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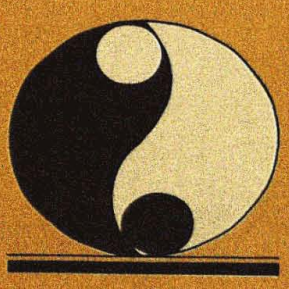

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AN EVALUATION OF INDIAN PLANNING MODELS AND ALTERNATIVE DESIGN STRUCTURES: THEORETICAL FOUNDATIONS AND TECHNICAL IMPLICATIONS

M. J. Manohar Rao and Ajit V. Karnik

This paper amounts to a comprehensive evaluation of Indian planning models and alternative design structures with special reference to their theoretical foundations and technical implications. It reviews the evolutionary changes that have taken place in the systems approach to macroeconomic modelling of the Indian economy over the last forty years. Considering that models have been used both at the official level, for planning purposes, as well as at the academic level, for providing inputs to the planning process, the paper covers both these aspects in a thematic manner. Commencing from the initial official efforts with their emphasis on designing aggregate growth models through the intermediate phases of developing consistency models and finally to the current academic interest in optimizing and non-optimizing systems, this evolution is primarily considered against the backdrop of the changing perspectives vis-a-vis economic problems, development strategies and policy choices.

1. Introduction

The last forty years have witnessed an accelerating interest in the field of development planning theory in India which has evolved from the initial attempts to formulate models of economic growth [Mahalanobis, 1953] into an established approach for formulating policies with an extensive literature and widespread practice [see Alagh *et al* 1993]. With the rapid development of the Indian economy, approaches to policy making have become exceedingly complex, with the result that Indian mathematical planners have developed a peculiar slang, full of expressions such as "complementary slackness", "two-gap models", "gradualist paths", "turnpikes", "flip-flop", amongst others. It is an acknowledged fact that even academic or professional economists working in other specializations do not fully comprehend this terminology, let alone economic politicians to whom the end results of the efforts of the development planning models have to be ultimately presented. Although debate continues over the role of the systems approach to planning and the relations between planning and implementation, there is, by and large, widespread recognition of the usefulness of some form of systematic economic planning as a guide-post for policy decisions.

The systems approach to macroeconomic modelling currently in vogue in India can be regarded as the product of a series of evolutionary modifications reflecting the changing perceptions of the basic characteristics of the Indian economy. For example, the existence of large and persistent budget deficits and its impact on investment and growth, while a debatable hypothesis in the 1950s and 1960s, is all too apparent in the 1990s as a result of the unchecked growth in government expenditure. On the other hand, models of closed economies have been discarded because they did not consider the crucial role of international trade and finance in the process of Indian economic development.

The analytical tools that were initially applied to the study of development planning theory in India were borrowed with little or no modification from advanced economies. The results of about forty years of theoretical refinement as well as analytical and empirical experimentation have been to create a second, third, as well as fourth, generation of planning models that have been successfully tested and restructured to fit within the framework of available policy options without vitiating the design of the existing overall development strategy [see Chakravarty, 1987].

However, of late, an aura of disillusionment has crept into the planning process in India because widening regional disparities and inadequate employment generation have implied that either there has been a flaw in the overall design of the development strategies adopted hitherto or that the implicit discipline of macroeconomic planning has been lacking or, equally important, that the explicit institutional changes that must accompany social and economic development have been absent.

Under the circumstances, it would be useful to

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review some of the problems of planning today as against the perspective of its evolution over the past forty years. First of all, planning techniques that were, more or less, heuristic or experimental twenty five or thirty years ago, have been accorded a sort of 'papal imprimatur' currently. These methods have centred largely on the multi-sector input-output framework and its extensions into linear programming and, of late, macroeconometric modelling.

In the course of this development, information has been collected extensively for use with these techniques, as a result of which work has increasingly veered towards more sophisticated modelling efforts to assess the nature of the trade-offs involved while planning. However, as far as income distribution and employment generation data are concerned, there has been a dearth of information which has pre-empted any meaningful assessment of our planning achievements on these two fronts.

