor

Analysis of level and structure of wage earning across productive sectors showed relatively high extent of wage inequality in Indian economy. It was found that incidence of poverty was highest in those sectors where distribution of wage earning were most unequal. These two sectors in Indian economy are agricultural and service sectors. Moreover, it is also seen that minimum wage substantially vary over sectors. In general it was noticed that minimum wage earned in unorganised sectors are less than the officially declared minimum wage and much less than that of organised sectors. Further, it is also seen that the extent of wage inequality among poor is much less than among non-poor. Thus, given the base year level of output, one of the major determinant of base year poverty is low level of wage paid in those sectors where most of the poor earn their income.

In order to study the implication of nominal wage revision we, therefore, consider two types of wage policies viz. (1) revision of (nominal) minimum wage earned by the poor (2) revision of nominal wage of the non-poor employed in organised sector of the economy. The first type of wage policy is a declared government policy for reducing poverty while the second type of wage revision takes place in the organised sector of Indian economy through revision of pay-scales, payments of dearness allowances etc. It may be noted that above types of wage revisions for the poor and the non-poor will lead to redistribution of real income among them. This is mainly because changes in nominal wage in one group will affect the level and pattern of output and prices in the economy which, in turn, will determine the level of real income of the poor and the non-poor. Thus in this case redistribution takes places through market mechanism.

6.5.1 Economic impact of changes in nominal wage

The types of wage revisions considered for analysis are described in Table 6.9 and their economic impact, as estimated by our model are presented in Tables 6.10 and 6.11. The results of alternative 1 show that increase in minimum wage of the poor has appreciable favourable impact on GDP, employment and private consumption. It can be seen that GDP, employment and private consumption increases by 1.73%, 8.77% and 2.79% respectively as the minimum wage is raised to Rs. 8.00 at 1979-80 prices. Moreover, the economic profile of the target and non-target groups, as presented in Table 6.11 show that the upward revision of minimum wage redistribute income in favour of the poor. Thus while the per capita income of the poor increases by 23.26% over the basic solution level due to upward revision of the minimum wage that of the non-poor falls by 1.83%. This fall in real of income of the non-poor occurs due to increase in aggregate price resulting from upward revision of minimum wage. Consequently both poverty and income inequality are reduced.

In alternative case 1 we assumed that increased private consumption demand of agricultural products due to increase in minimum wage will be met either through increased production of agricultural products or through import. In other words, there is no supply constraint on agricultural products. In Case (2) we relax this assumption and estimate the impact of upward revision of minimum wage when agricultural output is fixed at base year level. Form the results it can be seen that the beneficial effect of minimum wage revision on poor is much reduced in presence of agricultural output constraint in the economy. This is because of demand pull increase in prices of agricultural products in the face of agricultural output constraint. Consequently both poverty and inequality situation deteriorates as compared with the situation when there is no agricultural output constraint. However, even in presence of agricultural output constraint, the upward increase in minimum were redistribute income towards the poor - although at a lesser extent than when there is no agricultural output constraint. In this context we may note that in alternative cases 1 and 2 we have not considered the impact of increased minimum wage on the output of agricultural sector where bulk of the poor are employed. For this in alternative case 3 we reestimate the economic impact of increasing minimum wage when the output of agricultural sector is determined by supply response function. It may be recalled that the supply response function as considered in this study show inverse relationship between agricultural output and wage rate in agricultural sector. Thus increase in minimum wage in this case will reduce output and employment in agricultural sector.

However, the increased wage in agricultural sector will create demand for non-agricultural products and the output of non-agricultural sector will be increased. Thus the overall economic impact of increase in minimum wage as estimated under alternative 3 show that beneficial impact of minimum wage policy is much reduced if one considers the employment and output effects of increase in minimum wage. In this content we may note that increase in minimum wage pushes up the aggregate as well as consumer price indices to a considerable extent. It can be seen that upward revision of minimum wage to Rs. 8.00 increase the consumer price index by 6.0% to 8.0% if agricultural

Table 6.9 : Description of Alternative Wage Policies

Case no.	Description of alternative cases
(1)	(2)
1	Increase in minimum wage to Rs. 8 in all sectors.
2	Case 1 with output of sector 1 (foodgrain) fixed at basic solution level.
3	Case 1 with output of sector 1 determined by supply response function.
4	Minimum wage of Rs. 8 in all sectors along with subsidy of 0.05 in foodgrain output and fertilizer input.
5	Case 4 with output of sector 1 determined by supply response function.
6	10 percent increase in wage of the non-poor employed in organised manufacturing sectors.

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supply does not increase proportionately with demand. It is interesting to note that percentage of population below poverty line increase substantially due to increase in minimum wage although the per capita income of the poor show remarkable improvement. This leads to considerable reduction in Sen's index of poverty.

Table 6.10 : Macro-Economic Aggregates Under Alternative Wage Policies : Comparision with the Basic Solution

Alternative case number	GDP at factor cost	Private consumption	Employment	Import	Savings ratio	Aggregate consumer price Index
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	101.73	102.79	108.77	78.34	96.00	105.84
2	100.12	100.12	100.24	99.14	98.24	108.23
3	99.64	100.33	95.09	103.03	98.92	105.94
4	103.88	104.64	103.63	104.15	95.37	105.79
5	101.64	101.95	97.10	104.63	97.37	106.34
6	100.22	100.33	100.17	100.29	100.75	100.12

Much of the price raising effect of increase in minimum wage is mitigated in presence of subsidies on food grain and agricultural input. Thus the results of alternatives 4 and 5 show that while percentage of poor remain more or less at the basic solution level, their per capita income increase by 27.0% over the basic solution if the upward revision of minimum wage is accompanied with subsidies on food grain and agricultural inputs. However, in these case aggregate savings rate of the economy falls due to

Table 6.11 : Economic Profile of the Poor and the Non-poor under Alternative Wage Policies : Comparision with the Basic Solution

Alternative case number	Percentage of		Per capita income		Dependency ratio		Consumer price index		Inequality income consumption (Lorentz ratio)	Poverty (Sen's Index
	Poor	Non-poor	Poor	Non-poor	Poor	Non-poor	Poor	Non-poor		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1	105.89	94.48	123.26	98.17	99.84	101.10	107.38	102.73	85.95 80.19	33.55
2	112.02	88.75	117.59	99.71	102.41	104.62	111.33	109.96	92.90 88.02	63.02
3	110.57	90.85	117.89	98.86	105.74	107.32	107.32	107.37	91.35 86.40	61.94
4	100.12	97.94	127.36	99.06	97.64	96.90	105.17	100.10	80.60 74.42	37.91
5	100.94	94.42	121.04	99.57	103.59	103.90	105.52	100.34	88.55 83.57	52.30
6	101.74	98.37	99.41	101.69	100.44	49.57	100.85	100.95	102.89 102.73	102.90

fall in household and public savings. Finally the results of alternative 6 clearly show the unfavourable impact of nominal wage increase of the non-poor on the economic position of the poor. Thus we see that 10% rise in nominal wage of the non-poor, reduces the per capita income of the poor by 0.59% although GDP, employment and aggregate consumption rises. Moreover, the pattern of output shifts towards manufacturing sectors due to increased demand of industrial products at a high level of per capita income of the non-poor. Consequently both poverty and inequality situation in the economy worsens.

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Table 6.12 : Per capita utility and its percentage change over Basic Solution under Alternative Wage Policies

Alternative case number	Per capita utility		Change in per-capita utility	
	Equal weights	Poverty weights	Equal weights	Poverty weights
(1)	(2)	(3)	(4)	(5)
1	4.53	5.64	101.80	100.71
2	4.49	5.09	100.90	90.89
3	4.49	5.66	100.90	101.07
4	4.57	5.79	102.70	103.39
5	4.52	5.69	101.57	101.61
6	4.44	5.52	99.77	98.57

6.5.2 Welfare evaluation of wage policies

Per capita utility levels under alternative wage policies as estimated by 'equal weights' and 'poverty weights' form of social welfare function are presented in Table 6.12. The results indicate favourable welfare impact of minimum wage policy. However, this favourable impact is much reduced if there is agricultural output constraint in the economy. Increase in minimum wage along with subsidies on foodgrain output and fertilizer input seems to have substantial favourable welfare impact. It can be seen that in this case increase in per capita utility under 'equal weights' and 'poverty weights' social welfare evaluation schemes are 2.70% and 3.39% respectively. Finally we may note that increase in nominal wage of the non-poor show unfavourable welfare impact under both 'equal weights' and 'poverty weights' social welfare function.

6.6 Increase in agricultural output

Use of output as instruments for redistribution will depend upon the distributional characteristics of different sectors of production and consumption characteristics of different groups of population. In so far as the distributional characteristics of production is concerned we may note that increase in production of such sectors where pattern of factor income favours the poor, will shift the distribution of income towards the poor. This argument is based on the assumption that poor produce and earn their income in such sectors on which they spent a higher proportion of income. In other words, increase in production of such sectors which have strong income and consumption linkage with the poor will reduce poverty and income inequality. Such a sector in Indian economy is agricultural sector[3].

In this section we simulate the basic model with exogenous level of agricultural output to analyse the effectiveness of output as instruments for reducing poverty and income inequality. At this point we may note that keeping agricultural output exogenous in the basic model we considered two different modes of price formations in agriculture and industry viz. demand-supply based and cost-based modes of price formations respectively. Therefore,

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[3] This hypothesis as we have already seen in Chapter 4, also holds to a certain extent for the Indian economy. In this context we may note that stimulating production in labour intensive sector, although reduce poverty, need not reduce income inequality. Its impact on inequality will depend upon the distribution of factor income generated in such sectors. Thus, as rightly pointed out by Ahluwalia (1974), increase in production of labour intensive agricultural sector with highly concentrated land distribution, although reduces poverty, may actually increase income inequality. So the argument that increase in employment will reduce inequality, as used by ILO (1970) and Mohammad (1981), preassumes that distribution of factor income favour the poor.

exogeneous change in agricultural output will primarily affect the prices of agricultural sector which, through cost-interdependence of industries, will affect the prices of manufacturing products. Moreover, the changed agricultural output will affect the demand pattern of the economy which, in turn, will affect the level and structure of industrial output.

In order to study the economic impact of increasing agricultural production on poverty and income distribution the agricultural output in the basic model in increased by 5.0% over the basic solution level. The results indicate the favourable impact of increasing agricultural production on GDP, consumption and employment which increase by 2.58%, 3.77% and 2.43 respectively over their corresponding basic solution level. Increase in employment reduces the dependency ratio of the poor and the non-poor by 3.77% and 4.85% respectively. Aggregate consumer price index and the consumer price indices for the poor and the non-poor fall by 3.24%, 3.44% and 3.11% respectively. However the total import rise by 1.47% over its basic solution level. Further increase in agricultural production reduces poverty and income inequality. Thus it is seen that percentage of poor, Sen's index of poverty and Lorentz ratio register a decline of 8.11%, 16.94% and 6.33% respectively over their corresponding basic solution level. This reduction in poverty and income inequality may be explained because an increase in agricultural output improves the relative position of the poor in two ways. First, the aggregate nominal income of the poor increases as majority of them are employed in agricultural sector. Secondly, the increased agricultural production reduces the prices of agricultural products which, in turn, leads to substantial reduction in overall price level in the economy. As a result the increase in real income of the poor (4.57%) is more than their nominal income. Per capita income of the non-poor, on the otherhand, decline by 1.99% as the aggregate profit income, a portion of which accrues to them, is reduced at the lower level of prices. Welfare evaluation of increasing agricultural production also reveal that per-capita utility under both 'equal weights' and 'poverty weights' form of social utility function increase by 1.12% and 8.21% respectively over their corresponding basic solution level. Thus our results indicate increasing agricultural production is an effective instrument for reducing poverty.

6.7 Reallocation of sectoral investment

Level and pattern of investment in any economy determines growth of productive sectors overtime. In so far as the different productive sectors differ in pattern of factor income and poverty characteristics, the level and pattern of investment in different sectors will affect the aggregate distribution of income and poverty in the economy. Lack of investment in such sectors whose distributional characteristics favour the poor will, therefore, limit growth of income of the poor. In such a situation the government can redirect investment towards such productive sectors to raise the income of the poor[4/]. In this section our purpose is to analyse the impact of alternative level and pattern of investment on poverty inequality and other macro-economic variables. In this context we may note that fixed capital investment in the basic model is treated as an exogenous element. For the present we make fixed capital

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[4/] Another approach consists of redirecting investment directly towards the poverty group. But our model does not provide a framework for such an analysis as productive assets in our model are distinguished only according to sectors of production - not on ownership basis. Consequently investment can only be differentiated according to sectors of destination.

investment an endogenous element on the basis of accelerator type relation between growth and investment for capacity expansion; and treat the alternative rates of growth of capacity as parameters of the system. These rates of growth when changed parametrically will yield alternative level and pattern of investment (by destination) in the model.

6.7.1 Endogenous treatment of investment in IO model

In order to make gross fixed capital investment an endogenous element we have considered the acclerator type relation between investment and capacity expansion. According to this relation investment use of commodity 'i' for capacity expansion in industry 'j' at time 't', U_{ij}^{t}, is given by

$$U_{ij}^{t} = k_j . B_{ij} . \Delta v_{jc}^{t} \qquad \ldots\ldots (9)$$

where B_{ij} is (i, j)th element of capital coefficient matrix $B = (B_{ij})$ and v_{jc}^{t} is the postulated amount of capacity expansion in industry 'j'. The underlying assumption in this relation is that (i) at any point of time 't', unit expansion in capacity in industry 'j' requires fixed proportion of commodity ('i' as given by the coefficient B_{ij} and (ii) that whole of these amounts are made available from production in the same period. Thus the total fixed capital investment use of commodity 'i' is given by

$$I_i^{t} = \sum_{j=1}^{n} U_{ij}^{t} = \sum_{j=1}^{n} k_j . B_{ij} . \Delta v_{jc}^{t} \qquad \ldots\ldots (10)$$

However, one can relax the assumption (ii) and introduce, in the above relation, the time specific use of investment goods over construction period of the investment in industry 'j'.[5]

[5] While Chakrabarty (1969), Eckaus and Parikh (1968) considered time structure of fixed capital investment, Lahiri (1976) considered time structure of both fixed and working capital investment while endogenising investment in IO framework.

Thus if a_j (t) denotes the time distribution of investment goods in industry 'j' having construction period θ_j these investment in industry 'j' at time 't' is given by

$$U_j^t = k_j \left[\sum_{s=1}^{\theta_j} a_j(s) \left(v_{jc}^{t+s} - v_{jc}^{t+s-1}\right) \right] \qquad \ldots\ldots (11)$$

where k_j is incremental capital output ratio (ICOR) for sector 'j' and v_{jc} is its capacity value-added at constant price. Now under the assumption of uniform distribution of investment goods, relation (11) reduces to

$$U_j^t = k_j \left(v_{jc}^{t+Q_j} - v_{jc}^t\right) / \theta_j \qquad \ldots\ldots (12)$$

This relation (12) has been econometrically estimated by Planning Commission (1979) from time series data on u_j at constant market price and v_{jc} at constant factor cost for major industries in Indian economy. The estimated function, which has been called the investment function, has the following specification.

$$U_j^t = \alpha_j + d_j . v_j^t + k_j \left(v_{jc}^{t+Q_j} - v_{jc}^t\right) / \theta_j \qquad \ldots\ldots (13)$$

where α_j is called the intercept in the investment function d_j depreciation rate and v_j^t is value-added at constant price for industry 'j'.

In order to study the impact of level and structure of investment on the poor we express the relation (13) in terms of rate of growth of capacity expansion in sector j, denoted by R_j. Thus if R_j is the postulated rate of growth of capacity in industry 'j' beyond the year 't' then (13) can alternatively be written as

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$$U_j^t = \alpha_j + d_j.v_j^t + k_j.v_{jo}^t \left\{ (1 + R_j)^{\theta_j} - 1 \right\} / \theta_j \qquad ..... (14)$$

The total investment use of commodity 'i' at time 't' at constant factor cost is then given by

$$I_i^t = \sum_{j=1}^{n} B_{ij}.U_j^t / (1 + t_{coi}) \qquad ..... (15)$$

where t_{coi} is the average rate of indirect tax at the base year. Thus from relation (14) and (15) one can get alternative level and structure of investment (by origin as well as destination) for different configuration of R_j's. For the analysis considered in this section we shall trend R_j's as exogenous parameters and change them parametically to arrive at different level and structure of investment[6].

6.7.2 <u>Economic impact of changes in level and structure of sectoral investment</u>

In order to study the economic impact of alternative level and pattern of investment we replace the exogenous investment (by origin) in the output model by the equation (15) and treat the rates of growth of capacity output in different productive sectors as exogenous parametres. Alternative levels and pattern of investment (as obtained by changing these rates of growth) corresponds to certain stipulated growth of capacity output of different productive sectors and will affect poverty and income distinction by changing the level and pattern of output and prices.

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[6] R_j's will be treated as unknown endogenous variables in the plan model developed in Chapter 7.

Alternative stipulated rates of growth of sectoral capacity output considered for out analysis and used in equation (15) are presented in Table 6.13. Among the four alternatives considered the first alternative refers to 3% growth of agricultural sector, 5.0% growth of manufacturing sector, 9% growth electricity and 5% growth of service sectors and will be treated as basic solution with which results of the remaining three alternatives are compared.

Results of alternative 1 show that total gross investment requirement for achieving the above mentioned stipulated growth rate is Rs. 29,710 crores at 1979-80 prices; of which about 20.6% goes to agricultural sector and 23.5% goes to manufacturing sectors. This increase in level of investment over 1979-80 level yields favourable impact on GDP employment and consumption. Moreover, the economic position of the poor and non-poor improves upon respective base year level.

For studying the impact of relative rates of growth of agriculture and industry we increase the stipulated growth rates of agriculture and industry alternatively by 1% keeping the rates of growth of other sector same as alternative 1. These have been considered in alternatives 2 and 3. Finally to examine the impact of industrial growth when there is agricultural output constraint in the economy we increase in alternative 4 the stipulated growth rate of manufacturing industries (over the corresponding level of alternative 1) fixing the agricultural output at the level of alternative 1.

Economic effect of our variational exercises, as presented in Tables 6.14 and 6.15 show that growth of manufacturing industries have comparatively favourable impact on GDP, consumption and employment than that of agriculture as investment requirement for achieving 1% increase in growth of manufacturing industry is more than that required for same increase in growth of agriculture, incremental capital output ratio (ICOR) in manufacturing industries (4.82) being more than that of agriculture (3.61). However results of alternatives 2 and 3 when compared in terms of unit investment show comparatively favourable impact of investment in agriculture on aggregate employment. However, impact of alternative rates of growth in agriculture and industry on the economic position of the poor and the non-poor show that higher growth of agriculture has relatively favourable impact on the poor. Thus we see that increase in per capita income of the poor is more when agricultural growth is increased by 1% (alternative 2) than when industrial growth is increased by 1% (alternative 3). This is inspite of higher level of investment requirement of 1% growth in industry than 1% growth in agriculture. This is due to the fact that the construction sector where a substantial proportion of poor earn their income has larger share in gross investment of agriculture (61%) than that of manufacturing industry (32%). As a result, reallocation of investment towards manufacturing industries generate more income and employment among the non-poor employed in machine tools industry which enjoy a larger share (51%) in gross investment of manufacturing industries. Consequently the economic position of the non-poor improves more in case of growth of investment in manufacturing industries. Thus the reduction in poverty and income inequality due to increased investment in agriculture is more than that for the same increase in manufacturing industries.

The results of alternative 4 show that increase in investment in manufacturing industries when there is agricultural output constraint in the economy leads to 'demand pull' increase in agricultural prices, which, in turn, push up the industrial cost of production and hence prices of industrial products in the economy, consequently GDP, consumption, aggregate employment falls and distribution of income shifts in favour of non-poor. However, it is interesting to note that aggregate savings increases as a mechanism similar to 'forced savings' mechanism operates in the economy.

Table 6.13 : Description of Rates of Growth of Sectoral Capacity output under Alternative Investment Policies

Case No.	Rates of growth (%)			
	Agriculture	Manufacturing	Electricity	Services
(1)	(2)	(3)	(4)	(5)
1	3.0	5.0	9.0	5.0
2	4.0	5.0	9.0	5.0
3	3.0	6.0	9.0	5.0
4	Case 3 along with the output of sector 1 (food grain) fixed at that obtained in case 1.			

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Table 6.14 : Macro economic Indicators under Alternative Level and Structure of Sectoral Investment*

Case No.	GDP at factor cost	Private consumption	Gross investment	Share of gross investment		Employment	Rate of savings	Rate of investment
				Agriculture	Industry			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1	106799	81415	29710	20.6	23.5	164.45	23.41	24.77
2	102.80	102.46	106.20	95.63	114.47	103.90	102.31	103.19
3	104.29	103.74	109.28	116.99	97.02	102.47	103.37	104.68
4	99.34	97.38	106.20	118.93	97.02	98.35	108.24	106.94

* Figure of case (1) represent actual values, while that of cases (2), (3) and (4) are expressed as percentage of case (1). GDP, private consumption and gross investment in case (1) are expressed in Rs. crores while employment is expressed in million standard person years.

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Table 6.15 : Economic Profile of the Poor and the Non-poor under Alternative Level and Structure of Sectoral Investment*

Case no.	Percentage of		Monthly p.c. income (Rs.)		Dependency ratio	
	Poor	Non-poor	Poor	Non-poor	Poor	Non-poor
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	45.46	54.54	55.14	144.22	3.541	4.433
2	96.23	103.18	101.47	101.65	96.24	97.50
3	97.84	101.97	101.32	102.25	97.59	95.51
4	105.30	95.58	95.59	100.80	101.66	1.0288

* Figures corresponding to case no. 1 are actual value while that of case Nos. 2, 3 and 4 are expressed as percentage of case 1.

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Table 6.15 : Economic Profile of the Poor and the Non-poor under Alternative Level and Structure of Sectoral Investment

(Continued)

Case no.	Consumer price index		Inequality income consumption	Poverty Sen's index
	Poor	Non-Poor		
(1)	(8)	(9)	(10)	(11)
1	1.00	1.00	0.2519, 0.2129	17.8740
2	1.00	1.00	97.58, 97.45	92.32
3	1.00	1.00	98.73, 98.63	94.24
4	1.0643	1.0545	1.0773, 1.0756	1.0759

Table 6.16 : Per capita Utility under Alternative Sectoral Investment Policies

Alternative case number	Per capita utility	
	Equal weights	Poverty weights
(1)	(2)	(3)
1	4.53	5.99
2	4.57	6.20
3	4.54	6.12
4	4.49	5.70

6.7.3 Welfare evaluation of alternative sectoral investment policies

Per capita utility levels under alternative sectoral investment policies as estimated by 'equal weights' and 'poverty weights' form of social welfare function are presented in Table 6.16. It can be seen that increase in welfare is maximum when the sectoral investment is reallocated towards agricultural sector. In this case the increase in per capita utility level,' over that in case 1,' under 'equal weights' and 'poverty weights' welfare evaluation schemes are 0.88% and 3.50% respectively. The corresponding figures for reallocation of investment towards manufacturing sectors are 0.22% and 2.17% respectively. Further the results indicate that increased investment in manufacturing sectors of the economy in presence of agricultural output constraint may have unfavourable impact on social welfare.

6.8 Export promotion and import substitution

Export promotion and import substitution are the two competing strategies of economic development and the choice between them has been subject matter of discussion among policy makers. In a developing country, this choice is crucial because both of them affect (i) the foreign exchange reserve which is considered to be one of the most important factors limiting growth and (ii) income distribution and poverty in an economy through their influence on the level and pattern of output and prices. It is often suggested that for developing countries promotion of labour intensive manufacturing exports will help reducing poverty. For example, Ranis (1973), with reference to experence in Far-East countries, calls it a 'conventional wisdom' to export labour intensive manufacturing goods for reducing unemployment and poverty in labour surplus developing countries.

Import substitution, on the other hand, is generally discouraged on the ground that most of import substitution in developing countries has been capital intensive in nature and, therefore, has contributed relatively little towards reducing poverty and income inequality. Moreover, it has been argued that, scope of import substitution in agriculture, where most of the poor earn their income, is rather limited, and consequently the relative position of the poor will worsen with capital intensive import substitution in manufacturing sectors. Thus it has been emphasized by several authors (eg. Kervis (1973), Krueger (1970), Little, Scitovsky and Scott (1970) etc.) that countries adopting import substitution industrilization policy may have unfavourable impact on domestic distribution of income and poverty.

In so far as the relationship between foreign trade and income distribution is concerned one may have two different kinds of relationship viz. effect of income redistribution on foreign trade and that of foreign trade on income distribution. Income redistribution affect foreign trade position to the extent production of some consumption goods rely more heavily on imports than others. More specifically, it has been generally argued that total import content of the consumption of the low income group being less than that of high income group population, any redistribution of income in favour of poor will ease the foreign constraint in the economy. This sort of mechanism has been explored in a number of studies e.g. by Pyatt et al (1972), Paukert, Maton and Skolka (1974) etc. Foreign trade, on the otherhand, affect distribution of income via its impact on the level and pattern of output and prices in the economy.

Ideally the comparision of export promotion and import substitution strategy should be done in a frame work which captures the above mentioned two-way relationship between foreign trade and income distribution. In this context it may be mentioned that recently Mohammad (1981) used a model, developed by Paukert, Skolka and Maton (1974) based on Pyatt's methodology, to study the effectiveness of these policies for achieving economic growth and reducing income in equality in Indian Economy. This model, which is a standard semi-closed IO model, however, captures one way relationship of income redistribution with foreign trade and can be used for studying the impact of income redistribution on foreign trade[7]. But Mohammad (1981) surpassed the scope of the model by using it for studying the impact of foreign trade on income distribution. Thus although he assumes that " trade by bringing about higher levels of employment may reduce income inequality" (Mohammed (1981) pp. 132), he had to keep the income distribution parameter fixed under

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[7] We shall latter point out certain limitations of this model, for studying relationship between income distribution and growth, particularly in developing countries, while comparing this model with ours.

alternative export-promotion and import-substitution schemes. However, the export promotion and import-substitution strategies, although reduces poverty, may, in fact, increase income inequality, as revealed in the present study.