Forty years ago, few countries took any objective seriously other than that of maximizing growth. Now, the modification of social objectives and the introduction of new constraints have led planners to consider income distribution and employment generation targets as equally important goals of planning. Since per capita income is so low in developing countries, these other objectives become meaningful only when adequate overall economic growth can be attained. Thus, an attempt to shift emphasis does not imply that planners misjudged priorities in the past. Rather, it implies that the successes enjoyed by economic policies in accelerating growth now permit the planner to deal with income redistribution and employment generation more effectively. Perhaps more important than the development of planning models is the increasing ability and willingness of decision makers to employ them. In India, the economic leadership is currently being drawn from professionals with sufficient academic training to conceptualize problems and visualize their solutions, so that they can use the alternatives provided to them by the model builders. For methodological improvements in development planning to continue at the present rate and to be of practical use, this evolution is of utmost importance. This paper amounts to a brief survey of the systems approach to macroeconomic models in India over the last forty years with reference to, both, the specification of economy-wide development planning models officially used over the five-year plans since the inception of planning in 1950 as well as the design of alternative planning methods used either semi-officially or academically in an effort to complement existing planning policy.

Our purpose here is to provide a summary of Indian development planning models and macroeconomic systems, the theoretical foundations on which they are based and the technical implications which follow so that it could provide an idea of the applicability of some of the more widely used planning techniques. While the only conceivable manner in which this can be done is a literature survey, it is obvious that such a survey cannot develop each point in great detail. Our hope here is, apart from allowing the reader easier access to the source material, to provide an idea of how perceived economic problems have determined development strategy and model choice which, in turn, have influenced the evolution of planning theory in India.

2. *Planning Models*

2.1 *Characteristics of Planning Models*

The logic of planning theory entails that models should be designed to fit the overall development strategy of a country as well as its principal economic concerns. Strategy in this context refers to a chosen development path and the usefulness of the modelling approach in selecting the appropriate strategy depends on the country's size and degree of industrialization [see Chenery and Taylor, 1968]. Not surprisingly, planning models are, *ceteris paribus*, more useful in larger than in smaller countries.

In this context, it is important to emphasize at the outset that while any planning model should attempt to be a reflection of reality, no model can claim to be a perfect reflection. This is because the partial nature of economic theory as an explanation of human behaviour and the inferential character of our knowledge regarding the economic system, coupled to the highly stochastic

aspects of macroeconomic events, seem to suggest that the predictive power of invariably all macroeconomic models, no matter how large, is inherently low. Considering that large models, besides being more expensive to construct and solve computationally, are invariably more difficult to comprehend, there is clearly an inevitable trade-off involved between the benefits of disaggregation and the costs involved in actually doing so, which must be carefully weighed so that the rationale behind the model can be understood even from a non-technical viewpoint. In order to clearly demonstrate these trade-offs in model formulation, we briefly review three basic characteristics of planning models suggested by Tinbergen [1967].

The first important characteristic of a model is its scope, which can range from a sub-project to the entire economy. The whole world can also be included, as has been attempted to a certain degree by "Project Link" [see Ball, 1973]. The appropriate scope is determined by the problems to be analyzed. Thus, national issues such as savings generation, intersectoral investment allocation, or the impact of additional foreign loans are usually central to economy-wide models. On the other hand, choice of techniques, location of industries and size of plant are topics found in sectoral or project models which pay great attention to detail while treating the rest of the economy as fixed.

Time is another very important dimension. Models can be either static or dynamic. The former only compare one future date with the present while the latter, by incorporating endogenous variables over a number of time periods, provide information to the planner on how to attain a particular target, e.g., yearly investment levels for a plan (investment phasing) or cumulated investments over a plan period in order to generate a given level of income at some time in the future (investment timing). Another aspect of the treatment of time is how far into the future it is designed to project, as model design is intimately related to the problems under study. A short-term model (a macroeconometric model typically defined as forecasting for at most three years into the future) will often emphasize the role of financial variables, and may be estimated by econometric techniques. However, from the viewpoint of development planning, it is the medium-term (three- to seven-year horizons) and long-term or "perspective" planning models that have been most often invoked.

The next characteristic is the focus of the model, which is often closely related to its degree of aggregation (for a given scope and time horizon). In this sense, essentially three types of economy-wide models have been extensively applied in developing countries. The first, aggregate models, treat the whole economy as one producing sector and are oriented towards forecasts of the major national accounts aggregates. The most common representative of this type is the well-known Harrod-Domar model (a variant of which was used during the Indian first five-year plan), often extended into a two-gap model by explicit consideration of the foreign trade sector. A second type of economy-wide model is focused on "dualism", and usually is set up to highlight the dichotomies that exist between two sectors - a large, mostly agricultural "traditional" sector and a smaller, dynamic "modern" sector. This type of model provides insight into the development phases of an economy undergoing transition, and is critical for evaluating the broad lines of a country's development strategy since many dualisms are created by the structural rigidities of imperfect factor markets in less developed countries. Policy simulations using two-, three- or four-sector models (a variant of which was used during the Indian second five-year plan) have often been carried out for this purpose. In contrast with these models, there are the multi-sector inter-industry planning models which divide the economy into a number of explicit producing sectors. These comprise the input-output and linear programming systems which form the hard core of development planning models (the former having been used in Indian planning ever since the fourth five-year plan).

2.2 Properties of Planning Models

Several generalized properties of planning models are worth noting at the outset. First, they are almost always expressed in real terms. This implies that relative price changes are largely ignored and that interactions of inflation, finance

and flow of funds are often omitted from the formulation. These omissions are characteristic of planning exercises and can be remedied only by recourse to macroeconometric modelling.

Second, the specification, at best, includes a limited set of policy instruments. The models are used to sketch out future growth paths for the economy which seem feasible in terms of estimated savings and investment levels, availability of foreign exchange, and so on. Shifts in interest rates, forced development of financial markets, trade subsidies and all other policies to mobilize these resources do not appear in the formulation.

Third, all aspects of uncertainty - ranging from the price of the major import to the standard error of estimate of the capital-output ratio - are omitted from the formal model, being dealt with, if at all, by sensitivity analysis. Attempts to treat uncertainty more thoroughly have appeared in the literature, but only within the framework of macroeconometric models.

Finally, institutional limitations on policy appear only in rudimentary form. Political limitations on government action, the role of hierarchical entities in plan execution, dependence of the country on foreign governments - these and many other factors which deeply affect plan formulation are left out. The present procedure is to try and select planning models which approximate, as far as possible, the appropriate institutional framework.

2.3 Types of Planning Models

Planning models can be categorized generally into three types: (i) simulation models, (ii) optimization models and (iii) consistency models. The above classification involves the extent of endogenous choice, i.e., the extent to which projections are made within the model itself. A model is said to be fully determined if all the endogenous variables can be computed once certain policy variables are fixed and projections concerning the exogenous variables are made. Such models are frequently called simulation models. In other words, there are many alternative growth patterns consistent with the set of exogenous variables.

If some sort of optimization technique is used to close the simulation model, we refer to these as optimization models. A specialized case of such models are the programming models where linear programming is the technique invoked to solve the model.

In the literature on these types of models, a distinction is drawn between fixed and flexible targets. In the former case, the target variables are specified *a priori*. The optimization procedure is generally hidden behind these specified values, and the objective is to determine the values of the instrument variables that will be consistent with the targets. In this so- called 'instrument-target' approach [Tinbergen, 1952], the excess of the number of instruments over the number of targets is known as the "policy degrees of freedom". If the planning model is deterministic, then these positive policy degrees of freedom can be filled up by setting the extra instruments at arbitrary levels and policy makers need use only as many instruments as they have targets in order to achieve the desired values for all targets.

However, if the number of targets exceeds the number of instruments, then all these specified target values cannot be attained contemporaneously, and some form of trade-offs amongst the multiple objectives would have to be defined by the policy maker in order to decide the appropriate policy constellation.

In the case of flexible targets, the optimization procedure is an integral part of the planning problem which is determinate only after the optimization procedure has been worked out. For example, the classic planning problem involving flexible targets [see Ramsey, 1928] is the choice of an optimal savings rate which maximizes the (discounted) flow of consumption over a specified planning horizon. In such cases, no fixed targets for consumption can be specified *a priori* and the problem of specifying the time- path of consumption becomes determinate only after the associated optimization problem has been solved. In general, therefore, the flexible targets problem is more difficult to work with and, thus, in many planning situations, the fixed targets problem is generally preferred to best indicate the planners preferences.