Here our purpose is to estimate and compare, in Indian context, the impact of export promotion and import substitution, on poverty, income inequality and other important macro-economic aggregates like GDP, employment, savings etc. For this we shall simulate the basic model with alternative schemes of export promotion and import-substitution (see Tables 6.17 and 6.20). It may be mentioned that poverty and income distribution in the basic model are endogenously determined considering the distribution of factor income in different productive sectors and the interaction between output, price and income distribution. In the basic model any redistribution of income will affect the foreign trade via its impact on level and pattern of output and prices in the economy. On the other hand, any change in foreign trade either through export promotion or import substitution, will affect the distribution of income via its impact on level and pattern of output and prices. Thus the basic model captures the two-way relationship between foreign trade and income redistribution. Moreover, the impact of foreign trade policy on income distribution and poverty, in presence of agricultural output constraint, which is typical in developing countries, can also be studied by the basic model.

The effect of foreign trade policies on poverty, inequality and other macro-economic variables may be studied by analysing the quantitative impact of volume and structure of export and imports under alternative export promotion and import substitution schemes. In the basic model their impact are estimated considering the interaction between output, price and income

Table 6.17 : Description of Alternative Export Promotion Schemes

Case Nos.	Description of alternative cases
(1)	(2)
1	Exports of exportable sectors increased by 10 percent.
2	Case 1 with output of sector 1 (foodgrain) fixed at basic solution level.
3	10 percent rise in traditional exports of sectors 1, 2, 3, 4 and 6 through 12.
4	Case 3 with output of sector 1 fixed at basic solution level.
5	10 percent rise in non-traditional exports of sectors 5 and 13 through 28.
6	Case 5 with output of sector 1 fixed at basic solution level.

distribution in the economy. Alternative export promotion and import substitution strategies affect this interaction process via their impact on the level and pattern of aggregate demand and prices in the economy. It may be noted that for evaluating the alternative trade strategies our approach is comparative static in nature as we simulate the basic model with alternative trade strategies and compare the equilibrium solution with the 'basic solution' for analysing their impact on Indian economy.

6.8.1 Economic impact of changes in level and pattern of export

In recent years there has been much emphasis on export promotion in India for meeting the increasing demand for imports and also to utilise the ideal capacity of domestic industries. Consequently government of India has given various incentives for export promotion and Indian exports have changed both in terms of volume and composition. Thus for the year 1979-80 Indian exports accounted for about 7.31% of GDP at market prices [CSO (1982)] of which about 50% consists of agricultural and food products and 30% consists of manufacturing products.

For analysing the impact of volume and pattern of exports on Indian economy we consider six alternatives as described in Table 6.17. The first two alternatives are concerned with impact of volume of export in absence and presence of agricultural output constraints. The remaining alternatives mainly analysis the impact of pattern of exports. For this we have divided the exports into two groups viz. traditional export and non-traditional export. Traditional exports mainly originate from sectors like agricultural food products, mining and textiles. The non-traditionals are mainly manufacturing products. The impact of increase in traditional and non-traditional export are also analysed under alternative agricultural output constraint in the economy. (Alternative cases 4 and 6).

Table 6.18 contains the macro-economic impact of alternative volume and pattern of export on Indian economy. It is found that 10 percent increase in volume of exports, keeping the pattern same as in the year 1979-80, increases the GDP, private consumption and employment respectively by 1.40, 1.28 and 1.32 percent and when there is no agricultural output constraint in the economy. However, in presence of agricultural output constraint, this favourable impact of increase in export is much reduced as it can be seen comparing the results of alternative 1 and alternative 2. It is interesting to note that increase in volume of export is also accompanied by increase in import demand. Thus

Table 6.18 : Macro-economic Aggregates under Alternative Export Promotion Schemes : Comparision with Basic Solution

Economic Indicators Case No.	GDP at factor cost	Indirect tax less subsidy	Import	Private consumption	Employment	Savings ratio	Aggregate consumer price index
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	101.43	104.28	101.64	101.28	101.32	101.31	100.00
2	101.03	103.95	101.03	109.99	101.05	100.89	100.93
3	100.54	100.30	100.72	100.49	100.28	100.56	100.00
4	100.34	100.34	100.68	100.11	100.18	100.28	100.32
5	100.49	100.59	100.97	100.32	100.20	100.50	100.00
6	100.44	100.56	100.94	100.26	100.16	100.42	101.63

10 per cent increase in exports, in absence of any agricultural output constraint, increases imports by 1.64 per cent. Increase in volume of export also have favourable impact on the aggregate domestic savings rate of the economy. This increase (of about 1.3 per cent) is mainly due to increase in government revenue from export duties arising out of increased volume of exports. Foreign exchange position also show improvement due to increased exports, declining the foreign savings rate by 2.0 per cent.

Analysis of impact of pattern of export as considered in alternatives 3, 4, 5 and 6 show that export promotion of traditional sectors have more favourable impact on GDP, consumption, employment than that of non-traditional exports. This may be explained by the fact that increase in traditional export shift structure of production towards such industries where employment and value-added per unit of output is much higher than those resulting from increase in non-traditional sectors. Such changes in structure of production is induced through a change in pattern of consumer demand caused by change in pattern of export in the economy. However, this positive impact of change in pattern of export is much reduced if there is constraint on the agricultural output in the economy. Thus we see that 10 per cent increase in traditional export (alternative case 3) increases GDP, consumption and employment by 0.54 per cent, 0.49 per cent and 0.28 per cent respectively. The corresponding change due to 10 per cent increase in non-traditional export are 0.49 per cent, 0.32 per cent and 0.20 per cent respectively. Moreover, it is seen that increase in traditional export in presence of agricultural output constraint has more detrimental effect on the economy than that of non-traditional export.

Impact of increase in volume of exports and change in pattern of export on the poor and the non-poor are presented in Table 6.19. Results (alternative case 1) show that monthly per capita income and consumption of both the poor and the non-poor increases due to increase in volume of exports. However, the increase in income and consumption for the non-poor is much higher than that of the poor. Thus we see that while 10 per cent increase in export results in 1.55 per cent increase in income of the non-poor, the corresponding increase for the poor is about one per cent. In presence of agricultural output constraint (alternative case 2) even this positive impact on poor is turned into adverse impact. In such a situation the income of the poor falls by 34 per cent while that of the non-poor increases by 1.72 per cent. This is because export promotion in presence of agricultural output constraint causes demand pull increase in prices of agricultural products which, in turn, increases the prices of industrial products. This increase in prices increases

Table 6.19 : Economic Profile of Target and Non-target Group under Alternative Export promotion Schemes : Comparision with Basic Solution

Economic Indicators / Case No.	Percentage of		Dependency ratio		Monthly P.C. income	
	Poor	Non-Poor	Poor	Non-Poor	Poor	Non-Poor
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	98.79	100.01	98.72	99.32	100.95	101.55
2	101.47	98.62	101.09	100.09	99.51	101.72
3	99.01	99.87	99.60	99.20	100.25	100.85
4	101.34	98.74	99.70	99.21	99.70	101.22
5	99.24	98.24	99.97	99.22	100.06	100.98
6	100.12	99.88	99.70	99.25	99.91	100.15

Contd.../-

Table 6.19 : Economic Profile of Target and Non-target Group under Alternative Export Promotion Schemes : Comparision with Basic Solution

(Continued)

Economic Indicators : Case No.	Consumer price index		Poverty (Sen's Index)	Inequality (Lorentz Ratio) Income, consumption
	Poor	Non-Poor		
(1)	(8)	(9)	(10)	(11)
1	100.00	100.00	99.29	100.92, 100.57
2	101.14	101.08	100.92	102.73, 102.56
3	100.00	100.00	99.68	101.65, 100.17
4	101.22	100.29	100.40	100.32, 100.13
5	100.00	100.00	99.75	100.19, 100.18
6	100.17	100.15	100.32	100.25, 100.18

the aggregate profit of the economy and the nominal income of the non-poor increases. Moreover, increase in consumer price index for the poor (1.14 per cent) is more than that of the non-poor (1.08 per cent) as the terms of trade shifts towards agriculture due to increase in export in presence of agricultural output constraint. Consequently the distribution of real income shifts against the poor.

Analysis of impact of pattern of export reveals that increase of traditional export has comparatively more favourable impact on the poor than that of the non-traditional export. Thus comparision of alternatives (3) and (5) show that while 10 per cent increase in traditional export increases the income of the poor by 0.25 per cent, the corresponding increase for non-traditional export is only 0.06 per cent. The increase in income and comsumption of the non-poor, however, is relatively more than that of the poor for ~~increase~~ increase in both traditional and non-traditional export. Finally it may be noted that expansion of traditional export hurt the poor more than the non-traditional export when there is agricultural output constraint in the economy [alternative cases (4) and (6)].

Percentage of poor, Sen's index of poverty decline as a result of export promotion, provided there is no agricultural output constraint in the economy. Thus 10 per cent increase in volume of export reduces the percentage of poor by 1.21 per cent and the Sen's index by 0.71 per cent. However, if there is agricultural output constraint in the economy both the percentage of poor and Sen's index increase by 1.47% and 0.92 per cent respectively due to 10.0% increase in volume of exports. Further, it may be seen that expansion of traditional export has more favourable impact on poverty than that of the non-traditional export. This is mainly because traditional exports originate from such sectors which are more labour intensive and whose share of income among poor is more than the industries from which non-traditional exports originate. However, in presence of agricultural output constraint in the economy, poverty increases due to expansion of both traditional and non-traditional exports. Results on impact of inequality due to increase in volume of export and change in pattern of export show that export promotion strategies accentuates inequality. This is due to the fact that expansion of export increases both employment income and profit income of the economy. While a portion of employment income accrues to the poor, the entire increase of profit income and the residual employment income are appropriated by the non-poor. Thus we see that 10 per cent increases in export increase the income and consumption inequality (Lorentz ratio) by 0.92 per cent and 0.57 per cent respectively. In presence of agricultural output constraint the corresponding increase are respectively 2.73 per cent and 2.56 per cent. Further it may be seen that inequality accentuating effect of non-traditional export is more than that of the traditional export.

6.8.2 Economic impact of import substitution

Import in India for the year 1979-80 as estimated by CSO (1982) was about 9.0 per cent of the GDP at market prices, of which about 68.32 per cent was intermediate import and 31.68 per cent was import for final use. In the import for final use the share of consumption (private and government consumption taken together) was 58.54 per cent, while that of investment was 41.46 per cent. At the sectoral level, the major import using sectors are petrolium and natural gas (34.12%), Metal products (16.01%) Petrolium and coal products

(15.01%), Machine tools (15.0%), fertilizer (10.01%), paper and wood products (2.98%) and agriculture (2.67%).

In order to study the effect of import substitution we consider import substitution in both intermediate as well as final use. Further, to compare the effect of import substitution at individual sectors we mainly consider the major import using sectors viz. petrolium industry, Metal products, Machine tools, and fertilizer. The description of different import substitution schemes considered for analysis is given in Table 6.20.

Table 6.20 : Description of Alternative Import Substitution Schemes

Case No.	Description of alternative cases
(1)	(2)
1	10 percent import substitution in all importing sectors.
2	Case 1 with output of sector 1 fixed at basic solution level.
3	10 percent import substitution in machine tools industries.
4	10 percent import substitution in petrolium industry.
5	10 percent import substitution in metal product industry.
6	10 percent import substitution in fertilizer industry.

Results of Table 6.21 show that 10 per cent import substitution in all import using sectors increase the GDP, consumption and employment by 0.98 percent, 0.84 percent and 0.94 percent respectively. Aggregate import requirement subsequently fall by 4.76 per cent and aggregate savings rate increases by 2.76 per cent. Thus we see that import substitution, in general, have favourable impact on GDP, consumption and employment - although this positive impact is much less than that of corresponding increase in export. Moreover, in presence of agricultural output constraint this favourable impact is further reduced as it can be seen by comparing results of alternative (1) with that of alternative (2). At the sectoral level it may be seen that 10 per cent import substitution in petrolium industry has comparatively larger impact on the different economic variables than the same level of import substitution in other sectors. Thus it is found from the results of alternatives (4) and (5) that while 10 per cent import substitution in petrolium industry increases GDP, consumption and employment respectively by 0.85 per cent, 0.69 per cent and 0.87 per cent, the corresponding increase for import substitution in metal

Table 6.21 : Macro-economic Aggregates under Alternative Import substitution Schemes : Comparision with Basic Solution

Economic Indicators Case No.	GDP at factor cost	Indirect tax less subsidy	Import	Private consumption	Employment	Savings ratio	Aggregate consumer price index
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	100.98	101.43	95.24	100.84	100.94	102.76	100.00
2	100.36	99.35	90.61	100.20	100.29	102.98	100.32
3	100.14	100.34	99.74	100.12	100.20	100.79	100.00
4	100.85	100.49	97.24	100.69	100.87	101.31	100.00
5	100.44	100.56	98.23	100.35	100.46	100.89	100.00
6	100.11	100.59	99.14	100.10	100.16	101.82	100.00

Table 6.22 : Economic Profile of Target and Non-target Group under Alternative Import Substitution Schemes : Comparision with Basic Solution

Economic Indicators Case No.	Percentage of		Dependency ratio		Monthly P.C. income	
	Poor	Non-poor	Poor	Non-poor	Poor	Non-poor
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	99.39	100.52	99.47	98.57	100.32	100.99
2	101.21	98.86	99.82	100.52	99.66	101.19
3	99.95	100.42	99.90	94.13	100.11	100.45
4	99.43	100.46	99.78	99.20	100.14	100.69
5	99.68	100.43	99.86	99.19	100.13	100.57
6	99.97	100.45	99.93	99.20	100.09	100.40

Contd.../-

Table 6.22 : Economic Profile of Target and Non-target Group under Alternative Import Substitution Schemes : Comparision with Basic Solution

(Continued)

Economic Indicators Case No.	Consumer price index		Poverty (Sen's Index)	Inequality (income, consumption) Lorentz ratio
	Poor	Non-poor		
(1)	(8)	(9)	(10)	(11)
1	100.00	100.00	99.60	101.07, 101.02
2	100.34	100.32	101.86	101.69, 101.92
3	100.00	100.00	99.85	100.16, 100.15
4	100.00	100.00	99.75	100.35, 100.29
5	100.00	100.00	99.80	100.32, 100.27
6	100.00	100.00	99.84	100.18, 100.14

products industry are 0.44 per cent, 0.35 per cent and 0.46 per cent. It is expected because import content of petrolium industry is much greater than that of metal product industry and, therefore, import substitution in petrolium has greater impact on domestic production. The other two industries show more or less same effect on GDP, employment and consumption.

Economic impact of import substitution, both overall as well as sectoral, on the poor and the non-poor are presented in Table 6.22. It is seen that due to 10 per cent import substitution the income of the poor increases by 0.32 per cent while that of the non-poor increases by about 1.00 per cent. As in case of export promotion, this favourable impact of import substitution on the poor becomes adverse in presence of agricultural output constraint in the economy. Thus it can be seen from results of alternative (2) that, if there is agricultural output constraint, 10 per cent import substitution reduces the income of the poor by 0.34 per cent but increases the income of the non-poor by 1.19 per cent. At the sectoral level it is seen that import substitution in petrolium industry has comparatively larger impact on the economic condition of the poor and the non-poor than the corresponding import substitution in other industries. Further it may be noted that import substitution reduces poverty if there is no agricultural output constraint in the economy. This favourable impact of import substitution on poverty is however, much less than that of export promotion. Finally, it is interesting to note that increase in inequality due to import substitution is more than that due to export promotion.

6.8.3 Welfare evaluation of alternative export promotion and import substitution schemes

Welfare impact of export promotion and import substitution strategies, as measured by indices of per capita utility, are presented in Tables 6.23 and 6.24 respectively. Change in per capita utility indices over the basic solution per capita utility level suggest that both export promotion and import substitution have positive welfare impact, although under 'poverty weights' social welfare evaluation only export promotion strategies yeild improvement in welfare indices. However, increase in per capita utility level under export promotion is more than that of import substitution. Moreover, the strategy of promoting traditional exports seems to be more effective for increasing social welfare than that of non-traditional exports.

6.9 Conclusion

The policy simulations considered in this chapter were primarily meant for demonstrating the major characteristics of some redistributive policy instruments in terms of their impact on income distribution and poverty. Our analysis demonstrated the crucial role that the agricultural sector plays in tackling the problems of income distribution and poverty in India. Effectiveness of any policy instrument in this regard was found to very much depend upon its impact on agricultural production, employment and prices. Thus we found that increase in agricultural production and reallocation of investment towards agricultural sector improve the poverty situation considerably. Similarly subsidy on agricultural inputs and foodgrain output have significantly favourable impact on the economic position of the poor. Increase in minimum wage along with subsidies on agricultural input and output

Table 6.23 : Per capita Utility and its change over Basic Solution Utility Level under Alternative Export promotion Schemes

Alternative case number	Per capita utility		Percentage change in per capita utility	
	Equal weights	Poverty weights	Equal weights	Poverty weights
(1)	(2)	(3)	(4)	(5)
1	4.47	5.69	100.45	101.61
2	4.46	5.54	100.22	98.93
3	4.47	5.67	100.45	101.25
4	4.45	5.54	100.00	98.93
5	4.46	4.62	100.22	82.50
6	4.45	4.58	100.00	81.78

Table 6.24 : Per capita Utility and its change over Basic Solution Utility Level under Alternative Import Substitution Schemes

Alternative case number	Per capita utility		Percentage change in per capita utility	
	Equal weights	Poverty weights	Equal weights	Poverty weights
(1)	(2)	(3)	(4)	(5)
1	4.46	4.62	100.22	82.50
2	4.45	4.54	100.00	81.07
3	4.46	4.66	100.22	83.21
4	4.46	4.61	100.22	82.32
5	4.46	4.60	100.22	82.14
6	4.46	4.59	100.22	81.96

was also found to be quiet effective for eradicating poverty and reducing income inequality. However, effectiveness of this policy crucially depends upon its impact on agricultural production and employment. This, on the other hand, will depend upon the responsiveness of agricultural farmers to price incentives and also upon the working of agricultural labour market. Moreover, as the minimum wage policy has well known operational limitations and the subsidies put heavy pressure upon the budgetory resources of the economy this strategy appears less attractive than agricultural investment policy. In this content we should note that our analysis in this chapter suffers from one important methodological limitation. The limitation follows from the lack of integration of income distribution with growth in the basic model. This is an important limitation as evaluation of different redistributive policies should be based upon both distributional and growth effect of the policy instruments and should also consider the 'present' as well as 'future' income change of the poor and the non-poor. In the chapters that follow we try to over come this limitation by integrating growth and income distribution in a plan model and use it for reevaluating the different redistributive policy instruments.

CHAPTER 7

The Planning Model

7.1 Introduction

The policy analysis considered in Chapter 6 should be viewed as illustration of the major characteristics of the different growth and redistribution strategy. But the scope of these analyses are necessarily limited as income distribution and growth are not completely integrated with each other in the basic model. As a result, impact of different redistributive policies on the poor are evaluated in isolation from that of growth and investment policies. But ideally they should be examined conjointly as redistribution and growth are interrelated with each other. The basis of this integration is that income redistribution affects economic growth via its impact on the investible resources of the economy; and economic growth, in turn, influences income distribution process by affecting level and structure of output and prices. Moreover, as effect of growth and income redistribution take time to work themselves out, it is necessary to consider the policy analysis within a specific time frame of analysis so that one can compare the impact of any redistributive policy over time and can translate them into specific strategies for achiving targets of poverty and inequality reductions. Consideration of this two-way linkage between income distribution and growth within a specific time frame would also clearly bring into focus both long run and short run impact of different redistributive policies and help to estimate the trade-off between redistribution and growth. Our objective in this part of the study is to integrate income distribution and growth in a planning model and use it for evaluating the impact of different redistributive policies on growth of income of the poor and the non-poor. Moreover, we shall use this model for (a) comparing two alternative approaches towards poverty reduction viz. growth manimisation approach and inequality reduction approach, and (b) estimating the 'trade-off' between short run income redistribution and long run growth of income and consumption of the poor[1/].

7.2 Structure of the Plan Model

Integration of income distribution and growth in a plan model, however, requires addition of new dimensions to the traditional plan model[2/]. First, the distribution of income between the poor and non-poor should be determined within the model structure by tracing their income linkage with different productive sectors and identifying the forces that affect their economic position. Thus, private consumption in such a model gets estimated endogenously from the disposable income of the two groups of population. Second, major requirement is that the import should also be estimated endogenously from the sectoral requirement of import for both intermediate and final use. Endogenous treatment of private consumption and import, therefore, will enable one to study the repurcussion of income redistribution on households and foreign savings which are supposed to be two major constraints of economic growth in a developing economy. Next, in order to capture the impact of growth on income distribution the level and structure of investment, which affect the level and structure of output and prices, should be linked with aggregate as well as sectoral rates of growth of

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1/ The terms 'short run' and 'long run' used in this study refer only to relative distance of two future points of time from the base year. Thus terminal year, which is relatively near to the base year than the perspective year, indicates end of short run period.

2/ We shall review treatment of income distribution and poverty in the traditional planning model constructed in Indian context and compare them with our own treatment.

the economy. Fourth, these growth rates have to be estimated endogenously in the system in such a way that the growth programmes achieve the 'targets' at the specified points of time. These considerations, however, require that (a) static consistency between output, price, income and/or consumption distribution at each point of time and (b) intertemporal consistency between investment at one period and growth of output and investment at subsequent period, are maintained within the model.

7.2.1 A few additional notations

Most of the notations used in the description of the Plan Model have already been explained in section 3.2.1 of Chapter 3. Additional notations used in this chapter are given below. As already stated earlier subscripts i, j refer to input output sectors and subscript k refers to wage classes. Superscript 'T' refer to perspective year.

a_j = employment coefficient.

ΔS_i = change in stock.

E = aggregate export at current market price.

G = government consumption at current market price.

I = gross investment at current market price.

M = aggregate import at current year c.i.f. price.

p_v = GDP deflator.

R = post-terminal rate of growth of GDP.

R_j = post-terminal rate of growth of sectoral capacity value-added.

x^*_{j0} = base year output at the base year factor cost.

α_j = intercept in sectoral investment function.

B_{ij} = (i, j)th element of capital coefficient matrix.

η_j = employment elasticity.

θ_j = sectoral gestation period.

k_j = sectoral incremental capital output ratio (ICOR).

r^* = desired annual compound growth rate in GDP during plan period.

UT_j = capacity utilization factor.

Targets in the plan model :

α_*^T = Percentage reduction in the income - gap ratio of the poor at the perspective year over the base year.

β_*^T = percentage of population in the target group at the perspective year.

y_* = terminal year GDP at base year factor cost.

7.2.2 Time frame and plan targets

The time frame of analysis is provided by two future points of time, called 'terminal year' and 'perspective year' vis-a-vis the 'given' base year. The base year is 'given' in the sense that output, price, income distribution and other macro economic variables of the base year are taken as data in the plan model. These two points of time also define two periods viz. 'plan period', that is the period between 'base year' and 'terminal year' and 'post-plan period' that is the period between terminal year and perspective year. In the present study the base year, terminal year and the perspective year are 1979-80, 1984-85 and 1994-95 respectively.

The 'terminal year' therefore indicates the end of an economic plan and reflect the achievement during the plan period as compared with its different short run and long run objectives of economic planning. Moreover, the terminal year, because of its nearness to the base year, is subject to certain constraints viz. agricultural output constraint, savings constraint, skill constraint of the poor population etc. which can not be removed during the plan period. These constraints, as we will see latter, play an important role in determining the output, prices, income/consumption distribution at the terminal year. Perspective year, on the other hand, sets a time limit for realising the long run objective of planning and is subject to none of the terminal year constraints which have been removed by successive plans during the post plan period. Terminal and perspective year models are interdependent because perspective year targets determine the level and structure of terminal year investment which, in turn, influence the level and structure of output, investment and consumption at the perspective year.

Targets in the plan model are set in terms of aggregate national income (GDP) at the terminal year and poverty alleviation objective at the perspective year. In the present model terminal year GDP target has been set by assuming some desired rate of growth in GDP over the plan period. Thus if y_0 is the GDP at factor cost in the base year and r^* is the desired annual compound growth rate in GDP during the five year plan period then the targeted GDP at the terminal, y_*, is given by

$$y_* = y_0 (1 + r^*)^5 \qquad \ldots\ldots (1)$$

Perspective year poverty alleviation objectives are set in terms of a stipulated reduction in the percentage of the poor and an increase in the per capita consumption of the poor at the perspective year over that at the terminal year. Thus if α_*^T denotes the targeted percentage reduction in the income gap of the poor at the perspective year over at the same at the terminal year then α_*^T is given by

$$\alpha_*^T = \left\{ 1 - (\pi_0 - \bar{c}_b^{\,T}) / (\pi_0 - \bar{c}_b) \right\} \qquad \ldots\ldots (2)$$

where $\bar{c}_b$ and $\bar{c}_b^{\,T}$ are monthly per capita consumption of the poor, valued at base year market price, at the terminal year and perspective year respectively; and π_0 is the 'poverty line' at base year price. Given α_*^T as perspective year target and $\bar{c}_b$ endogenously determined by the terminal year income distribution and consumption model one can determine the perspective year per capita consumption of the poor from the above relation (2). The per capita consumption of the non-poor can then be determined from the aggregate private consumption as derived from the perspective year macro model and the targeted percentage of people below poverty line at the perspective year, β_*^T. The macro economic targets reflect the short run objective of increasing the per capita national income and long run objective of reducing poverty and inequality in aggregate consumption vis-a-vis their corresponding terminal year values. Moreover, as the consumption in the terminal year is endogenously determined for given GDP these targets enable one to study the 'trade-off' between income redistribution at the terminal year and growth of consumption of the target and non-target groups during the post-terminal period. With these targets and time frame of analysis the plan model integrates growth and income distribution in a two-period intertemporal framework through a system of interdependent macro and sectoral models defined for the terminal and the perspective year.