It is also important that alternative planning models should be interconnected: outputs from

one model should be capable of serving as inputs to another. For example, the savings rate in the Harrod-Domar model is usually exogenous, while it is frequently an endogenous variable in a financial or budgetary model. The assumed rate for one model should be consistent with the rate forecast by the other. Thus, models, like the static input-output system currently used for Indian planning purposes, which explicitly help to link up particular variables or sectors with each other are referred to as consistency models.

3. *Indian Planning Models*

3.1 *Introduction*

At a minimum, prediction planning techniques try to say something about the growth of GDP over the next half decade or so; some do no more than this. The underlying planning philosophy here is that the existing conditions in an economy (on which the model is based) are likely to remain largely the same over this horizon, and planning is merely the process of forecasting or predicting future growth and identifying, if possible, means of meeting increased demands generated by this growth.

The simplest GDP forecasts are based on the well-known Harrod-Domar model which was used as a framework for the Indian first five year plan and, in this introduction, we briefly discuss its specifications as it remains till today, in its two-gap version, the cornerstone of Indian macroeconomic planning. An understanding of the mechanics of this model will therefore help to pave the way for a better comprehension of the more complicated models used in the Indian context in the later plans.

The Harrod-Domar model incorporates the simplest of all hypotheses regarding technology, that the ratio of output to reproducible capital is constant:

$$Y(t) = (1/v)\, K(t) \tag{3.1}$$

where K(t) is capital stock at time t, Y(t) is output (GDP or a similar concept), and v is the average (assumed equal to the incremental) capital-output ratio. The evidence regarding levels and stability of such aggregate capital-output ratios has been reviewed by Kuznets (1971). If it is also true that a constant share (s) of output is saved, then, for a closed economy, we have:

$$I(t) = sY(t) = K(t+1) - K(t) + dK(t) \tag{3.2}$$

where I(t) is gross investment and d is the fraction of capital stock depreciated each period.

Now if $g = [Y(t+1)-Y(t)]/Y(t)$ is the growth rate of output, then, given eqs. (3.1) and (3.2), we have:

$$g = (sY - dK)/vY = (s/v) - d \tag{3.3}$$

which is the basic Harrod-Domar growth equation for predictive planning. For prescriptive planning purposes, this is usually written in terms of its logical inverse, given by:

$$s = v(g + d) \tag{3.4}$$

where g is now the target (or desired) growth rate of income. In this manner, the Harrod-Domar model also emphasizes savings behaviour and, if the data allow it, one can extend the analysis by disaggregating the sources of savings. For example, suppose there are different savings propensities out of agricultural income (YA) and non-agricultural income (YNA). Then this two-way partition of factor incomes implies that: Y = YA + YNA, yielding:

$$I = S = s_a\, YA + s_{na}\, YNA \tag{3.5}$$

where s_a and s_{na} are savings propensities from YA and YNA, respectively. Eqs. (3.4) and (3.5) yield the modified equation:

$$v(g + d) = [s_{na} - s_a]\,(YNA/Y) + s_a \tag{3.6}$$

which can be used to check on the feasibility of desired growth rates given savings behaviour and the distribution of income.

A common question to ask now is whether the economy is likely to generate the necessary quantum of savings in order to meet the target growth rate of income, given data on depreciation rates, capital-output ratios and income distribution. The answer, unfortunately, is often "No". The policy problems begin here.

3.2 The First Five Year Plan Model: 1951-56

The genesis of modelling efforts in India can be traced back to the first five year plan, 1951-56. This plan was based on the highly aggregative Harrod-Domar model of economic growth [Harrod 1939, Domar 1946] and the system was operationalised by linking together: (i) the planned rate of growth, g, (ii) the average propensity to save, s, and (iii) the incremental capital-output ratio, v, by means of a growth equation given by:

$$g = s/v \tag{3.7}$$

If the rate of growth, g, in eq. (3.7) is written as:

$$g = [Y(t) - Y(t-1)]/Y(t-1) \tag{3.8}$$

where Y(t) is real national income in time t, then substituting eq. (3.7) into eq. (3.8) leads to:

$$Y(t) = Y(t-1) + (s/v)\ Y(t-1) \tag{3.9}$$

or:

$$Y(t) = [1 + (s/v)]\ Y(t-1) \tag{3.10}$$

which is a first-order linear difference equation in Y(t) whose solution is given by:

$$Y(t) = [1 + (s/v)]^t\ Y(0) \tag{3.11}$$

where Y(0) is the level of income in the base year.

The first plan model, while adopting the generalized Harrod-Domar structure specified above, attempted to make the ensuing formulation more realistic by incorporating two very important modifications in the original assumptions. These pertained to: (i) the possibility of the gestation lag between investment and output being longer than one year and (ii) the possibility of the marginal propensity to save (mps) being more than the average propensity to save (aps).

If the gestation lag between investment and output is, say, two years (as was believed at that time), then eq. (3.9) becomes:

$$Y(t) = Y(t-1) + (s/v)\ Y(t-2) \tag{3.12}$$

or:
$$\delta Y(t) = (s/v) Y(t-2) \tag{3.13}$$

where δ is the backward difference operator.
For t=1, t=2 and t=3, eq. (3.13) will, respectively, become: —

$$\delta\ Y(1) = (s/v)\ Y(-1) \tag{3.14a}$$
$$\delta\ Y(2) = (s/v)\ Y(0) \tag{3.14b}$$
$$\delta\ Y(3) = (s/v)\ Y(1) \tag{3.14c}$$

Now, assume a savings function given by:

$$S(t) = sY(0) + \hat{s}[Y(t) - Y(0)] \tag{3.15}$$

where S(t) is savings in period t; Y(0) is national income in the base year; s is the aps and $\hat{s}$ is the mps (with $\hat{s} > s$).
For t=1, eq. (3.15) becomes:

$$S(1) = sY(1) = sY(0) + \hat{s}\delta Y(1) \tag{3.16}$$

Substituting eq. (3.16) into eq. (3.14c) yields:

$$\delta Y(3) = (s/v)Y(0) + (\hat{s}/v)\delta Y(1) \tag{3.17}$$

In general, for a planning horizon of T years and a gestation lag of i years, eq. (3.17) can be written as:

$$\delta Y(t) = (s/v)Y(0) + (\hat{s}/v)[Y(t-i) - Y(0)] \tag{3.18}$$
$$t = 1,2...T;\ i = 1,2...k < T$$

Given Y(0), such a model can be operationalised by assigning different values to the three parameters: average propensity to save (s), marginal propensity to save ($\hat{s}$) and the incremental capital-output ratio (v).
The choice regarding g, given values of s, $\hat{s}$ and v, implies a certain time-profile of investment over the plan period which can be determined using the multiplier-accelerator interaction.

Using the accelerator, we realize that:

$$I(t) = v\ [Y(t+1) - Y(t)] \tag{3.19}$$

Multiplying both the numerator as well as the denominator of the right-hand-side of eq. (3.19) by $\hat{s}$, i.e., the mps, we have:

$$I(t) = (v/\hat{s})\,[\hat{s}Y(t+1) - \hat{s}Y(t)] \quad (3.20)$$

Using eq. (3.15), and recognizing that S(t)=I(t), we have:

$$I(t+1) = sY(0) + \hat{s}\,[Y(t+1)-Y(0)] \quad (3.21a)$$

and: $$I(t) = sY(0) + \hat{s}\,[Y(t)-Y(0)] \quad (3.21b)$$

Subtracting eq. (3.21b) from eq. (3.21a) and substituting the result into eq. (3.20) yields:

$$I(t) = (v/\hat{s})\,[I(t+1) - I(t)] \quad (3.22)$$

which is a linear difference equation in I(t) whose solution is:

$$I(t) = [1 + (\hat{s}/v)]^t\, I(0) \quad (3.23)$$

Taking I(0), $\hat{s}$ and v as data, it was thus possible to build up a profile of investment over the plan and the additional output created by this investment would be exactly equal to the additional demand generated by this investment. In this way, the time paths of investment, income and, consequently, consumption were worked out which were consistent with steady growth.