7.2.3 Terminal year equations

The economic mechanism of determining output, price and distribution of income at the terminal year is same as that of the basic model except that fixed capital investment, by destination as well as origin and 'change in stock', which were exogenous elements, are now determined endogenously in the plan model. It may be recalled that in the basic model, we consider different rules of price and output determination in agriculture and industry. Thus prices of commodities produced in the subsystem S_1 consisting of agricultural sector are determined by forces of demand and supply, while prices of those produced in the subsystem S_2 consisting of non-agricultural sectors are cost determined. Accordingly output of sectors belonging to S_1 are either exogenously specified or determined by supply response function and that of the sectors belong to S_2 are determined by demand. Sectoral employment are determined by sectoral output on the basis of employment elasticities. Unlike the basic model, the sectoral labour coefficients are endogenously determined in the plan model. Distribution of income between the poor and the non-poor are determined by sectoral output and prices from the distribution of sectoral employment over different wage earning classes. Thus the output, price and distribution of income at the terminal year are determined from the following equations.

Output

$$x_i = x_{ai} / (1 - a_{ii}), \qquad \forall \ i \ \varepsilon \ S_1 \qquad \ldots\ldots (3)$$

$$x_i = \sum_{j=1}^{n} a_{ij} . x_j + C_i + I_i + G_i^* + E_i^* + \Delta S_i - M_i, \qquad \forall \ i \ \varepsilon \ S_2 \qquad \ldots\ldots (4)$$

Employment

$$EL_i = EL_{0i} \, (x_i \,/\, x^*_{i0})^{\eta_i} \qquad \ldots\ldots (5)$$

$$a_i = EL_i / x_i \qquad \ldots\ldots (6)$$

Price

$$p_{rj} = Dd_j / S_{0j}, \qquad \forall \;\; j \;\; \varepsilon \;\; S_1 \qquad \ldots\ldots (7)$$

$$p_j = (1 + r_j) \Big[\sum_{i=1}^{n} a^d_{ij} \; p_i \, (1 + t_i) + \sum_{i=1}^{n} a^m_{ij} \, p_{mi} \, (1 + t_{mi})$$

$$+ \, a_j \sum_{k=1}^{s} e_{kj} \cdot w_k \Big], \quad \forall \;\; j \;\; \varepsilon \;\; S_2 \qquad \ldots\ldots (8)$$

Income distribution

$$y_b = \sum_{i=1}^{n} \sum_{k=1}^{[k_0]/Y} e_{ik} \cdot w_k \cdot EL_i \qquad \ldots\ldots (9)$$

$$y_a = (1 - t_d) \Big[\sum_{i=1}^{n} \sum_{k=[k_0]/Y+1}^{s} e_{ik} \cdot w_k \cdot EL_i$$

$$+ \, (1 - t_c) \, (1 - s_c) \, PF_r + TRS^* \Big] \qquad \ldots\ldots (10)$$

$$\beta = Q_b \, \Big(\sum_{i=1}^{n} \sum_{k=1}^{[k_0]/Y} e_{ik} \cdot EL_i \Big) / \, P^* \qquad \ldots\ldots (11)$$

$$k_0 = Q_b \cdot \; \pi_0 \cdot \; p_{cb} \qquad \ldots\ldots (12)$$

$$Q_b = Z^*_0 \, \Big(P^* \,/ \sum_{i=1}^{n} EL_i \Big) \qquad \ldots\ldots (13)$$

where

x_{ai} = output net of self input for sector i.

x_i = gross output of sector i.

p_i = producer's price of sector i.

p_{rj} = market price of sector j

Dd_j = domestic final demand of sector $j \in S_1$

S_{0j} = domestic market supply of sector j at constant market prices $j \in S_1$

r_j = mark up for sector $j \in S_2$

e_{jk} = proportion of total employment in sector j falling in kth wage class.

w_k = average annual wage rate in kth wage class.

a^d_{ij}, a^m_{ij} = input-output coefficient with domestically produced and imported inputs.

y_b = aggregate income of the poor.

y_a = aggregate income of the non-poor.

β = percentage of people below poverty line.

k_0 = normative wage rate.

Q_b = dependency ratio of the poor.

As mentioned above, x_i in equation (3) is either exogenously specified or determined by (3) using the following supply response function for net output (x_a) of a particular sector (foodgrain) belonging to S_1

$$x_a = D.\, p_a^{(a+b)/c} .\, w^{-a/c} \left[p_f \, (1 + t_f) \right]^{-b/c} \qquad \ldots\ldots (14)$$

where

p_a, p_f = producer's price of foodgrain (sector 1) and fertilizer (sector 19) respectively as determined in the price model.

$$w = \sum_{k=1}^{s} e_{1k} \cdot w_k$$

= average wage rate for sector 1

t_f = indirect tax/subsidy on fertilizer

D, a, b and c (= 1 - a - b) are constants.

Among different components of final demand at the terminal year, private consumption demand, fixed capital investment demand and 'change in stock' are endogenously determined, the remaining components being exogenously fixed in real terms. Private consumption demand is endogenously estimated on the basis of output-income-price-consumption relation for the two groups of population as explained in Chapter 3 and, therefore, depends upon prices and distribution of income between the poor and the non-poor. Fixed capital investment demand by destination as well as origin are determined from accelerator type relation between fixed capital investment at the terminal year and post terminal rates of growth as explained in section 6.7.1 of Chapter 6. Sectoral rates of growth which were treated as exogenous elements there, are, however, determined, endogenously in the plan model. Sectoral 'change in stock', on the other hand, are determined by applying exogenously given 'stock coefficients' on the change in sectoral output. Aggregate as well as sectoral private consumption and investment demand and 'change in stock' at the terminal year, are, therefore, determined from the following equations.

Private consumption

$$c_b = y_b / \beta \cdot p^* \qquad \ldots\ldots (15)$$

$$c_a = y_a (1 - s_h)/(1 - \beta) \cdot p^* \qquad \ldots\ldots (16)$$

$$c_{ir} = \sum_{m=1}^{4} p^m \left\{ a_i^m \cdot p_{ri} + b_i^m \left(c^m - \sum_{j=1}^{m} a_j^m \cdot p_{rj}\right) \right\} \qquad \ldots\ldots (17)$$

$$C_i = c_{ir}/p_{ri} (1 + t_{coi}) \qquad \ldots\ldots (18)$$

Fixed capital investment

$$U_j = \alpha_j + d_j \cdot V_j + k_j \cdot V_{jc} \left\{ (1 + R_j)^{\theta_j} - 1 \right\} / \theta_j \qquad \ldots\ldots (19)$$

$$I_i = \Sigma B_{ij} \cdot U_j / (1 + t_{coi}) \qquad \ldots\ldots (20)$$

Change in stock

$$\Delta S_i = s_i (x_i - x_{i0}^*) \qquad \ldots\ldots (21)$$

where

c_b = per capita consumption of the poor

c_a = per capita consumption of the non poor.

c_{ir} = aggregate sectoral consumption at current market price.

C_i = aggregate sectoral consumption at base year factor cost.

U_j = investment by destination at base year market price.

I_i = investment by origin at base year factor cost.

ΔS_i = change in stock.

Sectoral import are determined by sectoral output and final demand using sectoral import coefficients of intermediate use and final demand.

Import

$$M_i = \sum_{j=1}^{n} a_{ij}^{m} \; x_j + h_i \; (C_i + I_i + G_i^{*}) \qquad \text{..... (22)}$$

7.2.4 Perspective year equations

Perspective year GDP (Y^T) is determined by the (unknown) post-terminal aggregate rate of growth of GDP (R) over the ten year 'post-terminal' period, defined by equation (23), and the given (targeted) terminal year GDP (y_*). Thus

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$$Y^T = y_* \, (1 + R)^{10} \qquad \text{..... (23)}$$

The perspective year macro model than gives the macro-economic relation between GDP and other uses of national income at the perspective year

$$Y^T \, p_v + T_y = C^T + I^T + G^T + E^T - M^T \qquad \text{..... (24)}$$

where

p_v = GDP deflator

T_y = total indirect tax less subsidy at the perspective year.

C^T = aggregate private consumption.

I^T = gross investment.

G^T = government consumption.

E^T = export.

M^T = import.

Aggregate private consumption at current market price at the perspective year (C^T) is then determined residually from equation (24) after deducting aggregate gross investment (I^T), government consumption (G^T) and net export ($E^T - M^T$) from the perspective year GDP at current market price ($Y^T p_v + T_y$).

The aggregate per capita consumption at current price of the poor (c_b^T) and the non-poor (c_a^T) are then obtained from the perspective year poverty alleviation targets (α_*^T, β_*^T). Sectoral consumption are obtained in the same way as in the terminal year. It may be noted that consumption of the poor and the non-poor at the perspective year are not endogenised on the basis of income-consumption relation as done at the terminal year; instead they are determined by the perspective year targets. Thus the aggregate per capita consumption of the two groups of population and the sectoral private consumption (C_i^T) are determined by the following equations.

$$c_b^T = [\, \alpha_*^T \cdot \pi_0 \cdot p_{cb} + (1 - \alpha_*^T)\, c_b \,] \qquad \ldots\ldots (25)$$

$$c_a^T = (C^T - c_b^T \cdot \beta_*^T \cdot P_*^T)/(1 - \beta_*^T) \cdot P_*^T \qquad \ldots\ldots (26)$$

$$c_i^T = \sum_{m=1}^{4} P^{mT} \left\{ a_i^m \cdot p_{ri} + b_i^m \left(c^{mT} - \sum_{j=1}^{n} a_j^m \; p_{rj} \right) \right\} / p_{ri}(1 + t_{coi}) \qquad \ldots\ldots (27)$$

where

α_*^T = targeted percentage reduction of income gap of the poor at the perspective year over the same at the terminal year.

β_*^T = targeted percentage of people below poverty line at the perspective year.

p_{cb} = consumer price index for the poor.

P^{mT} = total population in mth socio-economic group at the perspective year.

P_*^T = total population at the perspective year.

Sectoral fixed capital investment demand at the perspective year are determined on the basis of same accelerator type relation between investment for capacity expansion and post-perspective year rate of growth. The post-perspective year sectoral rates of growth are <u>assumed</u> to be the same as the corresponding post-terminal rate of growths which are treated as unknown variables in the system. Sectoral change in Stock (ΔS_i^T) and import (M_i^T) are obtained in the same way as the terminal year. Aggregate gross investment (I^T) and import (M^T) are then obtained as total of their corresponding sectoral estimates.

<u>Aggregate and sectoral investment</u>

$$U_j^T = \alpha_j + d_j . V_j^T + k_j \cdot V_{jc}^T \left\{ (1 + R_j)^{\theta_j} - 1 \right\} / \theta_j \qquad \ldots\ldots (28)$$

$$I_i^T = \sum_{j=1}^{n} B_{ij} . U_j^T / (1 + t_{coi}) \qquad \ldots\ldots (29)$$

$$\Delta S_i^T = s_i \, (x_i^T - x_i) \qquad \ldots\ldots (30)$$

$$I^T = \sum_{i=1}^{n} \left[I_i^T (1 + t_{coi}) \, p_{ri} + p_i . \Delta S_i^T \right] \qquad \ldots\ldots (31)$$

<u>Aggregate and sectoral import</u>

$$M_i^T = \Sigma \, a_{ij}^{mT} \, x_j^T + h_i \, (C_i^T + I_i^T + G_i^{T*}) \qquad \ldots\ldots (32)$$

$$M^T = \sum_{i=1}^{n} M_i^T \qquad \ldots\ldots (33)$$

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Aggregate government consumption, exports and indirect tax less subsidies

Aggregate government consumption G^T and exports E^T at current market price from the exogenously given sectoral values are obtained by

$$G^T = \sum_{i=1}^{n} G_i^{T*} \; p_{ri} \, (1 + t_{coi}) \qquad \ldots\ldots (34)$$

$$E^T = \sum_{i=1}^{n} E_i^{*T} \; p_i \, (1 + t_{ci}) \qquad \ldots\ldots (35)$$

$$\begin{aligned} T_y = & \sum_{i=1}^{n} \sum_{j=1}^{n} (a_{ij}^d \, p_i \, t_i + a_{ij}^m \, p_{mi} \, t_{mi}) \, x_j^T \\ & + \sum_{i=1}^{n} (C_i^T + G_i^T + I_i^T) \, [(1 - h_i) \, p_i \, t_i + h_i \, p_{mi} \, t_{mi}] \\ & + \sum_{i=1}^{n} E_i^T \cdot p_i \, t_{ci} \end{aligned} \qquad \ldots\ldots (36)$$

Sectoral output at the perspective year is then determined by demand while the perspective year sectoral prices are assumed to be same as in the terminal year.

Output

$$x_i^T = \sum_i a_{ij}^T \cdot x_j^T + C_i^T + I_i^T + \Delta S_i^T + G_i^{T*} + E_i^{*T} - M_i^T \qquad \ldots\ldots (37)$$

Finally sectoral (R_j) and aggregate (R) rates of growth are determined from the following equations.

$$R = (\Sigma \, V_j^T / \Sigma \, V_j)^{\frac{1}{10}} - 1 \qquad \ldots\ldots (38)$$

$$R_j = (V_{jo}^T / V_{jc})^{\frac{1}{10}} - 1 \qquad \ldots\ldots (39)$$

$$V_{jc} = V_j \,/\, UT_j \qquad \ldots\ldots (40)$$

$$V^T_{jc} = V^T_j \,/\, UT_j \qquad \ldots\ldots (41)$$

where V_{jc} and V_j are capacity and realised value added and UT_j is capacity utilisation factor for sector 'j'.

Thus, it can be seen from the perspective year equations, that given the post-terminal sectoral and aggregate rates of growth the perspective year sectoral as well as aggregate output, consumption, investment and level of consumption of the poor and non-poor are determined by the perspective year macro and sectoral equations. Further one may note that terminal year and perspective year models are interdependent. Interdependence of these models mainly reflect the two way interrelation between growth and income distribution as already stated. We may note that alternative schemes of income redistribution between the target and non-target groups generate different aggregate private consumption at the terminal year, and hence aggregate investment at the terminal year obtained residually from the same targeted terminal year GDP, after meeting the endogenous private consumption and other exogenous final uses, would also very. Post-terminal rates of growth corresponding to this terminal year investment will, in turn, determine the level and pattern of consumption, investment (and hence output) at the perspective year. The sectoral level and pattern of output at the perspective year will imply level and pattern of investment at the terminal year which, in turn, will affect the distribution of income at the terminal year via its influence on the level and pattern of output and prices in the economy.

This interdependence between terminal year and perspective year equations, however, will require that (1) consistency between macro and sectoral variables are maintained at each time point, and (2) that the sectoral level and pattern of output at the perspective year are consistent with level and pattern of investment at terminal year.

To ensure these consistencies we define the post-terminal aggregate and sectoral rates of growth (equations 36 & 37) in such a way that they depend upon both terminal year and perspective year value-added, and treat them as unknown parameters of the system. These post-terminal rates of growth are, therefore, estimated endogenously along with terminal year and perspective year unknown variables through an iterative process, so that the above mentioned consistencies are achieved in the system[3].

It may be noted that post-terminal rates of growth play a crucial role in this model by influencing the level and pattern of investment both at terminal as well as perspective year. Moreover, it is only through these post-terminal rates of growth that the impacts of terminal year income redistribution are transmitted to the perspective year and the feed back from the perspective year are carried to the terminal year. In other words, the post-terminal rates of growth are the channels through which the impact of two-way linkage between income distribution and growth are transmitted back and forth between terminal and perspective year. Thus the terminal year and perspective

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[3] It may be noted that, in our model, the macro-sectoral consistency will ensure that terminal year aggregate investment as obtained from the macro model is equal to the sum of sectoral investment estimated from the post-terminal rates of growth. Moreover, the macro-sectoral consistency is automatically satisfied at the perspective year by virtue of relations between macro and sectoral models.

macro and sectoral equations make an interdependent system to be solved simultaneously for determining the different economic variables at the terminal and perspective year.

7.3 Plan model solution procedure

The plan model described in the preceeding section can be viewed as a system of interdependent equations to which we want numerical solution. In order to solve this system we adopt an iterative procedure which directly follow from the logical structure of the model. We may note that any change in policy paramater and/or exogenous variable disturbs the model equilibrium which is established when supply is in aggrement with demand and the aggregate savings equals aggregate investment. The adjustment mechanism to reestablish the equilibrium starts with changes in prices, output and income distribution at the terminal year. Changed terminal year output, price and income distribution, on the otherhand, will change post terminal sectoral as well as aggregate rates of growth and the level and structure of output at the perspective year. Changed level and structure of perspective year output, in turn, will change the terminal year price, output and income distribution via its impact on post-terminal rates of growth and terminal year investment. The post terminal rates of growth play a crucial role in this adjustment process; it adjusts terminal year investment to the given terminal year GDP and also maintain the inter-temporal linkage between the terminal year and the perspective year. Thus the terminal year and perspective year solutions depend upon each other and the model can be solved by an iterative procedure which is recursive in time. The procedure adopted by us consists of the following steps starting with some initial guess values of sectoral output and prices at the terminal and perspective year.

(i) Estimate sectoral gross value added at both time points and their post terminal rates of growth (R_j) by equation (39).

(ii) Estimate terminal year sectoral employment (EL_i) and employment coefficient (a_j) by equations (5) and (6).

(iii) Estimate income and consumption of the poor and the non-poor (y_b, y_a, c_a, c_b) by equations (9), (10), (15) and (16).

(iv) Estimate terminal year sectoral private consumption (C_i) by equation (18).

(v) Estimate terminal investment by origin as well as destination (U_i and I_i) and change in stock (ΔS_i) by equations (19), (20) and (21).

(vi) Estimate terminal sectoral imports (M_i) by equation (22).

(vii) Estimate terminal year sectoral gross output (x_i) by equations (3) with (14) or by (4) as the case may be . Repeat step (i) through (vii) untill output vector stabilizes. Then proceed to step (viii).

(viii) Estimate terminal year sectoral prices (p_{rj}, p_j) by equations (7) and (8) using sectoral output as obtained in step (vii).
Repeat steps (i) through (viii) till prices stabilize. Then proceed to step (ix).

(ix) Estimate aggregate GDP growth rate (R) during post terminal period by equation (38).

(x) Estimate perspective year GDP by equation (23).

(xi) Estimate sectoral import (M_i^T) and total import (M^T) at the perspective year by equations (32 and (33).

(xii) Estimate sectoral investment (I_i^T), changes in stock (ΔS_i^T) and total gross investment (I^T), total government consumption (G^T) and indirect taxes less subsidy at the perspective year by equations (29), (30), (31), (34), (35) and (36) respectively.

(xiii) Estimate aggregate private consumption (C^T) at the perspective year by equation (24).

(xiv) Estimate perspective year aggregate as well as sectoral private consumption (c_b^T, c_a^T, C_i^T) by equations (25), (26) and (27).

(xv) Estimate perspective year sectoral output by equation (37). If these do not agree with the sectoral output of previous iteration available at step (i) within the pre-specified tolerance limit then repeat steps (i) through (xv).

In this context we may note that Five Year Plan investment and various endogenous variables are estimated after the whole system converges.

Further, it may be mentioned that the basic model as described in Chapter 3 has been solved following the above mentioned procedure. Needless to say that in this case Steps for estimating terminal year investment and the perspective year equations are omitted.

Simultaneous convergence of the terminal year and perspective year models establishes both intersectoral and inter temporal consistency. Due to inter sectoral consistency at the perspective year the GDP at the perspective year (Y^T) given by equation (23) equals[4/] the sum of sectoral value added (ΣV_j^T)

[4/] Starting with the output model in equation (37) it can be easily verified that the sum of the sectoral value added ΣV_j^T is equal to the value added Y^T used in the macro relation (24).

by virtue of macro relation (24), so that the targetted GDP at the terminal year (y_*) also equals the sum of the sectoral value added (ΣV_j) at the terminal year by virtue of relations (23) and (38). Hence the gross investment at the terminal year obtained residually from the terminal year macro relation (similar to perspective year macro relation 24) would also be equal to the sum of the sectoral gross investment used as investment demand in deriving sectoral output. On the other hand, sectoral fixed capital investments are derived by investment functions [equations (19) and (20)] using post terminal sectoral rates of growth (R_j), so that inter temporal consistency is maintained. These are verified after convergence of the whole system for each alternative case. In addition, the validity of savings investment balance at the terminal year considered in Chapter 3 is also tested with the empirical results. All the above numerical tests are carried out to ensure that the solution procedure ~~adopted~~ and its translation to computer programmes are appropriate.

CHAPTER 8

Estimation of Total Five-Year Plan Investment

8.1 Introduction

Estimation of total five year plan investment, aggregate as well as sectoral, raises a number of problems in a static input-output framework. Although in a dynamic framework these problems can be greately met, it involves assumptions regarding investment path of the economy during the plan period. In Indian plan exercises from First Plan to the Sixth Plan the aggregate total plan investment was based mainly on a global incremental capital output ratio (ICOR) and growth in net or gross domestic product, while its sectoral allocations were mostly decided on best judgement except in Fifth Plan where sectoral ICOR were used externally to meet consistency with the aggregate[1]. In Sixth Plan exercises[2], though sectoral terminal year investments were estimated endegenously by using investment functions and post-terminal growth rates, investment requirements during first four years of the plan period were estimated by suitably adjusting the sectoral investment growth paths obviously to meet some pre-assigned levels. In these exercises no consideration of possible growth path of sectoral capacity output or of committed pipeline investment and its impact on pre-terminal growth were taken into account in calculating the total five year plan investment. As a result the total five year plan investment is inconsistent with average annual growth of capacity during the plan period as implied by the plan model. Moreover, in such an exercise one does not have any information

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[1] See Approach to Fifth Five-Year Plan of India, Tables 3 and 4 (pp. 48-49).

[2] See Sixth Plan Technical Note.

regarding magnitude of pipeline investment the share of which in total plan investment is gradually increasing over years.

In this chapter we present a method for estimating the plan investment, sectoral as well as aggregate, along with its different components viz. pipeline committed investment, plan investment for capacity creation during plan and post-plan periods, using a distribution lag model of investment. This model, which is similar to those of Chakrabarty (1959), Eckaus and Parikh (1968), Lahiri (1976) etc. considers adequate time structure behind acelerator type relation between investment and capacity output and expresses the total plan investment as a function of pre-as well as post-terminal rates of growth of capacity output. These rates of growth, on the other hand, can be treated as unknown solution variables in a plan model and the total plan investment can be estimated consistently with plan objectives.

In what follows we describe the model (Majumdar and Bandyopadhyay, 1985) and use it for estimating the total plan investment during the Sixth Plan period[3/]. The results obtained by our method are then compared and discussed in relation to those reported in the Technical Note on the Sixth Plan of India (1981) (hereinafter referred as Sixth TN).

8.2 Methodology

Investment project in a particular year may be seen as an action once initiated is completed with a definite time lag between its initiation and completion. During this period different commodities are used up and at

[3/] This model will be used for calculating the Five Year Plan investment in the plan model.

the end a definite capacity is created. Total investment in a sector at a particular year is made partly to meet requirements of old projects and partly for new projects to be initiated during the plan period.

Consider a particular project with gestation period of w years and let w_k (k=1, 2, ... w) be proportion of investment to be made in the kth year of the gestation period. If such a project is undertaken in a sector with incremental capital-output ratio 'b', then the total investment at a particular year is given by

$$U_t = d_t + b. \sum_{k=1}^{w} a_{w-k+1} (V_{t+k} - V_{t+k-1}) \qquad ..... (1)$$

where, V_t is the capacity value-added or output at the year t and d_t is that part of investment which does not go for new capacity creation such as investment for repair and maintenance etc. If we assume uniform distribution of investment cost over gestation period, that is, if $a_k = 1/w$ for k=1, 2, ... w, as assumed in Sixth TN then (1) will reduce to

$$U_t = d_t + b (V_{t+w} - V_t)/w \qquad ..... (2)$$

which is same as considered in Sixth TN. Total investment for a plan period of T years (U_T) is then given by the sum total of U_t over this period, that is,

$$U_T = \sum_{t=1}^{T} U_t \qquad ..... (3)$$

Now the total plan investment U_T can be notionally split into three distinct components : (i) the committed investment to be made during the plan period for the projects started during the pre-plan period but to be completed during plan or post plan period (U_T^C); this type of investment is termed as pipeline investment, (ii) the new investment in the plan period for creating additional capacity in the plan period (U_T^P) and (iii) the new investment made in the plan period for creating new capacity in the post plan period (U_T^Q). For estimating these individual components let us demarcate the plan period by the terminal year T and the base year (0). The intervening years, including the terminal year, will be referred as plan period, while periods beyond the terminal year will be referred as post-terminal period. Investment requirement for any particular year 't' can also be split into corresponding components and estimates of U_T^C, U_T^P and U_T^Q can be built up from the corresponding estimates of invididual year 't' denoted by u_t^C, u_t^P and u_t^Q respectively.

For estimating u_t^C it is sufficient to note that for any year t during the plan period the pipeline investment is the committed investment required for the stream of projects started in the years (t - w + 1), (t - w + 2), ...(0), to create capacities in the years (t + 1), (t + 2)..... w respectively. Thus capacities upto the year w is created by pipeline investment and the years beyond the year w has no pipeline component of investment. Thus, omitting d_t for simplicity,

$$u_t^C = \begin{cases} b \sum_{k=1}^{w-t} (V_{t+k} - V_{t+k-1}) \cdot a_{w-k+1} & \text{for } t=1,2, \ldots, w-1 \\ 0 & \text{otherwise} \end{cases} \qquad \ldots\ldots (4)$$

For estimating u_t^P, it may be noted that for w < T any investment started in the year (t-w) or beyond does not create new capacities in the plan period. For the remaining years in the plan period, U_t^P consists of investments required for projects started in the years $(t - w + 1)$, ...t creating capacities in the year (t+1), (t+w). Note that $(t - w + 1) \geq 1$ and $(t + w) \leq T$. So, we shall have

$$u_t^P = \begin{cases} b \sum_{k=x_1}^{x_2} (V_{t+k} - V_{t+k-1}) \cdot a_{w-k+1} & \text{for } 1 \leq t \leq t-1,\ w < T \\ t+w \leq T & \\ 0 & \text{otherwise} \end{cases} \quad \ldots\ldots (5)$$

where $x_1 = \max(1, w-t+1)$ and $x_2 = \max(x_1, w)$

Similarly, for estimating U_t^Q let us note that for $w \leq T$ any investment started in the year $(T - w)$ or before will be completed during the plan period and hence will not make a part of U_t^Q for all t. Only those investment projects which are to start at the year $(T - w + 1)$ and after, will be completed during the post plan period. However, for $w < T$, all the years during the plan period will have a positive contribution to U_t^Q. Thus for $t = (T - w + 1)$ to T when $w < T$, and for t=1, 2, ... w when $w \geq T$, u_t^Q will consists of investment required for projects started in years max $(1, T - w + 1)$, ... t creating capacities in the years $(T + 1)$ ... $(t + w)$.

Thus,

$$u_t^Q = \begin{cases} b \sum_{k=T-t+1}^{w} (V_{t+k} - V_{t+k-1})\ a_{w-k+1} & \text{for } w < T \\ b \sum_{k=w-t+1}^{w} (V_{t+k} - V_{t+k-1}) \cdot a_{w-k+1} & \text{for } w \geq T \end{cases} \quad \ldots\ldots\ldots (6)$$

where, t varies from max $(1, T - w + 1)$ to max (T, w)

The total investment during the plan period, U_T, is then given by

$$U_T = U_T^C + U_T^P + U_T^Q$$

where,

$$U_T^C = \sum_{t=1}^{T} u_t^C = \begin{cases} b \sum_{k=1}^{w-1} (V_w - V_k) \cdot a_{w-k+1}, & \text{for } 1 < w < T+1 \\ b \sum_{k=w-T}^{w-1} a_{w-k+1} (V_w - V_k) + \\ \quad b \sum_{k=1}^{w-T-1} a_{w-k+1} (V_{w-k} - V_k) & \text{for } w > T+1 \\ 0 & \text{for } w=1 \end{cases} \quad \ldots\ldots (7)$$

$$U_T^P = \sum_{t-1}^{T} u_t^P = \begin{cases} b\,(V_T - V_w), & \text{for } w < T \\ 0 & \text{otherwise} \end{cases} \quad \ldots\ldots (8)$$

and $$U_T^Q = \sum_{t-1}^{T} u_t^Q = \begin{cases} b \sum_{k=T-w+1}^{T} a_{T-k+1} (V_{w+k} - V_T), & \text{for } w \leq T \quad \ldots\ldots (9) \\ b \sum_{k=1}^{T} a_{T-k+1} (V_{w+k} - V_w), & w > T \end{cases}$$

It can be noted from (7) that pipeline investment component of total five year plan investment is determined by gestation period and greater the gestation period higher is its share in total plan investment. Similarly from (8) and (9) one can see that the remaining components of U_T depend upon both pre-as well as post-terminal rates of capacity expansion. Because, if we denote the pre and post-terminal (annual) rate of growth of capacity by r and R respectively then $(V_T - V_w)$ in (8) can be expressed as $V_w \left\{ (1 + r)^{T-w} - 1 \right\}$, and $(V_{w+k} - V_T)$ in (9) can be expressed as $V_T \left\{ (1 + R)^{w+k-T} - 1 \right\}$ respectively.

Now to calculate the total investment for capacity creation in the plan period let us note that not the entire part of U_T^C create capacity during plan period, because there are sectors like 'electricity' for which gestation period is sufficiently long to cover the entire plan horizon. Thus the total plan investment for capacity expansion in the plan period is given by

$$U_T^* = \sum_{t=1}^{T} u_t^P + \sum_{t=1}^{T} \sum_{k=1}^{w-1} a_{w-k+1} \, (V_{t+k} - V_{t+k-1}) \qquad \ldots\ldots (10)$$

$$1 < t + k \leqq T$$

The total plan investment for capacity increase in the post-plan period is given by

$$U_T^{**} = \sum_{t=1}^{T} u_t^Q + \sum_{t=1}^{T} \sum_{k=1}^{w-1} a_{w-k+1} \, (V_{t+k} - V_{t+k-1}) \qquad \ldots\ldots (11)$$

$$t + k > T, \qquad w - t \geqq 1$$

However, if one assumes uniform distribution of investment over the gestation period the above expressions simplify to a great extent. Thus if $a_k = 1/w$ for all k, then the total plan investment is given by

$$U_T = \frac{b}{w} \sum_{t=1}^{w} (V_{T+k} - V_k) \qquad \ldots\ldots (12)$$

8.3 Estimate of Investment for Sixth Plan

In this study we have not attempted to estimate the investment distribution parameter a_k, k=1, 2, ... w and as such we such we shall use expression (10) through (12) for estimating the Sixth Plan investment and its different components using the same parameters provided in Sixth TN for 14 sectors. In the present method we are required first to estimate the capacity value-added V_t for t = 1, 2, ... w (sectoral value-added in case of Sixth TN investment factors) by solving the expression (1) which simplifies to the following when $a_k = 1/w$ for k = 1, 2, ... w

$$U_{t-w} = d_{t-w} + b \sum_{k=1}^{w} (V_{t-w+k} - V_{t-w+k-1})/w \qquad \ldots\ldots (13)$$

Putting t = 1, 2, ... w in (13) we obtain w equations with V_1, V_2, ... V_w as unknows which can be solved in terms of u_0, u_{-1}, $u_{-(w-1)}$ and V_0, V_1, ... $V_{-(w-1)}$ which are known from National Accounts Statistics (CSO, 1983). Post-terminal growth rates are used to estimate V_t for $t \geqq T$ (= 5) required in equations (6), (7), (10), (11) and (12). Sixth TN, however, has not provided post-terminal growth rates of any sector, though Sixth Plan document (Planning Commission, 1980) has provided growth rates of sectoral value-added for seven aggregated sectors both for Sixth Five Year Plan period and perspective period from 1984-85 to 1989-90. We have made use of these growth rates and other informations provided in Sixth Plan document in respect of perspective of development, to estimate post terminal growth rates for 14 sectors for which parameters of the investment functions are provided in Sixth TN.

In Sixth TN total Sixth Plan investment are shown for new capacity creation seperately during (i) Sixth Plan period (1980-85) and (ii) perspective period that is Seventh and Eighth Plan (1985-95). However, nowhere method of estimating them has been indicated. Expressions (10) and (11) in our method provide estimates of plan investment required for capacity creation during plan as well as post plan periods. Peculiarly enough, Sixth TN has not provided any investment for capacity creation in mining and electricity sectors during the Sixth plan period, thus ignoring the fact that a number of projects in these sectors, started in Fifth Plan period would not only be completed but even commissioned during Sixth Plan period. Sectoral total plan investment during the Sixth Plan period along with its different components, as estimated by the present method and those provided in Sixth TN for 14 sectors are aggregated to 7 sectors and presented in Table 8.1. Structure of investment, as given by the share of sectoral investment in the total investment are given in Table 8.2, while Table 8.3 compares the estimates by the present method with those provided in Sixth TN. In the following section we compare our estimate with those of Sixth TN.

8.4 Discussion and Conclusion

The total plan investment for Sixth Plan period estimated by the present method is Rs. 137,000 crore as against Rs. 158,700 crores as reported in Sixth TN. Thus our estimate is about 80 per cent of the official estimate of the total plan investment. However, our estimate of plan investment for agriculture, manufacturing, electricity and transport sectors are respectively 54 per cent, 67 per cent, 87 per cent and 83 per cent of Sixth TN estimates, while our estimate of mining, construction and service sector are higher than Sixth TN estimates by 48 per cent, 44 per cent and 32 per cent respectively (see Table 8.3). On the other hand, investment for capacity creation during plan period estimated by the present method enjoy higher share in total plan investment as compared to Sixth TN estimates. However, for agriculture and electricity sectors this share is less than those provided in Sixth TN. It is also seen that share of pipeline investment in total investment may be as high as 41 per cent for sector with long gestation period like electricity. When we turn to structure of investment (see Table 8.2) we see that share of agriculture and service sectors in total plan investment as estimated by us are substantially different from the estimates provided in Sixth TN. To explain the discrepency between our estimate and those provided in Sixth TN we may only point out certain inaccuraties in the Sixth TN method for estimating total plan investment and the inconsistencies in the reported results obtained from such a method. As noted earlier the Sixth TN estimates of total plan investment is based on arbitary adjustment factors (G_i^t, see Sixth TN) for first four years of plan period obviously to meet exogenously fixed sectoral and total plan investment. The present method, however, is based on detailed time structure of fixed capital investments which enables one to estimate the plan investment consistently with projected growth of output and capacity. Moreover, in this method different components of total plan investment viz. pipeline investment, investment for capacity creation during plan and post-plan period are estimated seperately. To mention the inconsistencies in the results reported in Sixth TN one may refer to agriculture sector. In Sixth TN, investment in this sector is estimated at Rs. 50510 million in 1979-80 (base line), while for 1984-85 it is estimated at Rs. 28518 million which is about 56 per cent of the base year investment. But when one compares the total five year plan investment in agricultural sector (Rs. 322420 million, see Sixth TN) with the above mentioned figures the inconsistency becomes quiet apparent. Because the annual investment requirement for agriculture (about Rs. 73,565 million) corresponding to the estimated total plan investment in agriculture is much higher than the terminal year investment in agricultural sector. In absence of pipeline investment and under the assumption of unfirm use of investment expenditure during gestation period (as done in Sixth TN) these figures appears to be inconsistent with each other. Inconsistency is also reflected when structure of plan investment is compared to that of the base year (1979-80) and terminal year (1984-85). Because of ad hoc method of using adjustment factors for different sectors in the plan period the total plan investment is also inconsistent with growth targets in Sixth Plan. As to the pipeline investment Sixth TN shows (see Table 8.1) that no investment is required for capacity increase in mining and electricity sectors during the plan period, the whole of plan investment being meant for Seventh and Eighth plans. This is incomprehensible as there are number of projects pertaining to these sectors which were started during Fifth Plan period and committed to be finished during Sixth Plan period. By our method, we find that about 73 per cent and 41 per cent of the total plan investment would be required for capacity creation in mining and electricity sectors respectively during Sixth Plan period.

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Thus, we see that total plan investment has to be estimated consistently with plan targets. For this the model for estimating the total plan investments, with a detailed time structure of fixed capital investment, has to be integrated with the core plan model. Moreover, the pipeline investment, the share which in total plan investment is substantial, has a vital role in estimating the plan investment and can not be ignored in such an exercise. In case any desired level of plan investment for a particular sector is required to be fixed exogenously it is imperative that the core plan model has to be modified to meet such constraint.

Table 8.1 : Total Five-Year Plan Investment at 1979-80 Prices (Rs. million)

Sector	By the Present Model: For Capacity Increase: During Sixth Plan Period **	By the Present Model: For Capacity Increase: During Seventh and Eighth Plan **	By the Present Model: Total *	As per Sixth TN: For Capacity Increase: During Sixth Plan Period **	As per Sixth TN: For Capacity Increase: During Seventh and Eighth Plan **	As per Sixth TN: Total
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1. Agriculture and allied	109033 (60.65)	70746 (39.35)	179779 (1.0)	294963 (88.13)	39717 (11.87)	334680
2. Mining	76019 (78.08)	21344 (21.92)	97363 (5.1)	0 (00)	65750 (100.00)	65750
3. Manufacturing	169962 (55.70)	135214 (44.30)	305176 (19.0)	171178 (37.61)	283971 (62.40)	455149
4. Construction	23526 (92.53)	1998 (7.47)	25424 (1.7)	7458 (42.37)	10142 (57.62)	17600
5. Electricity	54523 (26.50)	151167 (73.50)	205690 (41.3)	0 (0.0)	235541 (100.00)	235541
6. Railways and other transport	85606 (63.94)	48286 (36.06)	133892 (7.5)	51744 (32.33)	108806 (67.77)	160550
7. Service	248230 (58.68)	174824 (41.42)	423054 (2.0)	193777 (61.61)	123863 (38.94)	317640
Total	766899	603479	1370378	719120	807990	1586910

Notes : * Figures in brackets of this column indicate percentage share of pipeline investment.

** Figures in bracket of these columns indicate percentage share in the actual total investment.

Table 8.2 : Structure of Investment (Percentage Share of Sectoral Investment in Total Plan Investment)

Sector	By the present Model: For capacity expension: During Sixth Plan	By the present Model: For capacity expension: During Seventh and Eighth Plan	By the present Model: Total	As per Sixth Plan TN: For capacity expension: During Sixth Plan	As per Sixth Plan TN: For capacity expension: During Seventh and Eighth Plan	As per Sixth Plan TN: Total
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1. Agriculture and allied	14.22	12.38	13.12	41.02	4.58	21.09
2. Mining	9.91	3.54	7.10	0.0	7.58	4.14
3. Manufacturing	22.16	22.40	22.27	23.80	32.72	28.68
4. Construction	3.07	.31	1.86	1.04	1.17	1.11
5. Electricity etc.	7.11	25.04	15.01	0.0	27.14	14.84
6. Railways and other transport	11.16	8.00	9.78	7.20	12.53	10.12
7. Services	32.37	30.52	30.86	26.94	14.28	20.02

Table 8.3 : Comparison of Total Plan Investment by Present Model with that of Sixth TN

	Sector	Capacity Increase during Sixth Plan Period (Present model/Sixth TN)	Capacity Increase during Seventh and Eighth Plan period (present Model/ Sixth TN)	Total (Present Model/Sixth TN)
	(1)	(2)	(3)	(4)
1.	Agriculture and allied	0.3696	1.7813	0.5372
2.	Mining	-	0.3250	1.4810
3.	Manufacturing	0.9930	0.4760	0.6700
4.	Construction	3.1540	0.1870	1.4440
5.	Electricity etc.	-	0.6420	0.8730
6.	Railways and other transport	1.6544	0.4438	0.8340
7.	Services	1.2810	1.4114	1.3319
	Total	1.109	0.6600	0.8640

CHAPTER 9

Income Redistribution And Planned Economic Growth : Some Policy Analyses

9.1 Introduction

The dynamic characteristic of the plan model developed in Chapter 7 can be examined in two alternative approaches. One is what is called the simulation approach. In this approach the estimates of the different endogenous variables of the model are obtained by solving the system with the given values of the exogenous variables and parameters at different points of time : and then compared with the given initial values of the endogenous variables obtained under some preferred configuration of the targets, parameters and exogenous variables. The another way is to use some analytical technique to study the structural properties of the model[1/]. The dynamic characteristic of the plan model can be best examined by simulation rather than by analytical techniques. This is mainly because of large size and non-linear character of of the model. Moreover, as we allow the parameters and exogenous variables vary over time, it may be difficult to discuss the model in terms of analytical techniques. For this, in the next section, we present a version of what has been called 'the basic solution of the plan model' and discuss its result to illustrate the interactions amongst the variables of the plan model. Next we carry out policy simulation analysis with the plan model to highlight the role of different policy parameters in determining income distribution, poverty and growth in the plan model. The basic solution of the plan model

[1/] One such method, as used by Goldberger (1959), is to linearise the non-linear relationships of the model to find the reduced form of the model in which all the endogenous variables can be expressed in terms of exogenous policy parameters or, targets and variables.

gives economic configurations corresponding to the targets of (i) 5 percent GDP growth rate over the plan period and (ii) Reduction in the percentage of the poor to 10.0 percent and increase in per capita consumption obtained by 50.0 percent reduction in their income gap at the perspective year over the same at the terminal year. These target specifications under the basic solution are close to the 'preferred variant' of the Sixth Plan model of India.

9.2 The Basic Solution of the Plan Model:

To obtain the basic solution of the plan model we have to specify the different exogenous variables, technological, behaviourial and policy parameters of the model for the years in which the plan model is solved viz. the terminal year and perspective year. Moreover, we need complete economic description of the base year as a background for determining the charges in different economic variables over time. The 'bench mark' economic description of the base year as estimated by the basic model has already been given in Chapter 4 and we shall use them as a point of reference for comparing change in economic variables at the terminal and perspective year under the basic solution.

Information regarding the various exogenous variables and parameters for the terminal year and the perspective year are mainly taken from Sixth Plan Technical Note (hereafter referred as Sixth TN) and National Accounts Statistics (NAS), Central Statistical Organisation (CSO) (1981). In particular, input-output coefficients for the terminal year (1984-85) are taken from Sixth TN and are aggregated into 32 sectors according to our scheme of classification given in the Chapter 4. The input-output coefficients for the perspective year (1994-95) are taken to be same as that of the year 1984-85, as no separate information regarding input-output coefficients are available for the perspective year. Informations regarding the so-called capital coefficient matrix (B_{ij}), as used in the plan model, to calculate investment by 'Origin' (that is, by capital goods sector) are also taken from Sixth TN. But to convert them from purchaser's price to market price the trade and transport margins are taken out from them following the method as described in the Chapter 4 and are accounted into the respective sectors. The parameters of investment function viz. intercepts in investment functions, sectoral incremental capital output ratio, gestation period etc., are also taken from Sixth TN. The indirect rates for the terminal year are calculated from the information as provided in Sixth TN and are presented in Table 4.9 of Chapter 4. The exogenous components of final demand viz. public consumption, export for the terminal year are taken from Sixth TN after appropriate aggregation, and the same for the perspective year, in absence of any information, are obtained by applying 6.0 percent growth over the corresponding estimate of the terminal year. Some of the important macro-economic parameters which are not provided in Sixth TN are estimated from NAS, CSO (1981). Such macro-parameters are direct tax rate, corporate tax rate, corporate savings rate, household savings rate, share of corporate profit accruing to public sector etc. These informations for the perspective year, however, are not needed in our model, as aggregate savings is endogenously determined from macro savings investment identity. Finally, among various transfer items between public and private sectors for the years 1984-85 and 1994-95, aggregate interest payment of national debt, other current transfer from public to private sectors and miscellaneous receipts of the government from households are estimated using such informations as provided in draft Sixth Plan document. The estimates of different macro parameters for the terminal and perspective year are presented in Table 4.11 of Chapter 4. Finally the sectoral capacity value added which are required in estimating plan investment and the pre as well as post terminal rates of growth, are estimated following the method suggested by Majumder and Bandyopadhyay (1984) on the basis of informations on sectoral gross value added and investment for past years.

All the foregoing data, along with the above mentioned terminal year and perspective year targets are put together to generate the basic solution of the plan model which we now describe, as this solution will serve as a point of reference for our variational exercises.

The macro-economic picture produced by the plan model under the basic solution is presented in Table 9.1. For the exogenously fixed terminal year GDP of Rs. 124648 crores at factor cost corresponding to 5.0 percent targeted GDP growth rate over the plan period, the annual compound growth rate of GDP at market price is 5.98 percent over the plan period. Consequently the share of indirect tax less subsidy in GDP at market price has increased from 10.45 percent at the base year to 14.49 per cent at the terminal year. This increased share of indirect tax during the plan period is mainly due to increased sectoral rates of indirect taxation and volume of output at the terminal year. Aggregate gross disposable income in the economy at the terminal year, estimated at Rs. 146361 crores, shows an annual growth of 5.8 percent over the plan period. Aggregate private consumption and gross investment, at base year market price, at the terminal year show that share of consumption in GDP at market price has fallen from 69.0 percent at the base year to 65.0 percent at the terminal year, but that of gross investment has increased from 21.0 percent at the base year to 24.5 percent at the terminal year. Thus we see that average annual growth of aggregate consumption (4.7 percent) is less than that of GDP at market price implying acclerated growth of investment during the plan period. The average annual rate of growth of GDP at factor cost during the post-terminal period, as estimated by our model, is 5.88 percent which is 0.88 percent higher than pre-terminal growth of GDP. This acclerated growth of GDP during the post-terminal period is due to acclerated rate of investment during the plan period. Moreover, since this rate of growth of GDP is consistent with both terminal year GDP and perspective year poverty alleviation targets, the results show the need of acclerated growth of investment for achieving long run targeted reduction in poverty and income inequality. The GDP at factor cost and market price at the perspective year, are consequently estimated at Rs. 220661 crores and 243204 crores respectively. The perspective year private consumption and gross investment account for about 63.0 percent and 25.7 percent of GDP at market price. Thus we see that share of investment is further increased while that of consumption is further reduced at the perspective year vis-a-vis both base year and terminal year. Consequently the aggregate percapita consumption grows at the rate of 3.58 percent while percapita GDP (at market price) grows at the rate of 4.04 percent annually. Rate of growth of aggregate percapita consumption for the entire population as well as for the poor and the non-poor, as presented in Table 9.3, show that rate of growth of consumption for the population as a whole during the pre-terminal period is less than that of post-terminal period. Our results show that decreased rate of consumption, and increased rate of investment, during the plan period acclerate the growth of consumption during the post plan period. Thus we see

Table 9.1 : Macro-economic Aggregates under Basic Solution

(Rs. Crores 1979-80 prices)

Economic Indicators		Plan model estimates
	(1)	(2)
A.	Terminal year	
1.	GDP factor cost	124648
2.	Indirect tax less subsidy	21118
3.	GDP at market price	145766
4.	Private consumption	94683
5.	Government consumption	16882
6.	Gross investment	35740
6.1	Share in agriculture	25.1
6.2	Share in manufacturing industry	28.9
7.	Import	12900
7.1	Rate of import	8.85
8.	Export	11328
8.1	Rate of export	7.77
9.	Net factor income from abroad and other current transfers from rest of the world	595
10.	Gross disposable income	146361
11.	Tax as percentage of GDP at current market price	18.30
11.1	Direct tax	3.32
11.2	Indirect tax less subsidy	14.98
12.	Rate of investment@	23.92
13.	Rate of savings@	22.68

Contd.../-

Table 9.1 : Macro-economic Aggregates under Basic Solution (Continued)

(Rs. Crores 1979-80 prices)

	Economic Indicators	Plan model estimates
	(1)	(2)
14.	Employment (million standard persons years)	175.48
B.	Perspective year	
15.	GDP at factor cost	220661
16.	GDP at market price	243204
17.	Private consumption	152362
18.	Gross investment	62438
18.1	Share in agriculture	11.81
18.2	Share in manufacturing industry	30.41
19.	Rate of investment@	23.68
20.	Rate of savings@	22.37
C.	Total Plan investment	141815
D.	Incremental capital output ratio	3.86

@ As percent of GDP at current market price.

that while the annual growth of per capita consumption during the post plan period is 4.15 percent the same during the plan-period is only 2.45 percent resulting in 3.58 percent annual growth of percapita consumption during the fifteen year plan horizon. Further, rate of growth of percapita consumption of the poor and the non-poor show that annual rate of growth of percapita consumption of the poor, during the plan period, is much lower than that of the non-poor. In this context we may note that consumption in our model is determined endogenously from income flow to different socio-economic groups and hence the low rate of growth of consumption for the poor than the non-poor is due to inequality in income generation process at the terminal year. However, the post-terminal rate of growth of percapita consumption for the poor is much more than the non-poor, although the annual rate of growth in percapita consumption of the poor during the plan horizon is less than the non-poor. This is mainly due to exogenously reduced level of targeted perspective year poverty and consumption inequality. Economic profile of the poor and the non-poor as presented in Table 9.2 show that economic position of both poor and non-poor improves during the plan period, although the income as well as consumption gain of the non-poor is much higher than the poor. Consequently, although the poverty situation improves, consumption inequality increases at the terminal year over the base year.

The macro-economic aggregates of the basic solution described above are derived from the sectoral estimates and, therefore, better in insight regarding the working of the model can be gained by analysing the change, over time, in magnitude and direction of the sectoral estimates. Although the plan model has been run with 32 sectors of production we present, in Tables 9.4, 9.5 and

Table 9.2 : Economic Profile of the Poor and the Non-poor under Basic Solution

Economic Indicators		Plan model estimates
(1)		(2)
A.	Terminal year	
1.	Monthly percapita (p.c) income (Rs.) at 1979-80 price	126.59
1.1	Poor	54.89
1.2	Non-poor	191.39
2.	Monthly p.c. consumption (Rs.) at 1979-80 price	107.93
2.1	Poor	54.89
2.2	Non-poor	152.64
3.	Employment (million standard person years)	175.48
3.1	Poor	90.15
3.2	Non-poor	85.33
4.	Dependency ratio	4.09
4.1	Poor	3.64
4.2	Non-poor	4.56
5.	Poverty	
5.1	Percentage of poor	45.73
5.2	Sen's Index	18.13
6.	Inequality (Lorenz ratio)*	
6.1	Income inequality	0.259
6.2	Consumption inequality	0.225

Contd.../-

Table 9.2 : Economic Profile of the Poor and the Non-poor under Basic Solution (Continued)

Economic Indicators	Plan model estimates
(1)	(2)
B. Perspective year	
7. Percapita (monthly) consumption (Rs.) in 1979-80 price	162.02
7.1 Poor	66.83
7.2 Non-poor	172.60
8. Poverty : Percentage of poor	10.00
9. Consumption inequality (Lorenz ratio)*	0.059

* Between the poor and the non-poor.

Table 9.3 : Annual compound Growth Rates of GDP and aggregate Private Consumption under Basic Solution

Economic Variables	Estimates of Growth rate (%)
(1)	(2)
1. GDP at factor cost	
1.1 Pre-terminal (1979-84)	5.00
1.2 Post-terminal (1984-95)	5.88
1.3 Overall (1979-95)	5.59
2. Aggregate p.c. monthly consumption	
2.1 Pre-terminal	2.45
2.2 Post-terminal	4.15
2.3 Overall	3.58
3. Aggregate p.c. monthly consumption of the poor	
3.1 Pre-terminal	0.78
3.2 Post-terminal	1.99
3.3 Overall	1.58
4. Aggregate p.c. monthly consumption of the non-poor	
4.1 Pre-terminal	2.36
4.2 Post-terminal	1.24
4.3 Overall	1.61

9.6, the results for seven broad group of sectors. In this context we may recall that the plan model determines the sectoral output and their rates of growth considering interdependence of growth and income distribution. While considering this interdependence the plan model determines output and their rates of growth consistently with terminal year distribution of income given the targeted terminal year GDP and perspective year poverty alleviation targets. Further, terminal year level and structure of output and prices are determined by level and pattern of terminal year demand, of which private consumption and gross investment demand are endogenously estimated in the model.

Rates of growth of sectoral output and value added as presented in Table 9.4 show significant difference in pattern of sectoral growth during the plan and post-plan period. This difference in pattern of growth is a direct reflection of consumption inequality at the terminal year and the perspective year. At the terminal year the income distribution is endogenously determined in the plan model and show higher degree of inequality than both in the base year as well as perspective year. As a result the pattern of private consumption demand is shifted towards non-agricultural sector at the terminal year, while the pattern of demand at the perspective year, due to lower level of poverty and income inequality, is shifted towards agricultural sector. Consequently the implied post-terminal growth of agriculture is higher, and that of manufacturing industry is lower, than their respective pre-terminal growth rates. This is also reflected in the structure of terminal year and plan investment as presented in Table 9.5. It can be seen that, due to higher growth of agricultural sector during the post terminal period, the share of agricultural sector in terminal year investment is much higher than that of five year plan investment. Consequently the pre-terminal growth of construction sector which has highest share in investment of agriculture sector, rises above its corresponding post terminal level. Other sectors which show significant difference in pre-terminal and post-terminal growth rates are mining, electricity and service sectors. Comparision of sectoral growth over the 15 year plan horizon however, shows that manufacturing, electricity, construction and service sectors grow at annual rate of 6.0 to 7.5 percent, while agriculture grows annually at the rate of 4.25 percent.

The plan investment, total as well as sectoral, are estimated by the method presented in Chapter 8. According to this method, the total plan investment is a function of both pre-terminal as well as post-terminal growth rates which are endogenously estimated in the plan model. The total plan investment thus estimated is Rs. 141815 crores and the implied global capital output ratio during the plan period is 3.86. The structure of plan investment as presented in Table 9.5 shows that share of agricultural sector in plan investment is 12.0 percent while that of manufacturing sector is 30.0 percent. Further it may be noted that shares of transport, electricity and service sectors are more or less of the same order. Finally the structure of sectoral prices as presented in Table 9.6 show a shift in terms of trade in favour of the manufacturing sectors of the economy[2/]. This bears a reflection of growth pattern of different sectors of the economy during the plan period.

[2/] Sectoral import prices in the basic solution of the plan model and the subsequent alternative variants are held fixed at the base year level.

Table 9.4 : Annual Compound Growth rates of Output and Value Added under Basic Solution

Sector name	Output			Value added		
	Pre-terminal	Post-terminal	Overall	Pre-terminal	Post-terminal	Overall
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1. Agriculture	3.91	5.01	4.65	2.76	5.00	4.25
2. Mining & quarrying	11.34	5.73	7.57	11.27	5.74	7.56
3. Manufacturing	7.43	5.93	6.43	6.16	6.01	6.07
4. Electricity	9.15	6.03	7.06	5.11	6.03	5.72
5. Construction	7.53	5.98	6.49	5.30	5.98	5.75
6. Transport	8.38	5.64	6.55	7.09	5.64	6.12
7. Other services	6.43	6.56	6.52	5.89	6.56	6.34

Table 9.5 : Structure of Investment Under Basic Solution

	Sector name	Plan Investment	Terminal year investment
	(1)	(2)	(3)
1.	Agriculture	11.60	25.10
2.	Mining & querrying	6.82	3.80
3.	Manufacturing	29.83	28.90
4.	Electricity	15.77	14.40
5.	Construction	0.88	0.90
6.	Transport	16.43	9.60
7.	Services	18.67	17.30
	Total	100.00	100.00

Table 9.6 : Structure of Prices Under Basic Solution

	Sector name	Structure of prices
	(1)	(2)
1.	Agriculture	100.00
2.	Mining & quarrying	83.69
3.	Manufacturing	101.62
4.	Electricity	106.32
5.	Construction	94.21
6.	Transport	97.78
7.	Services	92.30

9.3 Variational exercise with the Plan Model

In this section we explore how growth, income distribution and poverty in our model respond to changes in certain policy parameters. Our main interest is to infer something about how growth and income distribution in Indian economy might respond to different policies aimed at improving growth, income distribution and poverty. For this purpose we have considered a number of variants of the basic solution of the plan model as described in Table 9.7. It is needless to mention that these variants are by no means exhaustive as our model can be as well simulated with other types of policy parameters. The variants considered in this chapter examine the impact of (i) increase in targeted GDP growth (ii) decrease in foodgrain output (iii) income transfer from the poor to the non-poor (iv) wage policy (v) tax-subsidy (vi) investment redistribution towards agriculture (vii) change of technology in agriculture (viii) increase in household savings rate (ix) increase in administered price (x) export promotion and import substitution and (xi) increase in population on income distribution, poverty and growth.

In this context we may note that changes in policy parameters and exogenous variables, in the plan model, affect the model solution in two ways. First, the model equilibrium adjust macro-economically to bring aggregate supply in line with aggregate demand, which amounts to making aggregate savings equal to gross investment demand. The main adjustment mechanism in our model is movement in terminal year output and price level and post-terminal growth which, in turn, affect the level and structure of output at the perspective year. Change in level and structure of terminal year output and prices are necessiated by change in level and structure of final demand which, on the

Table 9.7 : Description of alternative Policy Variants

Case number (1)	Description (2)
	Increase in targeted GDP growth
1	Targeted growth rate in GDP Over the Plan period is increased from 5.0 percent (as in the basic solution) to 5.5 percent.
2	Case (1) with food grain output fixed at basic solution level.
	Decrease in food grain output
3	Pre-terminal GDP growth rate of 5.0 percent (as in the basic solution) with output of food grain (sector 1) fixed at 95 percent of the basic solution level.
	Income transfer from the non-poor to the poor
4	2.0 percent income transfer from the non-poor to the poor.
5	Case (4) with food grain output fixed at basic solution level.
	Wage policy
6	Minimum wage increased to Rs. 8.00 (at 1979-80 prices) in all sectors.
7	Case (6) with food grain output determined by supply response function.
8	Increase in minimum wage to Rs. 8.00 along with 5.00 percent subsidy on food grain and fertilizer input price.
9	Case (8) with food grain output fixed at basic solution level.
10	Case (8) with food grain output determined by supply response function.
11	10.0 percent increase in the nominal wage of the non-poor employed in organised sectors of the economy.
12	Case (11) with foodgrain output fixed at basic solution level.
	Tax and subsidy
13	Indirect tax rates on inputs and final demand of taxable sectors increased by 0.02.

contd.../-

Table 9.7 : Description of alternative Policy Variants (Continued)

Case number	Description
(1)	(2)
14	Case (13) with foodgrain output fixed at basic solution level.
15	Case (13) with foodgrain output determined by supply response function.
16	5.0 percent subsidy on foodgrain output.
17	Case (16) with foodgrain output fixed at basic solution level.
18	5.0 percent subsidy on fertilizer input (to foodgrain sector) with foodgrain output determined by supply response function.
19	25.0 percent increase in direct tax rate.
	Investment redistribution towards agriculture
20	Investment in agriculture fixed at 20.0 percent higher than basic solution level.
	Change in Agricultural technology
21	Use of fertilizer input in foodgrain sector increased by 20.0 percent from the basic solution level.
	Increase in household savings rate
22	Savings rate of the non-poor increased from 20.2 percent to 23.0 percent.
	Increase in Administered Price
23	Price of petrolium products increased by 10.0 percent over that in the basic solution level.
	Export promotion and Import substitution
24	10.0 percent increase in exports of all exportable sectors.
25	Case (24) with foodgrain output fixed at basic solution level.
26	10.0 percent import substitution in all importing sectors.
	Population growth
27	35.0 percent increase in the rate of population growth.

other hand, depend upon the distribution of income at the terminal year and post-terminal growth. Income distribution at the terminal year, being determined by interaction of output and price, the plan model maintains two way interdependence between income distribution and growth. The post terminal growth plays a crucial role in this interdependence, first by adjusting itself to the terminal year GDP and second, by maintaining the inter-temporal linkage between the terminal and perspective years.

The macro-adjustments are accompanied by numerous micro changes in the model solution viz. shifts in employment, income and consumption levels by sectors and by socio-economic classes, changes in sectoral prices, sectoral unit value-added, profit, aggregate tax etc. Each model solution, therefore, is discussed at both macro and sectoral level considering their macro-economic and sectoral differences from the basic solution.

9.3.1 Increase in targeted GDP growth

In order to study the economic impact of increasing targeted GDP growth we have considered two alternative variants of the basic solution. In alternative 1 we increase the targeted GDP growth from 5.0 percent as considered in the basic solution to 5.5 percent. In alternative case 2 the above increase in targeted GDP growth is considered by fixing the foodgrain output at the basic solution level. The purpose here is to study the impact of increasing aggregate growth rate of the economy when the foodgrain output remains stagnant.

The first two columns of Tables 9.8 through 9.13 represent the economic impact of increasing GDP as considered under variant one and two.

The results of column one show that, due to half percent increase in targeted GDP over the basic solution, the terminal year aggregate consumption increases by 1.85 percent of the corresponding basic solution level. Terminal year investment is also increased by 6.32 percent of the basic solution level. The share of agricultural sector in terminal year investment drops while that of manufacturing sector rises due to increase in pre-terminal growth of GDP. Rate of investment and rate of import at the terminal year rise above the basic solution level. But the increase in the rate of domestic savings being less than that of investment, the rate of foreign savings increases with growth. Thus we see that half percent increase in pre-terminal GDP growth imply an increase in foreign enchange demand by about one percent. Moreover, the rate of increase in the terminal year aggregate employment over the basic solution being less than that of GDP the results indicate that labour intensity fall in the economy with growth. Post-terminal growth which was 5.88 percent under the basic solution, increases to 6.19 percent as the pre-terminal growth is increased from 5.00 percent to 5.5 percent. The annual growth of GDP over the plan horizon also increases to 5.59%. This is because of increased rate of terminal year investment under alternative 1 than under the basic solution. Consequently GDP, consumption and investment at the perspective year is more than that of the basic solution. Annual growth of percapita consumption during the post-plan period is also higher than the basic solution. Thus we see that increase in GDP growth, although decelerates the growth of consumption during the plan period, accelerates the post-plan growth of consumption and thereby the growth of consumption during the fifteen year plan horizon is about 0.40 percent more than the corresponding basic solution level. This increase in growth of consumption during the plan horizon, however, is not equally shared by the two groups of population. Economic profile of the poor and the non-poor (Table 9.9) under variant 1 shows that increase in income and consumption is more for the non-poor than the poor. Thus it can be seen that while the percapita consumption of the non-poor at the terminal year is about 1.25 percent of the basic solution, the same for the poor is only 1.18 percent. Consequently the pre-terminal growth of consumption of the poor is about one third of that of the non-poor during the plan period. However, the picture during the post plan period gets reversed to that of the plan period. This is because of stipulated drastic reduction in perspective year poverty and consumption inequality, due to which the post-terminal growth of consumption of the poor is more than that of the non-poor. However, the overall growth of consumption of the poor during the plan horizon is less than that of the non-poor. Increase in terminal year GDP reduces the poverty and marginally decrease income and consumption inequality at the terminal year. It can be seen that while both percentage of poor and Sen's index fall by 1.44 percent and 3.6 percent respectively, the consumption inequality is reduced by only 0.80 percent at the terminal year over the corresponding value under the basic solution. Sectoral rates of growth of output and value added as presented in Tables 9.11 and 9.13 show favourable impact of increasing terminal year GDP on the sectoral growth of output and value added. Moreover, overall growth of agriculture, during the plan horizon, is less than that of the manufacturing sector. Overall growth of service and electricity sectors indicates that their demand increase due to increase in terminal year GDP. But this overall increase when split into pre-terminal and post-terminal terms show that their demand falls as the distribution shifts towards the poor. Difference in structure of plan and terminal year investment, as estimated by our model, also reflect the difference in pre-terminal and post-terminal pattern of sectoral growth. The structure of plan investment show a fall in share of agriculture and rise in share of manufacturing industry. Structure of terminal year investment, on the other hand, show that share of agricultural sector is increased while that of manufacturing sector is reduced in comparision with the basic solution. The structure of sectoral prices as presented in Table 9.12 show that structure of price at the terminal year favours manufacturing sector as compared with the basic solution. Moreover increase in terminal year GDP target reduce the sectoral as well as aggregate price as compared to the basic solution. This is due the fact that employment elasticities with respect to output in most sectors are less than unity. Finally comparision of the results of variants 1 and 2 clearly show the harmful effect of increasing GDP on poverty and income distribution, when the foodgrain sector remains stagnant.

9.3.2 Decrease in foodgrain output

In the basic solution sectoral outputs are demand determined without any constraint on the output of any sector. It was assumed that terminal year demand will be met either through increased production or through imports. In variant three we run the basic solution with explicit agricultural output constraint at the terminal year. For this we fix the terminal year agricultural output at a level which is 5.0 percent less than the agricultural output obtained under the basic solution.

Agricultural output constraint at the terminal year influences the different economic variables via its impact on prices and income of agricultural sector. The reduced fixed level of agricultural output in variant three increases the prices of agricultural products and decreases the factor income generated in the agricultural sector of the economy. The increased price of agricultural output, in turn, influence the cost-structure of the non-agricultural sectors of the economy because of cost-interdependence among the different sectors of production. Due to this the general price level of the economy is pushed up through cost push mechanism. Thus in this variant the sectoral price are determined by interaction between demand - pull and cost-puch mechanism of price formation in agricultural and non-agricultural sectors of the economy.

The macro-economic impact of agricultural output constraint, as presented in column three of Table 9.8 show that GDP at market price increases by 1.13 percent over the basic solution level though the GDP target at factor cost is same as in basic solution. This increase is mainly due to increase in total indirect tax less subsidy at the higher level of sectoral prices. Aggregate private consumption at the terminal year is decreased by 1.12 percent over their corresponding basic solution level. Consequently rate of investment at the terminal year is increased by 3.82 percent in this variant over the basic solution level. Rate of domestic savings at the terminal year also rises significantly over the basic solution level, mainly due to increase in household, public and corporate savings. However, the rate of foreign savings falls as both rate of import as well as rate of export (as percentage of GDP at market price) falls at higher level of domestic price. The macro-economic changes at the model equilibrium are followed by macro-economic adjustment between aggregate savings and investment, the main equilibriating forces in this case being the changes in level and pattern of prices and output at the terminal year and consequent change in terminal year income distribution.

Increase in overall price level at the terminal year also shifts the terminal year income distribution towards the non-poor. Consequently the percapita consumption of the poor at the terminal year falls while that of the non-poor rises over their respective basic solution level. This fall in consumption of the poor is mainly due to fall in aggregate employment among the poor and rise in prices of agricultural products at the reduced level of agricultural output. Proportion of poor at the terminal year, the Sen's index of poverty increase and income and consumption inequality also rise over their corresponding basic solution level. (see Table 9.9).

Post-terminal growth, however, increases due to increased share of gross investment in the terminal year GDP. Thus we see that post-terminal growth of GDP increases to 6.13 percent, increasing the overall growth of GDP during the plan horizon to 5.75 percent. Due to this increased post-terminal growth the aggregate consumption during the post plan period increases at the annual rate of 4.40 percent and compensate the fall in growth of aggregate consumption during the plan period. Consequently the overall growth of percapita consumption during the plan horizon rises over the basic solution level. Aggregate percapita consumption of the poor during the plan horizon rises above the basic solution level as the fall in their growth of percapita consumption during the plan period is compensated by the rise in their consumption during the post-plan period. But the percapita consumption of the non-poor over the plan horizon show steady rise as their consumption rises both during the plan and post-plan period. This favourable impact on the consumption of the non-poor mainly results from the increase in their profit income at the terminal year and from the increased rate of GDP growth during the post-plan period. (see

Table 9.10). Pattern of sectoral growth of output and value added during plan period, as presented in Tables 9.11 and 9.13, show a clear shift towards manufacturing sectors of the economy. Thus it can be seen that while the rate of growth of output and value-added during plan period are reduced below the basic solution level, the same for manufacturing sectors rise above the basic solution level. This changes in sectoral pattern of growth are also reflected in the structure of sectoral prices at the terminal year (see Table 9.12). It can be seen that terms of trade, which was in favour of manufacturing sector in basic solution shifts in favour of agriculture in variant 3. It is found that reduced level of agricultural output at the terminal year pushes up the agricultural price by 7.0 percent which, in turn, increase the price of non-agricultural sectors due to cost interdependence amongst different productive sectors of the economy. Consequently aggregate price index increase by 1.8 percent. Thus our results indicate that decrease in foodgrain output worsens the economic position of the poor and shifts the distribution of income against them.

9.3.3 Income transfer from the non-poor to the poor

In order to analyse the economic impact of income transfer from the non-poor to the poor we have considered two variants of the basic solution of the plan model. In variant 4 we transfer 2.0 percent income of the non-poor, as obtained under the basic solution, to the poor. In absolute terms this amounts to transfering Rs. 1612 crores (at 1984-85 prices) to the poor. In variant 5 we analyse the impact of this income transfer when the foodgrain output is held at the basic solution level. In this context we may note that income transfer from the non-poor to the poor, for the given level of terminal year GDP will increase the terminal year aggregate consumption and reduce the terminal year gross investment. This is due to decrease in aggregate saving of the non-poor as a result of income transfer. Fall in terminal year investment will, however, reduce the post-terminal GDP growth rate which, in turn, will determine the perspective year level of consumptions of the poor and the non-poor. Thus the impact of terminal year income transfer is estimated by considering its both short run as well as long run impact on the poor.

Macro-economic impact of income transfer are presented in Table 9.8. It is seen that, due 2.0 percent income transfer from the non-poor to the poor, the aggregate percapita consumption at the terminal year increase by 0.05 percent over the basic solution level, while terminal year investment falls by 0.34 percent. The fall in the rate of investment is less than increase in rate of consumption as the rate of import falls due to income transfer from the non-poor to the poor. Rate of domestic savings also falls by 0.26 percent due to income redistribution in favour of the poor. However, the rate of foreign savings remains almost at the basic solution level although the aggregate foreign exchange requirement falls due to income redistribution. Post terminal growth rate, however, falls from the basic solution level of 5.88 percent to 5.85 percent bringing down the overall growth of GDP during the plan horizon from 5.59 percent to 5.57 percent. Rate of growth of percapita aggregate consumption during the plan period slightly rises but the same during the post-plan period falls and consequently the growth of per capita consumption during the plan horison is reduced from 3.58 percent in the basic solution to 3.56 percent under the variant 4. (see Table 9.10).

Economic position of the poor and the non-poor (see Table 9.9) at the terminal year as well as perspective year and their growth of consumption during the plan and post-plan period show that income transfer from the non-poor to the poor has favourable short run and long run impact on the poor. Thus the terminal year consumption inequality and poverty falls due to such income redistribution. Moreover, as the increase in growth of consumption of the poor during the plan period outweigh its fall during the post-plan period, the overall growth of percapita consumption of the poor during the plan horizon rises above the corresponding basic solution level. Further, we may note that overall growth of consumption of the non-poor is also above the basic solution level as the fall in growth of their percapita consumption during the plan period is more than compensated by the rise in growth of consumption during the post-plan period. However, the increase in overall consumption of the poor, during the plan period, is relatively more than that of the non-poor. . Patterns of growth of output and value-added during both plan and post-plan period (see Tables 9.11 and 9.13) are shifted towards agricultural sector as the major portion of the income transferred to the poor is spent on agricultural products. Consequently the overall rate of growth of agricultural sector increases above, and that of manufacturing sector falls below, the corresponding basic solution level. This shifts in pattern of sectoral growth during the plan and post-plan period towards agricultural sector result in increased share of agricultural sector, as compared with the corresponding basic solution level, in both total plan and terminal year investment. Finally comparision of results under variant 4 with that under variant 5 show that favourable growth and distributional impact of income transfer from the non-poor to the poor are much reduced if there is agricultural output constraint in the economy.

9.3.4 Growth maximisation and inequality reduction approach towards poverty reduction : A Comparision

Growth acceleration and inequality reduction are two contending approaches for reducing poverty in developing countries. As we have noted in the introductory chapter, the proponents of growth acceleration as major objective for reducing poverty assume that growth, with its so called " trickle down" effect will improve the economic position of the poor. However, empirical evidence so far produced show that 'trickle down' effect of growth is not too high to have substantial impact on poverty. Consequently it has been argued that income redistribution should be considered as an integral part of overall development strategy, and policies should be directly aimed at improving the distribution of income. In this section our purpose is to compare these two approaches in terms of their short run and long run impact on the economic position of the poor.

In order to compare these two approaches we shall consider the results under variant one, where the targeted GDP growth is increased from 5.0 percent to 5.5 percent, and the variant four, where a reduction in inequality is achieved by transfering 2.0 percent income of the non-poor to the poor with a GDP target of 5 percent as in the basic solution. Growth of percapita income and consumption of the poor under these two variants indicate (see Table 9.10) that inequality reduction approach has more favourable impact on overall growth of consumption of the poor than the growth maximisation approach. It can be seen that while the growth of consumption of the poor, under variant 4, over the fifteen year plan horizon is 1.71 percent, the same under variant one is 1.62 percent. This increase in percapita consumption of the poor, under inequality reduction approach is, however, at the cost of consumption loss of the non-poor during the plan horizon. Increase in targeted GDP, on the otherhand, increase the percapita consumption of both the poor and the non-poor, although the rate of increase of consumption of the non-poor is more than that of the poor. Indices of poverty and income inequality under variants one and four (see Table 9.9) also indicate the favourable impact of inequality reduction approach on economic condition of the poor.

9.3.5 Wage policy

Analysis of wage policies with the basic model as considered in Chapter 6 showed favourable impact of increase in minimum wage along with subsidies on agricultural input and foodgrain output on the economic position of the poor. We also noted that increase in nominal wage of the non-poor employed in unorganised sector of the economy has unfavourable economic impact on the poor. However, analysis of wage policies as considered in Chapter 6 does not consider the impact of such wage policies on long run growth of income of the poor and the non-poor. In this section our purpose is to examine the economic impact of different wage policies taking into consideration both short run and long run growth of percapita consumption of the poor and the non-poor. For this we have considered seven variants of the basic solution as described in alternatives 6 to 12 (see Table 9.7). In alternative 6 we increase the minimum wage in all sectors to Rs. 8.00 at the terminal year, when the base year daily wage rate is as low as Rs. 3.00 in some sectors of the economy. In variant 7 this minimum wage policy is evaluated when the foodgrain output is determined by supply response function. Variants (8), (9) and (10) estimate the economic impact of increase in minimum wage policy with 5.0 percent subsidy on agricultural input (fertilizer) and foodgrain output under three alternative assumptions regarding supply of foodgrain output viz. (a) foodgrain output is determined by demand (b) foodgrain output is exogenously specified and (c) foodgrain output is determined by supply response function. Finally in variants (11) and (12) we examine the economic impact of increasing nominal wage of those employed in organised sector of the economy when (a) there is no constraint in foodgrain supply and (b) when foodgrain output fixed at the basic solution level.

In this context we may note that empirical conclusion regarding implication of different wage policies depend upon how the labour market operates in different sectors of the economy. In organised sectors wages are generally fixed through bargain while in unorganised sector it is determined in neoclassical fashion. In such a situation increase in minimum wage in unorganised sector may reduce aggregate employment through capital labour substitution and the minimum wage policy may be less effective in reducing poverty. In fact our results under variant 7 demonstrate such a phenomenon.

Macro economic impact of increase in minimum wage, as presented in Table 9.8 (variant 6) indicate that aggregate consumption increases by 1.24 percent while aggregate employment falls by 2.35 per cent of the corresponding basic solution levels. Aggregate terminal year investment is also reduced by 3.38 percent and consequently growth of GDP during post terminal and the entire plan horizon are reduced below the basic solution level. Rate of investment and rate of savings fall by 3.31 percent and 3.44 percent respectively. Prices of agricultural and manufacturing sectors increase by 9.0 percent and 4.05 per cent respectively, pushing up the aggregate price level by 5.0 percent over the basic solution level.

Economic profile of the poor and the non-poor as presented in Table 9.9 show that percapita consumption of the poor increase by 24.56 percent but the same for the non-poor decrease by 4.11 percent as minimum wage is raised to Rs. 8.0. However, the dependency ratio of both the poor and the non-poor increase as the aggregate employment falls below the basic solution level. Further we may note that percentage of poor below the poverty line increases as some non-poor are pulled down below poverty line due to price varising effect of minimum wage policy. However, as the percapita consumption of the people below poverty line rises Sen's index of poverty line shows remarkable improvement over the basic solution. This is also reflected in growth of percapita consumption of the poor during fifteen year plan horizon (see Table 9.10). Results under variant 7, however, show that favourable impact of increase in minimum wage policy on the poor is reduced in case foodgrain output is determined in neoclassical fashion. Results under variants (8), (9) and (10) indicate that increase in minimum wage along with subsidies on agricultural input and output is also quite effective in reducing poverty, but it has unfavourable impact on the short run and long run growth of the non-poor. Moreover the subsidies reduce the terminal year investment and consequently the GDP growth during the post-terminal period and also over the fifteen year plan horizon fall below the corresponding basic solution level. In this context we may note that increase in minimum wage along with subsidies on agricultural input and output is more effective in reducing poverty if foodgrain output is demand determined (variant 8) than when the foodgrain output is exogenously fixed (variant 9) or determined by supply response function (variant 10). Economic impact of minimum wage and subsidy policy, as considered in variants (8), (9) and (10), on the non-poor is, however, unfavourable both in short and long run.

In variants (11) and (12) we examine the impact of raising nominal wage of the non-poor by 10 percent over the basic solution level. This types of income redistribution takes place when nominal wages of the non-poor employed in organised sectors of the economy are raised either by revision of wage rates or through payment of additional dearness allowances, while the wages of the poor, employed in unorganised sector of the economy remain unchanged. Such increase in wage, increases the general price level by pushing up the unit wage cost of production in different productive sectors of the economy.

Macro-economic impact of such wage revision as considered in variant (11) is presented in Tables 9.8. It may be seen that aggregate private consumption and employment increase by 0.05 percent and 0.03 percent respectively, while the terminal year investment falls by 0.20 percent.

Post-terminal rate of growth of GDP decreases marginally due to lower level of terminal year investment. Consequently overall growth of GDP during the fifteen year plan horizon decreases from 5.59 percent to 5.57 percent. Growth in aggregate percapita consumption over the plan horizon is same as that of the basic solution. However, the growth of percapita consumption of the poor during the plan period is reduced from 0.78 percent to 0.72 percent as income is redistributed from the poor to the non-poor. During the post-plan period the growth of consumption of the poor rises slightly above the corresponding basic solution level which, however, could not outweigh the fall in their growth of consumption during the plan period. As a result the overall growth of percapita consumption of the poor during the entire plan horizon has fallen marginally below the basic solution level. Further, it is interesting to note that increase in percapita consumption of the non-poor during the plan period is nullified by its fall during the post-plan period and consequently growth of percapita consumption of the non-poor during the entire plan horizon remain almost at the basic solution level. Thus our results indicate that wage increase in the organised sector may worsen the economic position of the poor; although the economic position of the non-poor is not substantially improved in the long run. Finally, the results under variant (12) show that unfavoural impact of wage increase of the non-poor is more when there is foodgrain output constraint in the economy.

9.3.6 Tax subsidy

Tax-subsidy policies have been traditionally used as instruments for income redistribution. In a mixed economy taxation plays a dual role viz. (i) it provides a machanism for redistributing income through intervention in output and factor markets and (ii) it provides a means for mobilising resources which can be used for raising income of the different sections of populations through appropriate expenditure policies. Subsidies, on the otherhand, are among the most powerful instruments for balancing growth rates and also for equitable distribution of income for protecting the weaker sections of the population. During the last decade subsidies by Government of India on a number of commodities have grown at a rapid rate. The breakdown of various agricultural subsidies at current prices during 1981-82 shows that subsidies on foodgrain and agricultural input (mainly fertilizer) account for a major portion of total agricultural subsidy. In this context we may mention that fertilizer subsidy is a development subsidy meant to reduce the cost of production in agriculture and, therefore, is treated as a means to stimulate agricultural production. Food subsidies, on the otherhand, are essentially subsidies to consumers as the free market price in India during the last decade has been higher than procurement price. We may further note that there have been very few empirical studies in India to analyse the economic impact of different types of tax-subsidies on income distribution, poverty and growth.

Our analysis of different indirect tax-subsidy schemes in Chapter 6 focused their role for redistributing income through intervention in output and factor markets. In this section we shall evaluate the economic impact of direct taxation and indirect tax-subsidy schemes on income distribution, poverty and growth. The types of tax-subsidy policies considered for analysis are described in Table 9.7. In variants 13, 14 and 15 we increase the sectoral tax rates by 0.2 under three alternative treatments of foodgrain output viz. (i) foodgrain output is demand determined (ii) foodgrain output is exogenously specified and (iii) foodgrain output is determined by supply response function. Thus in variant (13) we assume that foodgrain supply increase proportionately with demand either through increased domestic production or through increased imports. In variant (14) we assume that foodgrain output will be same as that before imposition of additional taxes. Finally under variant (14) we consider the impact of indirect taxation on cost of production and agricultural supply response of the farmers. In variants (16) and (17) we consider the impact of subsidies on foodgrain output under alternative treatment (i) and (ii) of foodgrain output as stated above, while in variant (18) we study the impact of subsidy on fertilizer input when foodgrain output is determined by supply response function. Finally, in variant (19) we study the growth and income distributional impact of increasing direct tax rate.

Macro-economic impact of indirect taxation as presented in Table 9.8 shows that increase in indirect tax rate by 0.2 in all taxable sectors push up the agricultural price by 3.44 percent, prices of manufacturing products by 2.9 percent and the overall price index by 3.0 percent. As a result aggregate consumption at the terminal year falls by 2.13 percent but gross investment rises by 18.0 percent. This increase in terminal year investment takes place as resources are redirected from consumption towards investment due to rise in indirect tax rate. Economic position of the poor and the non-poor as presented in Table 9.9 reveal adverse economic impact of increase in indirect tax rate. Percapita income of both the poor and the non-poor falls and indices of poverty and income inequality at the terminal year rise in comparision with their corresponding basic solution levels. Consequently growth in percapita consumption of the poor and the non-poor during the plan period are reduced substantially. However, due to increased level of investment at the terminal year, post-terminal growth in GDP increase as a result of which growth of consumption of both the poor and the non-poor rise to a higher level. But growth in percapita consumption of the poor during the fifteen year plan horizon falls below but that of the non-poor rises above the basic solution level. Pattern of sectoral growth of output and value-added shows remarkable shift towards manufacturing industries as a result of increase in indirect tax rates. Finally, it may be noted that adverse impact of increase in indirect tax rate is more when foodgrain output is determined by farmers supply response.

Macro-economic impact of subsidies on foodgrain output show that terminal year aggregate consumption and employment increase but gross investment falls; and consequently post-terminal GDP growth is reduced below the basic solution level. Prices of agricultural products fall by 3.18 percent but the prices of manufacturing products remain unaffected. Consequently economic position of the poor and the non-poor improve and poverty and income inequality reduce at the terminal year. Economic position of the poor and the non-poor deteriorate during post-plan period. However, overall growth in percapita consumption of the poor over the fifteen year plan horizon is marginally above but the same for the non-poor is below their corresponding basic solution level.

Macro-economic impact of input subsidy shows that subsidy on fertilizer input is more effective than food subsidy in improving the economic condition of the poor. This is due to greater income and employment generating effect of input subsidy than that of the food subsidy. Consequently increase in agricultural input subsidy lead to substantial reduction in terminal year poverty. Further we may note that growth of percapita consumption of the poor during the entire plan horizon rise above but the same for the non-poor fall below the basic solution level. Finally the results of variant 10 shows that increase in direct tax rate redistribute income towards the poor and marginally improve their economic position.

9.3.7 Investment redistribution towards agriculture

Agriculture is the most important sector both for overall income growth and also for improvement of economic condition of the poor. A policy of investment redistribution towards agriculture, therefore, is a more efficient way of raising the employment and income of the poor. This calls for use of the resources mobilized not for consumption but for investment in various forms. Investment requirement by different sectors at the terminal year are estimated by accelerator type investment functions taking into consideration growth of capacity creation during the post-terminal period. A diversion of additional investment resources for agricultural development is considered in tthe present study by some autonomous investment in agriculture, with zero gestation lag, at the terminal year. Minor or ground water irrigation, construction of irrigation channels etc. are generally of this type. In variant (20) we provide Rs. 800 crores for such investment in agricultural sector by increasing the intercept of the investment function. This additional investment is assumed to be made in such investment projects with incremental capital output ratio of about 2 resulting in 2.0 percent increase in output of foodgrain sector over the basic solution level.

Macro-economic picture under variant (20) show the favourable impact of investment redistribution towards agricultural on the economic condition of the poor. This is understandable as the increase in foodgrain output due to increased agricultural investment has generated more income and employment among the poor. Moreover, this has reduced the agricultural price level by 2.5 percent, resulting in 0.7 percent fall in aggregate price index. It may be noted that aggregate private consumption at the terminal year has increased by about 0.4 percent but gross investment has reduced by 1.5 percent of their corresponding basic solution level. Post terminal growth of GDP has been consequently reduced by 0.28 percent. Growth of agricultural sector the during the plan period rises above but the same during the post-plan period fall below the basic solution level. Total five year plan investment is also higher by about 9.0 percent in which share of agriculture sector is about 4.0 percent more than the basic solution. Investment redistribution towards agriculture reduce, poverty and income inequality. Percentage of poor and Sen's index are reduced by 1.2 percent and 3.2 percent respectively. Monthly percapita consumption of the poor has increased by 1.0 percent at the terminal year but the same for the non-poor has been adversely affected. Thus our results indicate that investment redistribution towards agriculture has favourable impact on income distribution and poverty both in the short run and long run.

9.3.8 Change in agricultural technology

In this section we try to analyse the impact of increased use of fertilizer input in agricultural production on poverty, income distribution and growth. This increased use of fertilizer may be seen as a consequence of introducing new technology in agricultural production. For this we replace fixed coefficient agricultural production function of input-output model by Cobb-Douglas type production function as described in Chapter 4. This production function is integrated with the input-output model to study the repurcussion of new technology in agriculture on other sectors of the economy. In variant (21) we increase the fertilizer use per unit of agricultural output by 20.0 percent. Due to increased use of fertilizer input in agricultural sector, output of agriculture and fertilizer sectors are expected to increase and generate more income and employment in the economy. It may be noted that aggregate consumption at the terminal year has increased by 2.7 percent over the basic solution level. Percapita income of the poor increases while poverty and inequality decrease at the terminal year. Growth of percapita of the poor during the fifteen year plan horizon is higher but the same for the non-poor is lower than their corresponding basic solution level. Agricultural prices fall but that of the manufacturing sectors rise as a result of increased fertilizer use in agriculture. Thus technological improvement in foodgrain production through increased fertilizer dose has considerable favourable impact on poverty and income distribution.

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9.3.9 Increase in household savings rate

In variant (22) we examine the impact of increasing the rate of household savings on long run growth of consumption of the poor and the non-poor. Increase in household savings rate at the terminal year reduce the level of consumption of the non-poor at the terminal year of the plan. The consumption of the poor is also expected to be reduced due to indirect linkage of income and consumption of the poor with that of the non-poor through commodity demand. However, the terminal year aggregate investment is increased as the terminal year GDP is held fixed. Thus what is interesting to examine is whether the increased post-terminal growth of percapita consumption of the poor and the non-poor, due to increase in post-terminal GDP growth, are sufficient to make-up the loss of consumption during the plan period. Our results indicate that loss of percapita consumption of the non-poor during the plan period is made up by the increase in their percapita consumption during the post-plan period. But this does not happen for the poor as the increased growth of their percapita consumption could not outweigh their consumption loss during the plan period. Thus we see that growth of percapita consumption of the non-poor over the plan horizon rise above, and that of the poor falls below, their respective levels in the basic solution. Results on other economic indicators show that foreign savings falls and domestic savings rises due to increase in domestic household savings rate. Further it is interesting to note that, although the consumption inequality at the terminal year falls, the income inequality and poverty rise at the terminal year due to rise in household savings rate. Thus it appears that increase in household savings rate has favourable economic impact on the non-poor and unfavourable economic impact on the poor, although long run growth is increased due to increase in household savings rate.

9.3.10 Increase in Administered price of petrolium products

Petrolium products are important items of intermediate and private consumption in Indian economy, the prices of which are generally administered by the government to keep the demand of such product in line with the domestic supply. In the basic solution prices of such products are determined by 'mark-up' pricing rule. But in our model prices of any non-agricultural sector may be treated as exogenous so that the output of such sector adjust with demand. In this section we shall examine the economic implication of 10.0 percent exogenous increase in the prices of petrolium products. For this purpose, in variant (23), we increase the price of petrolium products, as obtained under the basic solution, by 10.0 percent. Such an increase in prices of petrolium products, in our model, will increase the general price level of the economy, through cost-push mechanism, as the different productive sectors in our model are cost-interdependent. This change in level and pattern of sectoral price will, in turn, affect the level and pattern of output and growth via its influence on the distribution of income and level and pattern of aggregate demand of the economy. Moreover, macro-economic and sectoral changes, in our model, will take place simultaneously to restore the savings-investment equality in the system. At the macro level the increase in price level, due to increase in prices of petrolium products, will reduce the share of aggregate consumption and increase the share of aggregate investment in the terminal year GDP which is held fixed. Distribution of income at the terminal year shifts against the poor due to increase in general price level which, in turn, will change the pattern of aggregate demand, and hence output, at the terminal year. The aggregate savings increase to adjust itself to the increased level of aggregate investment at the terminal year. The post-terminal GDP growth will be increased due to higher level of terminal year investment and consequently the perspective year GDP, aggregate consumption and investment also increase.

The macro-economic picture under variant (23), as presented in Table 9.8, coroborates the above mentioned directions of macro-economic changes. It can be seen that of level of percapita aggregate private consumption at the terminal year decreases by 0.29 percent while that of gross investment increases by 0.75 percent. Increase in the rate of investment is more than the decrease in rate of aggregate consumption as the rate of import falls at the reduced level of private consumption. In this context we may note that import content of private consumption is higher than that of investment in Indian economy. Aggregate employment is also reduced by about 0.04 percent as the pattern of output at the terminal year shifts from the labour intensive agricultural sector to capital intensive non agricultural sector due to shift in the terminal income distribution from poor to the non-poor. Rate of foreign savings is also reduced below the basic solution level as the foreign exchange requirement of the economy falls. Economic profile of the poor and the non-poor shows 4.23 percent fall in percapita consumption of the poor and 0.18 percent increase in percapita consumption of the non-poor. Employment among the poor falls while that among the non-poor raises due to shift in pattern of output from the agriculture sector to the non-agricultural sector of the economy. Consequently, percentage of poor along with their dependency ratio rises. Indices of poverty and income inequality also show that both poverty and income inequality at the terminal year increase due to rise in price of petrolium products. The growth of percapita consumption of the poor during the plan period falls below and the same during the post-plan period rises above their respective basic solution levels. However, the rise in percapita consumption during the post-plan period can not outweight the fall of consumption during the plan period. Consequently overall growth of percapita consumption of the poor, during the entire plan horizon, is slightly below the corresponding level the basic solution. Percapita consumption of the non-poor, however, rises during both plan and post-plan periods and their overall growth of consumption during the plan horizon is much higher than that of the poor and also than that of the basic solution. Thus we see that rise in prices of petrolium products increases poverty and income inequality in the short run but seems to have favourable impact on long run economic growth.

9.3.11 Export promotion and import substitution

In variants (24), (25) and (26) we analyse the impact of export promotion and import substitution on income distribution poverty and growth. In Chapter 6 we studied the impact of these trade policies only on income distribution and poverty as the basic model does not provide the analytical frame work to study their impact on economic growth. The plan model, however, provides an integrated treatment of income distribution and growth, and therefore, can be used to study the economic impact of export promotion and import substitution on growth, income distribution and poverty. For this purpose we increase the terminal year export by 10.0 percent in all exportable sectors in variant (24), while in variant (26) import substitution is considered through 10.0 percent reduction in imports in all importing sectors. The results under variant (24), show that increase in export reduces the terminal year investment and increase the terminal year private consumption by 4.22 percent and 8.07 percent respectively. Moreover, it is seen that aggregate employment at the terminal year increases by about 0.18 percent and the terminal year income distribution shifts in favour of the poor. However, the aggregate savings rate at the terminal year falls slightly below the basic solution level. This macro-economic changes at the terminal year is caused by change in pattern of terminal year output resulting from increase in the level of output of export generating sectors which are relatively more labour intensive. Rate of foreign savings is reduced by 2.74 percent as the exports are increased while the rate of import slightly falls. Moreover the macro-economic aggregates indicate favourable impact of increase in export on the terminal year economic position of the poor and the non-poor. It is interesting to note that this favourable impact is more for the poor than the non-poor. However, the post-terminal growth is reduced from 5.88 percent in the basic solution to 5.77 percent under variant (24). Consequently the growth of consumption during the post-terminal period falls below the basic solution level. Moreover the increase in consumption during the plan period can not outweigh the fall in consumption during the post-plan period and the growth of consumption over the plan horizon falls below the basic solution level. The same phenomenon is observed for the growth of consumption of both the poor and the non-poor. Thus it appears that favourable terminal year impact of rise in export is nullified if one considers its long run impact on growth of consumption of the different socio-economic groups. Further, comparision of results under variant (24) and variant (25) show that favourable short run impact of export promotion on the economic condition of the poor disappears when the policy of export promotion is pursued in the presence of agricultural output constraint in the economy. Finally results under variant (26) clearly show the import substitution has an unfavourable impact on the economic position of the poor.

9.3.12 Effects of population growth

The growth of population affects both the rate of growth and distribution of income through its impact on rate of savings. A higher rate of population growth leads to a lower rate of growth of percapita income and this in turn slows down the rise in aggregate savings of the economy. In variant (27) we have increased the population from 717.2 million (as in Sixth Plan) to 737.0 million (as per Seventh Plan). This is about 3.0 percent rise in population above the basic solution level. In otherwords this envisage a 35.0 percent rise in the rate of population growth during the plan period. Macro-economic results show that increase in population has reduced the per capita consumption and investment at the terminal year. Rate of savings has shown a marginal fall from the basic solution level. Aggregate employment has also reduced resulting in rise in dependency ratio of both the poor and the non-poor. Total five year plan investment has reduced by 3.16 percent. Economic position of both the poor and the non-poor have been adversely effected and poverty and income inequality have increased at the terminal year. Growth of GDP during the post-terminal period has been reduced pulling down the GDP growth over the plan horizon below the basic solution level. Rate of growth of aggregate per capita consumption and the same for the poor and the non-poor have considerably slowed down due to increase in population growth. Thus the empirical results under variant (27) show that rise in population has adverse effect on both short run and long run growth, income distribution and poverty.

9.4 Trade-off between income redistribution and growth

In this section we shall examine the extent of trade-off between income redistribution and growth for Indian economy under the various growth and redistributive policies considered in the present study. In recent years there has been growing theoretical and empirical literature on the link between income distribution and growth. At the theoretical level, one of the key arguments showing trade-off between income redistribution and growth, which stems back as far as Adam Smith, is that the different socio-economic classes have different tendencies to consume rather then accumulate and therefore, any redistribution 'revenue' between classes would change the overall savings rate and hence growth. Based on this idea is the view that inflation redistribute income from wages to profit and this 'forced savings' through inflation is also a method of increasing growth. Another line of argument incorporates Keynesiam notion of negative correlation between income and marginal propensity to consume. This argument attributes the difference in savings rate to income groups and concludes that more even distribution in income will reduce the overall savings rate and growth. Finally, there is another converse argument, which may be relevant for developing countries. This is that if growth is slowed down by a shortage of demand then redistribution of income in favour of the poor will accelerate growth.

In this context we may note that first two arguments assume that redistribution of income will reduce private savings needed for investment and would, therefore, be harmful to future growth. But redistribution of income may increase the public and corporate savings and may offset the reduction in private savings. Moreover, it is also implicitly assumed that entire private savings will be translated into productive investment within the economy.

Empirical studies on the link between growth and income redistribution is, however, far from unambiguous. Thus Chenery and Elkington (1975) while analysing the patterns of development during sixties, from cross-country data, found that share of savings in GNP in developing countries is 15 to 16 per cent, while the same for the developed countries is about 22 percent. Similarly Gupta (1975) has found that growth and equity trade-off exists for Indonesian economy. On the otherhand, some hold the view that, even if the growth equity trade-off exists, its magnitude is small and can outweigh the positive effects of more equal distribution of income. For example, Chinn (1972) found low negative growth effect of progressive income redistribution of Taiwan and Korea. Similar result has also been found by Mohammed (1981) for Indian economy.

These studies seem to confirm the view that a certain trade-off between income redistribution and growth exists. But this view can not be taken for granted for the following reasons : First, most of these studies do not distinguish between private, public and corporate savings. The evidence of negative impact of income redistribution on savings is mainly on private savings. But as noted above, the public and corporate savings may increase as a result of increased level of output due to income redistribution. Secondly these studies implictly assume that entire private savings will be translated into productive investment within the economy. This assumption may be questioned in view of the fact that a major portion of savings may be used in unproductive speculative investment or may be diverted outside the economy. Thirdly, they assume that domestic savings is only constraint limiting growth while in fact, it is one of the various constraints which limit growth of the developing countries. For example, foreigh exchange constraint may be more binding on growth than the domestic savings in many developing countries. The recent experience of Indian economy actually points to this fact. Thus it has been argued that redistribution of income towards the lower income group may ease the balance of payment constraint and contribute to faster growth, as the goods which carry relatively higher weight in budget of the poor people have relatively low import content.

This was explored by Paukert, Maton and Skolka (1979) for Philipines and was found that income redistribution decreased the import content of GDP, although the absolute level of import is increased as a result of increase in GDP level due to income redistribution. Fourthly one may question the adequacy of their analytical frame work for studying the link between growth and income redistribution. This is because the analytical frame work of these studies do not consider the two - way interrelation between growth and income distribution. The interrelation between growth and income distribution in this frame work is studied by considering the impact of income redistribution on private savings and then translating the aggregate private savings into aggregate growth rate using a global capital output ratio. Thus in this framework income redistribution does not affect the level and pattern of investment which is treated as exogenous element in these studies. Consequently the impact of growth on income distribution is ignored in such a framework. Finally we may note that extent of trade-off between income redistribution and growth depends upon the types of growth and redistributive policy instruments used in a particular economy. For certain types of policies this trade-off may be quite large when there may exists some redistributive policy instrument for which the growth equity trade-off is minimum. In fact our results suggest such a possibility. Thus the evaluation of growth equality trade-off should be policy specific and it would be useful to look for such redistributive policies for which this trade-off is minimum.

In the plan model of the present study we attempted to overcome the above limitations. It may be recalled that aggregate domestic savings in the present model consist of household savings, private corporate savings and public savings so that impact of income redistribution on aggregate savings is based on the impact on individual categories of domestic savings. Secondly, the import being endogenously estimated on the basis of import content of both final and intermediate demand, the impact of income redistribution on rate as well as absolute level of import is also taken into account in the present model. Moreover, the endogenously estimated rate of foreign savings plays a crucial role in maintaining aggregate savings investment identity in the present model. Finally, the trade-off between income redistribution and growth in the present model is estimated for different redistributive policy instruments via the impact of income redistribution on gross investment. Moreover, as the present model provides a mechanism of translating the gross investment into investment by sector of destination and consequently into sectoral rates of growth, the income distribution and growth are integrated with each other on the basis of the two-way relationship between them.

The trade-off between income redistribution and growth under alternative policies can be evaluated by comparing the percapita consumption levels of different socio-economic groups at the terminal and perspective year. This can be done by aggregating percapita consumption level of different groups into a single utility index using the social utility function as described in Chapter 6. Change in percapita utility level at the terminal and the perspective year will give some idea regarding the extent of growth equity trade-off for various redistributive policies. Percapita utility level at the terminal and the perspective year, under alternative redistributive policies, are calculated using 'equal weight' and 'poverty weight' social welfare function as described in Chapter 6. Percapita utility level so estimated are presented in Table 9.14. We may note that percapita utility level for the basic solution under 'equal weight' and 'poverty weight' social welfare function are higher than the corresponding base year values. We may note from Tables 9.9 and 9.10 that extent of trade-off between income distribution and growth show wide variation under different growth and redistributive policies. Comparision of percapita utility level at the terminal and perspective year as presented in Table 9.14 show that growth oriented policies like indirect tax policy, household savings policy and price policy show substantial trade-off where these policies reduce the terminal year consumption, and thereby increase terminal year investment, and post-terminal growth of percapita consumption. Redistributive policies like minimum wage policy and income transfer policies, which increase terminal year consumption but decrease post terminal growth of percapita consumption, also show trade-off between income distribution and growth. But extent of trade off under these policies is less than that of growth policies. Finally we may note that policies of increasing agricultural output through redirection of investment towards agriculture or by introduction of new agricultural technology seems to be quite effective in achiving growth with income redistribution as these policies exhibit little trade-off between growth and income redistribution.

Table 9.8 : Macro-economic Indicators at Terminal year (as percentage of Basic Solution)

	Economic Indicators	Alternative case number						
		(1)	(2)	(3)	(4)	(5)	(6)	(7)
1.	GDP at market price	102.47	102.49	101.13	99.96	100.00	99.93	100.28
2.	Monthly per capita consumption	101.85	101.67	98.88	100.05	99.78	101.24	100.60
3.	Gross investment	106.32	106.95	103.82	99.66	100.66	96.62	97.12
3.1	Share in agriculture	99.20	99.20	100.40	99.60	99.60	96.41	96.02
3.2	Share in industry	101.04	101.04	100.00	100.34	100.35	100.69	97.91
4.	Import[1/]	100.68	100.79	100.79	101.02	100.11	100.11	101.69
5.	Export[1/]	92.55	97.55	99.87	100.00	100.00	100.00	99.74
6.	Employment	101.45	101.40	99.64	100.21	100.10	97.65	96.04
7.	Rate of investment	103.75	104.32	106.67	99.71	100.65	96.69	100.28
8.	Rate of savings	102.80	103.35	108.77	99.74	100.62	96.56	99.54
9.	Five year Plan investment	107.22	107.01	110.52	100.93	100.37	92.22	96.43
9.1	Share in agriculture	106.85	103.05	98.30	109.99	101.35	111.26	97.90
9.2	Share in industry	102.24	103.02	102.47	97.47	99.83	95.92	104.43
10.	ICOR[2/]	97.67	97.41	102.33	101.04	100.25	99.22	101.29
11.	Aggregate price	99.20	99.48	101.76	99.99	96.33	104.89	100.63
11.1	Agriculture	99.56	100.67	107.03	99.62	101.88	109.05	111.15
11.2	Manufacturing industry	99.21	99.18	99.84	100.10	100.03	104.05	103.57

1/ As percentage of GDP at current market price.

2/ Incremental capital output ratio.

Contd.../-

Table 9.8 : Macro-economic Indicators at Terminal year (Continued)
(as percentage of Basic Solution)

	Economic Indicators	Alternative case number (8)	(9)	(10)	(11)	(12)	(13)	(14)
1.	GDP at market price	98.94	99.26	99.33	99.99	99.99	103.96	103.93
2.	Monthly per capita consumption	102.56	100.68	102.65	100.05	100.46	97.87	98.09
3.	Gross investment	91.49	98.03	95.88	99.80	99.77	118.00	116.99
3.1	Share in agriculture	97.21	97.21	95.62	100.40	100.40	100.00	99.60
3.2	Share in industry	100.35	100.69	102.08	100.00	100.00	99.31	99.31
4.	Impor	99.66	101.13	101.69	99.89	99.89	101.13	101.10
5.	Expor	101.03	100.77	100.64	100.00	100.00	96.14	96.27
6.	Employment	97.86	97.34	96.54	100.03	100.04	100.20	100.29
7.	Rate of investment	94.77	101.12	98.95	99.60	99.80	113.50	115.59
8.	Rate of savings	97.86	103.61	100.97	99.83	99.83	112.15	117.24
9.	Five year Plan investment	98.27	103.61	100.25	100.42	99.86	107.46	106.06
9.1	Share in agriculture	132.59	96.18	95.93	107.96	100.76	98.89	99.58
9.2	Share in industry	89.87	99.18	103.55	97.99	99.60	100.00	98.90
10.	ICOR	102.59	102.33	103.11	100.52	99.96	93.00	91.70
11.	Aggregate price	104.01	107.24	104.42	100.74	96.26	103.11	102.75
11.1	Agriculture	104.96	117.99	107.98	100.57	100.24	103.44	102.05
11.2	Manufacturing industry	104.45	104.01	103.89	100.92	100.74	102.89	102.92

Contd.../-

Table 9.8 : Macro-economic Indicators at Terminal year (Continued)
(as percentage of Basic Solution)

	Economic Indicators	Alternative case number						
		(15)	(16)	(17)	(18)	(19)	(20)	(21)
1.	GDP at market price	104.17	99.24	99.26	100.03	100.01	99.93	100.01
2.	Monthly per capita consumption	101.27	101.08	109.13	105.71	99.30	100.41	102.69
3.	Gross investment	120.21	96.50	96.41	101.37	102.16	98.53	98.08
3.1	Share in agriculture	100.00	100.49	100.40	100.00	99.60	107.17	99.60
3.2	Share in industry	100.00	100.00	99.65	101.04	100.35	97.23	100.34
4.	Import	102.03	99.89	99.88	101.02	100.45	99.55	99.89
5.	Export	96.01	100.83	100.77	100.00	100.00	100.13	100.00
6.	Employment	97.99	100.23	100.25	101.25	99.82	100.12	100.29
7.	Rate of investment	118.27	97.23	97.14	101.34	102.16	101.09	100.54
8.	Rate of savings	119.58	94.44	97.35	101.06	102.01	103.84	103.13
9.	Five year Plan investment	110.02	98.78	98.89	102.72	100.90	101.50	99.56
9.1	Share in agriculture	101.27	110.16	111.35	101.16	96.95	132.43	107.37
9.2	Share in industry	102.73	96.84	96.61	103.35	101.22	93.45	98.19
10.	ICOR	94.56	101.89	101.92	102.65	100.92	101.81	99.48
11.	Aggregate price	102.67	95.11	95.10	95.26	95.75	99.33	98.71
11.1	Agriculture	84.33	96.92	96.90	98.83	100.10	97.46	95.42
11.2	Manufacturing industry	102.62	100.28	100.28	99.69	99.87	100.10	104.46

Contd.../-

Table 9.8 : Macro-economic Indicators at Terminal year (Continued)
(as percentage of Basic Solution)

	Economic Indicators	Alternative case number					
		(22)	(23)	(24)	(25)	(26)	(27)
1.	GDP at market price	100.16	99.99	99.92	99.92	99.88	99.88
2.	Monthly per capita consumption	96.90	99.71	108.07	98.24	107.28	107.28
3.	Gross investment	109.73	100.75	95.78	95.93	95.60	95.60
3.1	Share in agriculture	99.20	100.00	100.80	100.79	100.40	100.40
3.2	Share in industry	101.04	100.00	99.30	99.65	99.65	99.65
4.	Import	102.15	100.00	98.98	99.09	89.94	89.94
5.	Export	99.87	100.00	110.04	110.04	101.16	101.16
6.	Employment	99.29	99.96	100.18	100.16	99.40	99.40
7.	Rate of investment	109.54	100.77	95.84	96.00	96.70	96.70
8.	Rate of savings	108.93	100.75	99.37	99.49	100.67	100.67
9.	Five year Plan investment	97.99	100.79	99.09	98.58	96.84	96.84
9.1	Share in agriculture	97.29	106.10	108.21	103.64	100.08	100.08
9.2	Share in industry	104.01	98.75	98.03	98.78	98.75	98.75
10.	ICOR	104.66	100.78	99.48	98.96	101.29	101.29
11.	Aggregate price	99.82	100.74	100.06	95.91	99.82	99.82
11.1	Agriculture	100.39	100.57	99.85	100.14	97.97	97.97
11.2	Manufacturing industry	99.42	100.92	100.14	100.16	99.41	99.41

Table 9.9 : Economic profile of the Poor and Non-poor (as percentage of Basic Solution)

Economic Indicators	Alternative case number (1)	(2)	(3)	(4)	(5)	(6)	(7)
Terminal year							
1. Monthly per capita (p.c.) income							
1.1 Poor	101.18	100.71	97.18	104.55	103.92	124.56	121.94
1.2 Non-poor	101.25	101.37	100.74	96.33	97.13	96.10	96.66
2. Monthly p.c. consumption							
2.1 Poor	101.18	100.71	97.18	104.55	103.92	124.56	121.94
2.2 Non-poor	101.25	101.43	101.50	96.28	97.22	95.89	96.55
3. Employment							
3.1 Poor	99.98	100.43	96.31	95.36	97.53	101.52	101.29
3.2 Non-poor	103.02	102.43	102.80	105.35	102.81	93.58	90.49
4. Dependency ratio							
4.1 Poor	98.62	98.63	100.27	99.72	99.72	102.47	116.76
4.2 Non-poor	98.24	98.46	101.10	100.00	99.34	103.29	105.48
5. Poverty							
5.1 Percentage of poor	98.56	99.05	103.17	95.17	97.44	104.07	105.47
5.2 Sen's index (%)	96.41	97.68	108.22	87.86	91.01	36.62	42.97
6. Inequality							
6.1 Income	98.72	99.65	105.79	91.89	95.67	88.69	88.84
6.2 Consumption	99.20	100.00	105.43	90.70	93.24	79.14	82.29
Perspective year							
7. Monthly p.c. consumption	105.81	106.09	101.35	99.82	100.24	98.57	100.92
7.1 Poor	99.52	100.28	98.83	101.85	101.60	110.08	108.99
7.2 Non-poor	106.04	106.33	101.46	99.73	101.18	98.08	100.57

Contd.../-

Table 9.9 : Economic profile of the Poor and Non-poor (as percentage of Basic Solution) (Continued)

Economic Indicators	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	Alternative case number						
Terminal year							
1. Monthly per capita (p.c.) income							
1.1 Poor	121.38	119.68	126.36	99.74	99.76	98.14	98.72
1.2 Non-poor	96.44	98.60	96.90	100.31	100.30	98.90	98.67
2. Monthly p.c. consumption							
2.1 Poor	127.38	119.68	126.36	99.74	99.76	98.14	98.72
2.2 Non-poor	95.93	98.95	100.12	100.30	100.30	98.83	98.59
3. Employment							
3.1 Poor	99.93	105.67	100.06	100.36	100.34	102.18	101.60
3.2 Non-poor	95.66	88.54	92.82	99.68	99.72	98.14	98.91
4. Dependency ratio							
4.1 Poor	102.20	102.74	103.30	100.00	100.00	99.72	99.72
4.2 Non-poor	102.63	104.82	104.38	100.00	100.00	100.22	100.00
5. Poverty							
5.1 Percentage of poor	102.14	108.57	103.65	100.33	100.31	101.97	101.31
5.2 Sen's index (%)	30.45	49.36	37.45	100.77	100.72	105.24	103.53
6. Inequality							
6.1 Income	85.33	97.68	87.64	100.81	101.93	103.78	102.70
6.2 Consumption	76.51	87.19	81.40	100.62	103.47	101.64	100.53
Perspective year							
7. Monthly p.c. consumption	95.64	98.51	98.44	99.88	99.88	112.75	112.54
7.1 Poor	111.24	108.07	109.89	99.88	99.89	99.24	99.46
7.2 Non-poor	94.97	98.09	92.58	99.88	99.87	113.33	113.09

Table 9.9 : Economic profile of the Poor and Non-poor (Continued)
(as percentage of Basic Solution)

Economic Indicators	Alternative case number						
	(15)	(16)	(17)	(18)	(19)	(20)	(21)
Terminal year							
1. Monthly per capita (p.c.) income							
1.1 Poor	96.94	101.35	101.37	102.01	99.89	101.10	102.09
1.2 Non-poor	99.05	101.52	100.44	100.29	99.15	99.71	99.42
2. Monthly p.c. consumption							
2.1 Poor	96.94	101.35	101.37	102.01	99.89	101.10	102.09
2.2 Non-poor	100.19	100.22	100.23	100.23	99.16	99.54	99.12
3. Employment							
3.1 Poor	100.17	98.76	98.78	101.25	99.88	98.89	97.94
3.2 Non-poor	95.69	101.78	101.82	100.85	99.75	101.42	102.78
4. Dependency ratio							
4.1 Poor	101.92	99.72	99.72	97.35	100.00	99.72	99.72
4.2 Non-poor	102.63	99.56	99.34	99.10	100.22	99.56	99.34
5. Poverty							
5.1 Percentage of poor	102.23	98.56	98.53	97.40	100.00	98.80	97.66
5.2 Sen's index (%)	108.16	96.14	96.08	95.10	100.22	96.80	93.93
6. Inequality							
6.1 Income	104.63	106.49	99.88	102.66	101.00	99.20	99.23
6.2 Consumption	103.65	102.22	98.22	101.42	99.42	87.26	98.31
Perspective year							
7. Monthly p.c. consumption	114.11	98.16	98.10	100.72	101.26	97.57	99.44
7.1 Poor	98.62	100.54	100.55	99.34	99.95	100.45	100.85
7.2 Non-poor	108.48	98.06	97.99	100.78	101.32	97.45	99.37

Table 9.9 : Economic profile of the Poor and the Non-poor (as percentage of Basic Solution) (Continued)

Economic Indicators	Alternative case number					
	(22)	(23)	(24)	(25)	(26)	(27)
Terminal year						
1. Monthly per capita (p.c.) income						
1.1 Poor	99.63	95.77	100.11	99.98	99.62	95.55
1.2 Non-poor	99.68	100.14	100.09	100.12	99.61	101.25
2. Monthly p.c. consumption						
2.1 Poor	99.63	95.77	100.11	99.98	99.62	95.55
2.2 Non-poor	96.18	100.18	100.09	100.19	99.59	95.94
3. Employment						
3.1 Poor	99.53	99.21	100.09	94.76	99.89	102.23
3.2 Non-poor	99.06	100.66	100.27	105.87	98.89	97.63
4. Dependency ratio						
4.1 Poor	100.55	100.52	99.72	99.72	100.55	103.02
4.2 Non-poor	100.66	100.01	99.78	99.78	100.66	103.51
5. Poverty						
5.1 Percentage of poor	100.21	100.70	99.91	100.04	100.50	102.25
5.2 Sen's index (%)	100.83	107.26	99.67	100.05	101.58	105.40
6. Inequality						
6.1 Income	100.30	103.59	99.88	101.59	100.35	101.42
6.2 Consumption	97.29	103.91	99.91	103.38	100.84	102.32
Perspective year						
7. Monthly p.c. consumption	105.36	100.35	97.58	97.65	96.32	102.64
7.1 Poor	99.83	99.74	100.03	99.98	99.83	99.26
7.2 Non-poor	105.60	100.38	97.47	97.55	96.17	102.79

Table 9.10 : Annual Compound rates of growth of GDP and Private Consumption

(Percent)

Economic variables	Basic Solution	Alternative case number						
		(1)	(2)	(3)	(4)	(5)	(6)	(7)
1. GDP								
1.1 Pre-terminal	5.00	5.50	5.50	5.00	5.00	5.00	5.00	5.00
1.2 Post-terminal	5.88	6.19	6.23	6.13	5.85	5.93	5.66	5.93
1.3 Overall	5.59	5.96	5.99	5.75	5.57	5.62	5.44	5.62
2. Private consumption								
2.1 Pre-terminal	2.45	2.83	2.79	2.22	2.46	2.40	2.70	2.57
2.2 Post-terminal	4.15	4.54	4.59	4.40	4.12	4.19	3.86	4.18
2.3 Overall	3.58	3.97	3.99	3.67	3.56	3.59	3.47	3.64
3. Per Capita (p.c.) consumption of poor								
3.1 Pre-terminal	0.78	1.02	0.92	0.20	1.68	1.55	5.30	4.87
3.2 Post-terminal	1.99	1.92	1.94	2.15	1.72	1.75	0.73	0.85
3.3 Overall	1.58	1.62	1.60	1.50	1.71	1.69	2.23	2.17
4. P.c. Consumption of the Non-poor								
4.1 Pre-terminal	2.36	2.62	2.65	2.59	1.59	1.78	1.50	1.65
4.2 Post-terminal	1.24	1.70	1.72	1.27	1.59	1.54	1.47	1.65
4.3 Overall	1.61	2.00	2.02	1.71	1.59	1.62	1.48	1.65

Contd.../-

Table 9.10 : Annual Compound rates of growth of GDP and Private Consumption (Continued)

(Percent)

Economic variables	Basic Solution	Alternative case number (8)	(9)	(10)	(11)	(12)	(13)	(14)
1. GDP								
1.1 Pre-terminal	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
1.2 Post terminal	5.88	5.28	5.77	5.60	5.86	5.86	7.04	6.97
1.3 Overall	5.59	5.19	5.51	5.40	5.57	5.57	6.35	6.32
2. Private consumption								
2.1 Pre-terminal	2.45	2.97	2.59	2.82	2.46	2.46	2.01	2.05
2.2 Post-terminal	4.15	3.42	3.92	3.80	4.13	4.13	5.63	5.59
2.3 Overall	3.58	3.27	3.47	3.47	3.57	3.57	4.41	4.40
3. Per Capita (p.c.) consumption of poor								
3.1 Pre-terminal	0.78	5.77	4.46	5.23	0.72	0.73	0.40	0.52
3.2 Post-terminal	1.99	0.61	0.95	0.75	2.00	2.00	2.10	2.06
3.3 Overall	1.58	2.31	2.11	2.22	1.57	1.58	1.53	1.55
4. P.c. Consumption of the Non-poor								
4.1 Pre-terminal	2.36	1.51	2.14	1.66	2.42	2.42	2.12	2.07
4.2 Post-terminal	1.24	1.13	1.15	1.37	1.19	1.19	2.63	2.63
4.3 Overall	1.61	1.26	1.48	1.47	1.60	1.60	2.46	2.45

Contd.../-

Table 9.10 : Annual Compound rates of growth of GDP and Private Consumption (Continued)

(Percent)

Economic variables	Basic Solution	Alternative case number (15)	(16)	(17)	(18)	(19)	(20)	(21)
1. GDP								
1.1 Pre-terminal	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
1.2 Post-terminal	5.88	7.16	5.62	5.61	5.95	6.04	5.60	5.74
1.3 Overall	5.59	6.43	5.41	5.41	5.63	5.69	5.40	5.49
2. Private consumption								
2.1 Pre-terminal	2.45	1.94	2.67	2.68	2.39	2.31	2.53	2.61
2.2 Post-terminal	4.15	5.79	3.84	3.83	4.25	4.35	3.85	4.01
2.3 Overall	3.58	4.49	3.45	3.44	3.63	3.66	3.41	3.54
3. Per Capita (p.c.) consumption of poor								
3.1 Pre-terminal	0.78	0.10	1.05	1.05	0.46	0.75	1.00	1.19
3.2 Post-terminal	1.99	2.19	1.91	1.90	2.08	1.99	1.92	1.86
3.3 Overall	1.58	1.49	1.62	1.62	1.87	1.58	1.61	1.64
4. P.c. Consumption of the Non-poor								
4.1 Pre-terminal	2.36	2.16	2.40	2.41	2.41	2.19	2.26	2.18
4.2 Post-terminal	1.24	2.74	1.02	1.01	1.29	1.45	1.02	1.26
4.3 Overall	1.61	2.55	1.48	1.47	1.66	1.70	1.43	1.57

Contd.../-

Table 9.10 : Annual Compound rates of growth of GDP and Private Consumption (Continued)

(Percent)

Economic variables	Basic Solution	Alternative case number					
		(22)	(23)	(24)	(25)	(26)	(27)
1. GDP							
1.1 Pre-terminal	5.00	5.00	5.00	5.00	5.00	5.00	5.00
1.2 Post-terminal	5.88	6.56	5.93	5.77	5.58	5.59	5.81
1.3 Overall	5.59	6.04	5.62	5.38	5.39	5.33	5.54
2. Private consumption							
2.1 Pre-terminal	2.45	1.81	2.39	2.48	2.47	2.32	1.90
2.2 Post-terminal	4.15	5.02	4.21	3.88	3.89	3.82	4.01
2.3 Overall	3.58	3.94	3.60	3.41	3.41	3.32	3.30
3. Per Capita (p.c.) consumption of poor							
3.1 Pre-terminal	0.78	0.70	0.66	0.80	0.78	0.70	0.42
3.2 Post-terminal	1.99	2.01	2.02	1.98	1.99	2.01	2.09
3.3 Overall	1.58	1.57	1.57	1.58	1.58	1.57	1.53
4. P.c. Consumption of the Non-poor							
4.1 Pre-terminal	2.36	1.57	2.40	2.37	2.39	2.28	2.00
4.2 Post-terminal	1.24	2.19	1.26	0.97	0.97	0.88	1.09
4.3 Overall	1.61	1.98	1.64	1.44	1.44	1.34	1.39

Table 9.11 : Annual Compound rates of growth of Value added for broad groups of sectors

(Percent)

Sectors/period	Basic Solution	Alternative case number (1)	(2)	(3)	(4)	(5)	(6)	(7)
1. Agriculture								
1.1 Pre-terminal	2.76	3.02	2.95	2.29	2.96	2.80	3.01	2.06
1.2 Post-terminal	5.00	5.25	5.30	5.31	4.90	4.99	4.54	4.87
1.3 Overall	4.25	4.50	4.51	4.29	4.26	4.26	4.03	3.93
2. Manufacturing								
2.1 Pre-terminal	6.16	6.85	6.90	6.41	6.03	6.14	6.02	6.76
2.2 Post-terminal	6.01	6.37	6.41	6.22	6.05	6.10	5.85	6.03
2.3 Overall	6.07	6.53	6.57	6.31	6.05	6.12	5.91	6.27
3. Electricity								
3.1 Pre-terminal	5.11	5.64	5.66	5.21	5.09	5.12	5.15	5.91
3.2 Post-terminal	6.03	6.33	6.37	6.26	5.96	6.08	5.87	5.99
3.3 Overall	5.72	6.10	6.14	5.91	5.71	5.76	5.63	5.97
4. Services								
4.1 Pre-terminal	5.89	6.40	6.41	6.00	5.81	5.84	5.78	5.99
4.2 Post-terminal	6.56	6.89	6.93	6.79	6.57	6.64	6.29	6.77
4.3 Overall	6.34	6.73	6.76	6.53	6.32	6.38	6.54	6.52

Contd..../-

Table 9.11 : Annual Compound rates of growth of Value added for broad groups of sectors (Continued)

(Percent)

Sectors/period	Basic Solution	Alternative case number						
		(8)	(9)	(10)	(11)	(12)	(13)	(14)
1. Agriculture								
1.1 Pre-terminal	2.76	3.48	2.58	2.35	0.78	2.27	2.33	2.43
1.2 Post-terminal	5.00	4.16	4.76	4.57	5.00	5.00	6.01	5.95
1.3 Overall	4.25	3.94	4.03	3.82	3.58	4.25	4.77	4.77
2. Manufacturing								
2.1 Pre-terminal	6.16	5.70	6.30	6.61	4.75	6.13	6.20	6.13
2.2 Post-terminal	6.01	5.46	5.86	5.68	5.99	5.99	7.26	7.22
2.3 Overall	6.07	5.55	6.01	5.99	5.58	6.04	6.91	6.86
3. Electricity								
3.1 Pre-terminal	5.11	5.01	5.21	5.93	4.18	5.06	4.98	4.96
3.2 Post-terminal	6.03	5.51	5.95	5.66	6.02	6.01	7.14	7.10
3.3 Overall	5.72	5.39	5.71	5.75	5.40	5.70	6.98	6.38
4. Services								
4.1 Pre-terminal	5.89	5.70	5.94	5.96	5.91	5.90	5.95	5.93
4.2 Post-terminal	6.56	6.15	6.59	6.44	6.54	6.54	7.79	7.74
4.3 Overall	6.34	6.00	6.38	6.28	6.33	0.33	7.18	7.14

Contd.../-

Table 9.11 : Annual Compound rates of growth of Value added for broad groups of sectors (Continued)

(Percent)

Sectors/period	Basic Solution	Alternative case number						
		(15)	(16)	(17)	(18)	(19)	(20)	(21)
1. Agriculture								
1.1 Pre-terminal	2.76	1.83	3.03	3.04	2.21	2.67	2.93	2.83
1.2 Post-terminal	5.00	6.18	4.75	4.74	5.13	5.14	4.76	4.85
1.3 Overall	4.25	4.71	4.17	4.17	4.15	4.13	4.15	4.17
2. Manufacturing								
2.1 Pre-terminal	6.16	6.58	5.95	5.95	6.66	6.24	6.01	6.16
2.2 Post-terminal	6.01	7.33	5.76	5.75	6.03	6.19	5.72	5.88
2.3 Overall	6.07	7.09	5.82	5.82	6.24	6.21	5.82	5.97
3. Electricity								
3.1 Pre-terminal	5.11	5.42	5.03	5.03	5.68	5.13	5.06	5.29
3.2 Post-terminal	6.03	7.18	5.79	5.78	6.00	6.18	5.76	5.86
3.3 Overall	5.72	6.59	5.54	5.53	5.90	5.83	5.53	5.67
4. Services								
4.1 Pre-terminal	5.89	6.05	5.87	5.87	5.98	5.85	5.85	5.87
4.2 Post-terminal	6.56	7.89	6.30	6.29	5.61	6.73	6.29	6.43
4.3 Overall	6.34	7.28	6.16	6.15	6.41	6.44	6.14	6.24

Contd.../-

Table 9.11 : Annual Compound rates of growth of Value added for broad groups of sectors (Continued)

(Percent)

Sectors/period	Basic Solution	Alternative case number					
		(22)	(23)	(24)	(25)	(26)	(27)
1. Agriculture							
1.1 Pre-terminal	2.76	2.39	0.74	2.28	2.86	2.67	2.84
1.2 Post-terminal	5.00	5.58	5.07	4.77	4.78	4.79	4.77
1.3 Overall	4.25	4.51	3.61	3.93	4.14	4.08	4.13
2. Manufacturing							
2.1 Pre-terminal	6.16	6.55	4.80	6.12	6.13	6.00	6.02
2.2 Post-terminal	6.01	6.75	6.06	5.16	5.02	5.65	6.04
2.3 Overall	6.07	6.69	5.65	5.48	5.79	5.77	6.03
3. Electricity							
3.1 Pre-terminal	5.11	5.23	4.21	5.06	5.06	4.88	5.25
3.2 Post-terminal	6.03	6.68	5.46	5.73	5.74	5.76	5.97
3.3 Overall	5.72	6.20	6.08	5.51	5.52	5.46	5.73
4. Services							
4.1 Pre-terminal	5.89	5.73	5.90	5.90	5.91	5.67	5.93
4.2 Post-terminal	6.56	7.29	6.62	6.25	6.15	6.27	6.36
4.3 Overall	6.34	6.77	6.38	6.13	6.26	6.08	6.57

Table 9.12 : Structure of Market prices (Agriculture = 100)

Sector	Basic solution	Alternative case number (1)	(2)	(3)	(4)	(5)	(6)	(7)
1. Agriculture	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
2. Mining and quarrying	83.69	82.79	81.83	77.85	84.14	82.15	77.24	74.64
3. Manufacturing	101.62	101.26	100.13	94.79	101.11	99.78	96.96	94.69
4. Electricity	106.32	105.66	104.46	99.10	106.82	104.37	98.42	95.54

Contd.../-

Table 9.12 : Structure of Market prices (Agriculture = 100) (Continued)

Sector	Basic solution	Alternative case number (8)	(9)	(10)	(11)	(12)	(13)	(14)
1. Agriculture	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
2. Mining and quarrying	83.69	80.71	71.17	77.03	83.56	88.25	82.20	83.39
3. Manufacturing	101.62	101.12	89.58	97.77	102.06	102.12	101.07	102.49
4. Electricity	106.32	102.59	90.81	98.46	109.81	109.88	106.89	108.40

Contd.../-

Table 9.12 : Structure of Market prices (Agriculture = 100) (Continued)

	Sector	Basic solution	Alternative case number (15)	(16)	(17)	(18)	(19)	(20)	(21)
1.	Agriculture	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
2.	Mining and quarrying	83.69	82.16	86.65	86.66	83.84	83.51	86.03	87.57
3.	Manufacturing	101.62	101.59	105.54	105.16	102.50	101.39	104.38	106.52
4.	Electricity	106.32	107.59	109.91	109.92	106.59	106.16	109.21	111.90

Contd.../-

Table 9.12 : Structure of Market prices (Agriculture = 100) (Continued)

	Sector	Basic solution	Alternative case number (22)	(23)	(24)	(25)	(26)	(27)
1.	Agriculture	100.00	100.00	100.00	100.00	100.00	100.00	100.00
2.	Mining and quarrying	83.69	82.87	83.56	84.00	83.74	82.87	83.83
3.	Manufacturing	101.62	100.64	101.97	101.95	101.64	101.42	101.92
4.	Electricity	106.32	105.61	108.27	106.60	106.28	106.49	106.46

Table 9.13 : Rates of growth of Output during plan period by broad group of sectors (Percent)

Sector	Basic solution	Alternative case number						
		(1)	(2)	(3)	(4)	(5)	(6)	(7)
1. Agriculture	3.91	4.18	4.10	3.42	4.12	3.96	4.06	3.80
2. Mining and quarrying	11.34	11.99	12.04	11.63	11.27	11.36	11.28	11.95
3. Manufacturing	7.43	8.08	8.12	7.70	7.32	7.42	7.34	8.00
4. Electricity	9.15	9.71	9.72	9.26	9.14	9.17	9.19	9.19

Contd.../-

Table 9.13 : Rates of growth of Output during plan period (Continued) by broad group of sectors (Percent)

Sector	Basic solution	Alternative case number						
		(8)	(9)	(10)	(11)	(12)	(13)	(14)
1. Agriculture	3.91	4.45	3.50	4.11	3.92	3.93	3.97	3.74
2. Mining and quarrying	11.34	10.93	11.46	11.75	11.30	11.30	10.20	12.35
3. Manufacturing	7.43	7.04	9.26	7.84	6.08	7.40	11.30	8.20
4. Electricity	9.15	9.05	7.21	10.00	8.91	9.10	11.08	9.68

Contd.../-

Table 9.13 : Rates of growth of Output during plan period by broad group of sectors (Percent) (Continued)

Sector	Basic solution	Alternative case number						
		(15)	(16)	(17)	(18)	(19)	(20)	(21)
1. Agriculture	3.91	3.57	4.20	4.21	3.86	3.82	4.09	4.24
2. Mining and quarrying	11.34	12.76	11.12	11.12	11.75	11.45	11.23	11.34
3. Manufacturing	7.43	8.59	7.24	7.24	7.84	7.48	7.29	7.42
4. Electricity	9.15	10.17	9.07	9.08	9.75	9.17	9.10	9.35

Contd.../-

Table 9.13 : Rates of growth of Output during plan period by broad group of sectors (Percent) (Continued)

Sector	Basic solution	Alternative case number					
		(22)	(23)	(24)	(25)	(26)	(27)
1. Agriculture	3.91	3.55	3.88	4.02	4.00	3.82	3.99
2. Mining and quarrying	11.34	11.83	11.35	11.39	11.40	11.06	11.31
3. Manufacturing	7.43	7.72	7.44	7.41	7.42	7.23	7.33
4. Electricity	9.15	9.28	9.14	9.10	9.11	8.91	9.30

Table 9.14 : Percapita Utility level at the Terminal and Perspective year under Alternative Policies

Alternative variant No.	Percapita utility			
	Terminal year		Perspective year	
	Equal weight	Poverty weight	Equal weight	Poverty weight
1	4.58	6.08	5.11	10.37
2	4.57	5.95	5.11	10.37
3	4.54	5.81	5.07	10.30
4	4.58	6.25	5.05	10.33
5	4.57	6.13	5.06	10.33
6	4.62	5.94	5.05	10.42
7	4.61	5.84	5.07	10.43
8	4.64	6.05	5.02	10.41
9	4.60	5.69	5.05	10.40
10	4.65	5.99	5.00	10.37
11	4.56	5.97	5.05	10.31
12	4.56	5.97	5.05	10.31
13	4.54	5.87	5.17	10.41
14	4.54	5.90	5.17	10.42
15	4.54	5.85	5.13	10.36
16	4.57	6.07	5.04	10.30
17	4.57	6.08	5.04	10.30
18	4.59	6.10	5.03	10.29
19	4.56	6.03	5.07	10.32
20	4.58	6.06	5.03	10.34
21	4.57	6.12	5.05	10.31
22	4.54	5.95	5.10	10.35
23	4.56	5.92	5.05	10.33
24	4.61	5.99	5.03	10.29
25	4.55	6.10	5.03	10.29
26	4.56	5.96	5.02	10.27
27	4.56	5.82	5.06	10.27
Basic solution	4.56	5.98	5.06	10.31

CHAPTER 10

Review Of The Study

10.1 Introduction

In this chapter our purpose is to review our study in the light of recent growing theoritical and empirical literature on the relationship between income distribution and growth and the policy responsiveress of this relationship. For this we shall, however, restrict ourselves to the set of studies which try to capture this relationship in input-output framework and analyse the different policy approaches towards the problems of income distribution, poverty and growth. A representative sample of this set will be : Pyatt et al (1972), Cline (1972), Lopes (1972), India's Fifth and Sixth plan (1972, 1979), Weiskoff (1973), Sinha et al (1979), Mohammad (1981), Ghosh and Sengupta (1984) etc. As should be expected from the variety of references the studies differ among themselves in a number of details in modelling the relationship between growth and income distribution and types of policy analysis considered by them. We shall be concerned with certain basic and common elements in their approach towards modelling the relationship between income distribution and growth in IO framework and empirical conclusions regarding certain policy issues drawn from such models. Accordingly we shall first give a brief summary of some important aspects of this literature as reviewed in Chapter 2 of the present study and then compare with our own contribution pointing out certain limitations of the existing models - the limitations which we try to overcome in the present study. Finally, we compare the empirical results obtained in this study with those of the existing literature and indicate certain differences in policy conclusions, which arise out of the difference between modelling the income distribution alongwith its relation with growth in such studies and that of ours.

10.2 Comparision with the existing studies

As noted in Chapter 2 the key argument regarding the link between growth and income distribution is that "different classes have different tendencies to consume, rather than accumulate. Thus any redistribution between socio-economic classes will change the overall saving rate and economic growth. Against this there is the converse argument, which has some relevance for the developing countries, that if growth is slowed by shortage of aggregate demand then redistribution of income in favour of the lower income groups will accelerate growth. Further there is another argument stemming from demand theory, which was used by Paukert (1973), that propensity to consume different items varies between income groups with the consequence that income redistribution influences the balance of payment to the extent that total supply of some consumption goods rely more heavily on imposts than others. More specifically, it is argued that the goods which carry a relatively high weight in the budget of the higher income groups will involve a relatively high import content. Thus, to the extent the balance of payment constraint is binding, redistribution of income to the lower income groups will ease that constraint and constribute to a faster growth. Moreover, it has been argued that income redistribution from the rich to the poor may increase growth by lowering the capital intensity of production and the overall capital - output ratio. In this context we may recall that the above mentioned studies, while using these types of arguments, mainly focus on (i) differences in consumption and savings behaviour of different socio-economic groups and (ii) difference in sectoral capital and labour intensities for estimating the impact of income redistribution on economic growth. Moreover, these studies follow a common methodology which has the following basic features.

(a) The model used is a semi-closed input-output model with endogenous private consumption.

(b) To endogenise consumption the total personal income in the economy is obtained by aggregating the personal income generated in indivisual sectors of the economy. Next in order to determine the household income distribution by size classes from total personal income, a hypothetical income distribution is exogenously imposed on the aggregate personal income; and average income of the different fractile groups of households are obtained. Finally, the level and pattern of aggregate private consumption are obtained by using the different savings ratios and demand/engel functions for different fractile groups of households.

(c) The resulting levels of total consumption for each commodity are then used in the input-output system with exogenous public consumption, investment and export to estimate the effect of hypothetical income redistribution on level of production, employment, import, domestic savings etc.

(d) The second round effect of the changed aggregate personal income, due to change in level and pattern of output, on consumption vector are estimated by iterative solution scheme.

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The earliest instance of application of this methodology is by Paukert, Maton and Skolka (1974) for Iranian economy, the latest being by Mohammed (1981) for Indian economy.

To compare this methodology with that of ours we may note that in any study on income redistribution one should consider three sets of variables viz. (i) the distribution of personal income generated with in each industry (2) the distribution of household income by size classes and (3) a mapping which translates the distribution of personal income into household income. While distribution of personal income generated within each industry depends upon the distribution of ownership of capital asset and the distribution of employment over different wage classes, the mapping of this distribution into distribution of household income depends upon the number of employed persons per household and the household size. Ideally two of these three variables should be endogenously determined so that the third variable can be residenally determined.

As noted in Chapter 2, the distribution of personal income within each industry, in the above mentioned methodology, is not explicitly considered and is assumed to be fixed. The share of personal income in value-added of each industry are, therefore, kept constant. The distribution of household income by size classes is exogenous. Finally, a certain mapping between implicit personal income distribution and exogenous household income distribution under alternative hypothetical redistribution of income, is assumed to exist-although it is not specified. Thus, in this methodology neither personal income distribution nor household income distribution are endogenously estimated. As a result it is assumed that hypothetical redistribution of household income neither affects nor is affected by the distribution of personal income within each industry. Consequently the alternative level and pattern of output under alternative stipulated redistribution of income, although changes the level of average income in different fractile groups of households, it leaves the inequality in household income distribution unaltered. This is mainly because the household income distribution in this methodology is not derived from the distribution of personal income generated within each industry.

Apart from the above mentioned deficiencies in modelling of income distribution the above methodology ignores the role of prices, unequal distribution of productive assets, inequality in structure of wage earnings which play important role in shaping both personal income distribution and household income distribution in developing countries. Moreover, these models ignore the output constraint and capital constraint which are also typically found in developing countries. Absence of such constraints in these models unnecessarily exaggerates the feasibility of the different income redistribution scheme analysed in these studies. Moreover these models are not suitable for formulation of income redistribution policy measures as the income redistribution in such models can not be expressed in terms of different income redistributive policy instruments like indirect tax subsidy, wage rates, investment etc.

In the present study we have attempted to remove some of the above mentioned limitations of the existing analytical framework. Firstly, the distribution of income between the poor and non-poor, in our model, is determined endogenously from the distribution of personal income generated within each productive sector and an endogenously estimated dependency ratio (mapping) which translates the personal income into household income in order to calculate percapita income within each group of population. For this we focus on two sources of inequality in distribution of personal income within each industry. The first is between wage and profit and the second is the inequality in the structure of wage earning. Secondly, in our model, the interaction of output and price play a crucial role in determining the distribution of personal income. For this we consider two different modes of price formation (and implicitly of output determination) in agriculture and non-agriculture viz. the demand pull and cost-push price mechanisms. This dichotomy of price formation and also of output determination, in agriculture and non-agriculture allows us to study the implication of agricultural output constraint on distribution of income and poverty. Moreover, we can also test the feasibility of different redistributive policies with and without agricultural output constraint in the economy. Finally, we may point out that in our model we distinguish private, public and corporate savings so that the impact of income redistribution on aggregate domestic savings rate of the economy is estimated by considering the impact on individual categories of savings in the economy. Thus, in our model the scope of income distributional policy analysis is extended as compared to the models discussed earlier.

Results of various studies mentioned above that redistribution towards greater equality would increase GDP and employment. Redistribution of income towards lower income group also changes the pattern of output towards labour intensive commodities and increase the labour intensity of production in the economy. Thus Paukert et al (1974) found that, for Philippines economy, any hypothetical redistribution of income towards poor led to significant rise in employment, to a lower degree of capital intensity of production and to lower capital output ratio. Other studies point to the offsetting reduction in the demand for services as a result of redistribution, leading to the conclusion that redistribution may have only limited impact on the demand for labour. In so far as the impact of redistribution on balance of payment is concerned, Pyatt et al (1973), Paukert et al (1974) found that inspite of lowering of import content of GDP, absolute level of import rises due to rise in GDP level as a result of income redistribution towards lower income group. Domestic private savings and its rate are also found to fall due to income redistribution from the rich to poor. Thus Skolka and Garzuel (1976) in their study on Iranian economy found significant fall in private savings (by about 28.0 percent) due to income redistribution.

Recently Mohammad (1981) applied this methodology for Indian economy. His finding supports the positive effect of income redistribution on GDP employment and personal income. According to his estimate reduction of inequality in Indian economy from 0.46 (Gini coefficient) to 0.27 (about 60.0 percent reduction) through income redistribution will increase the GDP level by 5.27 percent, employment by 8.48 percent, personal income by 7.3 percent and reduce the personal savings by 14.0 percent. His results, however, indicate that the absolute level of import in Indian economy remains more or less unaltered due to redistribution of income. It is also reported that the capital output ratio increase as the income is redistributed progressively towards the poor. Thus he found that reduction of income inequality from 0.46 to 0.27, through hypothetical redistribution of income, would increase the capital output ratio from 1.1354 to 1.1816. To compare our empirical result with that of Mohammad (1981) we may note that income in our basic model is redistributed through policy instruments. Thus the amount of income redistributed depend upon the nature and magnitude of change in the policy instruments. However, our result also supports the general finding of positive impact of income redistribution towards the poor on the level of GDP, employment and personal income. Thus our results on income redistribution in Chapter 6 show that 1.0 percent income transfer from the non-poor to the poor, increase the GDP by 0.79 percent, private consumption by 0.87 employment by 1.32 percent savings ratio by 0.65 percent and reduce income inequality by 0.24 percent. Absolute level of import reduce by 0.14 percent and thus the rate of import falls by 0.05 percent. The same extent of reduction in income inequality through hypothetical income redistribution, as considered by Mohammad (1981), increase GDP by 0.68 percent, employment by 1.1 percent, personal income by 0.99 percent. Personal savings is increased in this case by 0.55 percent, while absulute leve of import reduce by 0.22 percent. This comparision of the empirical results show that our results are directionally similar in so far as the effect of income redistribution on GDP employment consumption and import are concerned. However, it appears that the estimate vary in magnitude which may be due to the difference in our analytical framework and also in various estimates of exogenous parameters.

To compare our results on the distributional and poverty impact of export promotion and import substitution with that of Mohammad (1981) we may note that this methodology which is based on that of Pyatt is not suitable for such an exercise as the distribution of income in this methodology is exogenous and consequently export promotion and import substitution schemes do not change the distribution of income. Mohammad (1981), however, went beyond the scope of this methodology by using it for such an analysis. For this, he had to assume that " if these is substantial increase in employment, the inequality of income distribution is likely to be reduced" (Mohammad (1981) pp. 132). But our results on export promotion and import substitution show that both export promotion and import substitution, although reduce poverty, may increase income inequality. Further, his observation that level of GDP, employment etc. are neutral to pattern of export promotion and import substitution, does not hold in our model. In fact our result indicate that promotion of traditional exports will have more favourable impact on GDP, employment, poverty etc. than that of non-traditional export. Further, our result indicate that promotion of traditional export in presence of agricultural output constraint may even reduce GDP, employment and increase poverty. Such an exercise was, however, not considered by Mohammad (1981). Finally our result, as in Mohammad (1981) also indicate that export promotion have more favourable impact on GDP employment etc. than import substitution.

This methodology has also been used to study the trade-off between income redistribution and growth by showing the negative impact of income redistribution on aggregate private savings. Empirical estimates given by different authors show that a certain growth - equity trade-off exists but its magnitude is rather small. Thus Chinn (1972) found for Taiwan and Korean economy low negative growth effect of progressive income redistribution. Chinn (1972) estimated that imposition of income distribution of U.K. would cause a reduction in annual growth rate by 1.0 percent in Brazil, by 0.66 percent in Argentina and zero percent in Venezuala. Mohammad (1981) estimated that annual percentage rate of growth of income in Indian economy would fall from 4.44 percent to 3.46 percent as the income inequality is reduced by 60.0 percent through hypothetical income redistribution from 0.46 (Gini) to 0.27[1]. Thus he concluded that there exists trade-off between growth and equity for Indian economy. But the model on the basis of which the growth equity trade-off is estimated considers the impact of income redistribution only on personal savings, leaving aside the impact on public and corporate saving which may be significantly positive. Further, he assumed that entire personal savings will be translated in productive investment within the economy. Apart from these limitation, the model suffer from a fundamental limitation as noted in Chapter 2. This is the lack of integration between growth and income distribution on the basis of two way relationship between them. Because of this, the model, although considers the impact of income redistribution on private consumption and savings, leaves the investment unaffected due to income redistribution. Consequently it is assumed that income redistribution, although affects growth, leaves the level and structure of investment unaffected. This however, is an unrealistic assumption. Thus while studying the growth-equity trade-off this model has gone beyond its scope. For such an analysis one has to determine the income distribution and growth endogenously taking into consideration the two-way relationship between them. The present study has attempted this in the plan model, as presented in Chapter 7 which determines the terminal year income distribution, poverty, consumption, investment and the post-terminal growth consistently with each other from the given terminal year GDP and perspective year poverty alleviation targets. Thus any redistribution of income at the terminal year, for the given terminal year GDP, affects not only terminal year consumption and savings but also the level and structure of terminal year investment and hence the post-terminal growth.

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[1] In Mohammad (1981), long run GDP growth rate is calculated by applying a global capital output ratio on only personal savings, which is really not meaningful, as other components of savings are neglected in this model.

Thus in our model the growth-equity trade-off is estimated by considering the impact of income redistribution not on aggregate saving, but on aggregate investment. Aggregate savings at the terminal year adjust itself to terminal year investment through changes in terminal year pattern of output and price due to change in income distribution.

In this context it is interesting to compare our model structure with that of Fifth Plan (1973) and Sixth Plan (1981) models of India, where the redistribution of private consumption on growth was studied in an 'open-loop' input-output framework using same time frame of analysis and targets as our model. For this we shall concentrate on the treatment of distribution and growth in these models leaving aside the other details which have been stated earlier. A comparative study of Fifth and Sixth Plan models is also given in Majumdar and Panda (1982).

We may start by mentioning that consumption in both Fifth Plan and Sixth Plan models are not endogenous in the sense that they are not derived on the basis of output-income-consumption relation of different income classes. Moreover, the distribution of consumption in both the models are given by two parameter lognormal distribution with exogenously fixed inequality parameters.

In order to estimate the level and pattern of output, consistently with (a) level and pattern of private consumption demand, under alternative postulated poverty reduction targets and (b) with the given terminal year GDP level, these models estimate the aggregates percapita consumption in the economy residually from the given terminal year GDP after deducting investment and other use of national income. The percapita aggregate consumption thus obtained is used in two-parameter lognormal distribution, with exogenously fixed variance (inequality) parameter to determine the aggregate percapita consumption in different consumption expenditure classes and the aggregate consumption of different commodities (sectors) are then obtained conventionally. The sectoral consumption vector so obtained is used in input-output system to determine sectoral output.

Terminal year investment in Fifth Plan model was determined exogenously. For this the total plan investment was first estimated by applying a global incremental capital output ratio to increase in GDP over the plan period and then aggregate terminal year investment is obtained by phasing of total plan investment over different years of the plan period through a step function. The total terminal year investment thus obtained was distributed among different investment goods sectors by exogenously fixed sectoral proportion and were used as investment demand by origin in input-output system. Sixth Plan model, however, determines the terminal year investment by destination endogenously on the basis of accelerator type investment function relating investment by destination with growth of sectoral value-added during the post-terminal period. However, post terminal growth rates of value-added of each sector was assumed to be a constant multiple of pre-terminal growth rates, which makes the sixth plan model intertemporally inconsistent as noted in Chapter 8 of the present study. Next the terminal year investment by 'origin' is estimated from terminal year investment by 'destination' using the so-called capital coefficient matrix for only construction and remaining capital goods combined which was distributed over different capital goods sectors using sectoral proportions as in Fifth Plan model.

Thus we may note that while in Fifth Plan model both terminal year aggregate as well as sectoral consumption and investment are not functionally related to sectoral output and value-added, in Sixth Plan model only terminal year investment is functionally related to sectoral output and value-added. So private consumption and its sectoral distribution in both Fifth and Sixth Plan models are exogenous and the impact of consumption redistribution are considered in open-loop input-output framework in both the models. Consequently, as noted by Tendulkar (1971), aggregate pre-terminal and post-terminal growth rates of capital goods sectors in Fifth Plan model showed relative invariance to stipulated redistribution of consumption although the sectoral growth of food-grain and textile sectors were affected significantly. Moreover, due to absence of functional relationship of aggregate as well as sectoral private consumption with sectoral output and value-added, redistribution of consumption in Sixth Plan model, like Fifth Plan model, takes place at the stage of disposition of income rather than at the stage of income generation. Consequently, it is implicitly assumed that redistribution of consumption can be made without affecting income distribution of Indian economy. In this context we may mention that Sixth Plan model has also been used to estimate the poverty reducing effect of redistributive measures like Integrated Rural Development Programme (IRDP) adopted by Government of India. It has been claimed by Planning Commission that because of such measures, the percentage of population below poverty line came down to 41.0 percent during the first two years of the Sixth Plan. The method of evaluation, however, has aroused an interesting debate regarding the effect of aggregate income growth in reducing poverty and the effectiveness of some of the redistributive policy measures. The method, as described by Gupta and Dutta (1984) while estimating the poverty reducing effect of IRDP assume (i) distribution neutrality of growth, (ii) poverty reducing effect of IRDP to be proportional to nominal expenditure on such programmes and (iii) reduced rate of growth of population during the first two years of Sixth Plan. Sundaram and Tendulkar (1982) however show that even if one accepts the assumption of distributionally neutral growth but corrects for population undercount and the net impact of IRDP, the percentage of population below poverty line turns out to be 46.5 percent by the same method. Here we may note that the linkage between income and consumption expenditure in the Sixth Plan model is not established by tracing the income flow from the productive sectors to different socio-economic groups. As a result the income augmenting effect of IRDP was calculated on the basis of exogenously given investment to net income ratio. Thus this method of evaluation does not take into consideration the impact of such expenditure schemes on other productive sectors and population groups of the economy. Secondly the assumption of distribution neutrality of growth which follow from the use of lognormal distribution for generating the distribution of aggregate consumption accorss income class, may not be true as shown by policy exercises with our plan model. In fact our results show that increasing aggregate GDP in face of agricultural output constraint may even worsen income inequality. Such an analysis should therefore, be carried out using an integrated framework for analysing growth, income distribution and poverty. Thus Tendulkar (1971), while commenting on the treatment of consumption redistribution and growth in Fifth Plan model of India, noted that 'Conceptually the interactions between growth and redistribution can be examined when (i) aggregate growth rate as well as composition of output mix (ii) aggregate level of consumption (iii) quantum, composition and allocation of investment (iv) mobilisation and canalisation of domestic savings to finance investment (v) the incidence of mobilisation on different income groups becomes endogenous to the specification of redistribution namely (a) changes in the relative importance (in total pre-tax income) of different groups of income earners with different marginal savings rates and (b) changes in commodity composition of private consumption expenditure resulting from (a) above after taking into account the incidence of fiscal subsidy measures required for redistribution'. In the light of this comment we may note that terminal year aggregate as well as sectoral consumption in the plan model of the present study are endogenously determined from the distribution of factor income generated within each industry and hence directly related to the extent of terminal year income re-distribution. Consequently level and pattern of terminal year investment and pre-terminal as well as post-terminal growth also depend upon the extent of terminal year income redistribution. Moreover, income redistribution in our plan model are carried out in terms of specific redistributive policies and their impact are studied on growth of per-capita consumption of different groups of population during the plan as well as post-plan period.

To compare the empirical results obtained from our with that of Sixth Plan model we may pointout that the terminal year GDP and the perspective year poverty alleviation targets under the basic solution of the plan model in the present study are very close to the preferred variant in Sixth plan model of India. Comparision of the macro-economic variables as estimated under the basic solution of the plan model with that of Sixth Plan model of India (as presented in Sixth Plan Document, Planning Commission) show that terminal year aggregate private consumption is less and the terminal year investment is more in our model than the corresponding estimates of the Sixth Plan model of India. Consequently, the rate of terminal year investment is about 1.19 percent less than the corresponding rate in the Sixth Plan model. Moreover, the rate of import at the terminal year of our model is higher than the Sixth Plan estimate although the terminal year GDP in our model is same as that of the Sixth Plan model. Rate of domestic savings which is 24.48 percent in Sixth Plan model turns out to be 22.89 percent (endogenous) according to our model. As a result the rate of foreign savings as estimated by our model is much higher than that of the Sixth Plan model. Aggregate employment as estimated by our model is about 3.3 percent less than that of the Sixth Plan model.

Economic profile of the poor and the non-poor at the terminal year, as estimated by our model, show that per-capita consumption of the poor is less and that of the non-poor is more than the corresponding estimate of the Sixth Plan model. Moreover the proportion of poor and income inequality at the terminal year, which are endogenously estimated in our model, is much higher than the corresponding postulated terminal year levels under the preferred variant of the Sixth Plan model. The rate of growth of per capita consumption during the sixth plan period as estimated by our model is much lower and while the same for the non-poor is much higher than the sixth plan model. The structure of plan investment in our model show higher share of manufacturing sector and lower share of agriculture in the total as compared with Sixth Plan estimate. Moreover the growth of capital goods sector under alternative redistributive policies show significant change during the pre-terminal as well as post-terminal period. Further it was found that structure of investment and pattern of growth shift towards agricultural sector as income is redistributed towards the poor. Finally, the growth equity trade-off as estimated by the plan model show that the extent of trade-off widely varies over the different types of growth and redistributive policies. Thus there exists policy like indirect tax-subsidy or minimum wage policy which show substantial trade-off as against agricultural investment policy for which this trade-off is minimum. However, for certain types of policies like export promotion policy or income transfer policy this trade-off is not too high to offset the beneficial effect of income redistribution on the economic position of the poor.

10.3 Concluding remarks

The present study was aimed at illustrating some of the methodological issues in modelling income distribution and its relation with growth, and highlighting some major distributional characteristics of alternative growth and redistributive policy instruments. The policy simulations in this work should, therefore, be viewed as illustrations of different policy approaches towards the problems of poverty and income distribution in relation to growth. The most important methodological issues, as noted in the introductory chapter of this study, is to provide an integrated treatment of income distribution, poverty and growth in planning frame work. This is because the impact of different policy instruments on growth, income distribution and poverty follows from complex interaction of different economic variables, which take time to work themselves out; and it is necessary to translate the different inequality and poverty reduction targets into specific time bound economic actions whose feasibility can be examined. This requires a dynamic quantitative framework with explicit time frame where growth, income distribution and poverty are integrated with each other. In the present work a modest attempt has been made in this direction.

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