A major lacuna of the first plan model was that it treated the entire economy as a single unit and ignored intersectoral interactions. This led Bhagwati and Chakravarty [1969] to dismiss the first plan model as an intellectual appendage with little impact on actual plan formulation. Notwithstanding this, the major contribution of this model lay in identifying the incremental capital-output ratio and the rate of investment as the two crucial determinants of growth and this recognition provided a focus to the modelling exercises of the later plans.

3.3 The Second Five Year Plan Model: 1956-61

The approach to the second five year plan was based on two models constructed by Mahalanobis [1953]: the two-sector model and the four-sector model. The two-sector model of Mahalanobis gave a wider scope to the Harrod-Domar model by extending it into an optimization framework. This systems approach to planning focused attention on the bottlenecks that may be created by a shortage of capital goods (and not savings, as assumed in the earlier model). As long as one ignores the possibility of importing investment goods (as may be realistic in a large country facing a foreign exchange crisis), this leads naturally to a disaggregation of production into capital goods and consumption goods branches. If it is also assumed that capital goods cannot be shifted from a sector once they are installed there (a hypothesis which is critical), the main choice is where to assign newly produced capital: to the capital goods sector itself or to the consumption sector. This decision is the crucial one in the Feldman-Mahalanobis-Domar (FMD) class of models.

The two-sector model divided the economy into the consumer goods industry (C) and the investment goods industry (I). Total initial investment, I(0), was fixed forming the datum for the model. The target variable was the rate of growth of national income (Y). The instrument variables, θ_I and θ_C, were the relative shares of investment in the two sectors ($\theta_I + \theta_C = 1$); while the structural parameters, β_I and β_C, were the reciprocals of the incremental capital-output ratios (ICORs) in the two sectors. The model also assumed full capacity utilization and a single period lag between investment and output.

The increase in total income of the investment goods sector between any two periods is given by:

$$I(t) - I(t-1) = \theta_I\beta_I\, I(t-1)$$

or: $$I(t) = (1 + \theta_I\beta_I)\, I(t-1) \quad (3.24)$$

The solution of this difference equation is given by:

$$I(t) = (1 + \theta_I\beta_I)^t\, I(0) \quad (3.25)$$

which can be written as:

$$I(t) - I(0) = I(0)\,[(1 + \theta_I\beta_I)^t - 1] \quad (3.26)$$

Similarly, for the consumption goods sector, we have:

$$C(t) - C(t-1) = \theta_C\beta_C\, I(t-1) \quad (3.27)$$

Therefore,

$$C(t) - C(0) = \theta_C\beta_C\, I(0) + \theta_C\beta_C\, I(1) + \theta_C\beta_C\, I(2) + \ldots + \theta_C\beta_C\, I(t-1) \quad (3.28)$$

Using eq. (3.25), this yields:

$$C(t) - C(0) = \theta_C\beta_C I(0) + \theta_C\beta_C [1 + \theta_I\beta_I] I(0) + \ldots + \theta_C\beta_C [1 + \theta_I\beta_I]^{t-1} I(0) \quad (3.29)$$

Replacing the infinite series on the right-hand-side of eq. (3.29) by its sum yields:

$$C(t) - C(0) = (\theta_C\beta_C / \theta_I\beta_I) I(0) [(1+\theta_I\beta_I)^t - 1] \quad (3.30)$$

In a closed economy, as was assumed by excluding the foreign sector, we have: $Y(t) = C(t) + I(t)$. This implies that:

$$Y(t) - Y(0) = [C(t) - C(0)] + [I(t) - I(0)] \quad (3.31)$$

Substituting eqs. (3.26) and (3.30) into eq. (3.31) yields:

$$Y(t)-Y(0) = I(0) [(1+\theta_I\beta_I)^t - 1] [1+(\theta_C\beta_C/ \theta_I\beta_I)] \quad (3.32)$$

If we now assume that: $I(0) = \alpha Y(0)$, where $\alpha < 1$, then eq. (3.32) can be re-written as:

$$Y(t) = Y(0)[1+ \alpha \{ \{(\theta_C\beta_C +\theta_I\beta_I)/(\theta_I\beta_I)\} \{(1+\theta_I\beta_I)^t -1 \}\}] \quad (3.33)$$

which is the famous Mahalanobis income growth equation.

The following comments can be made regarding the growth equation: (a) α equals the average propensity to save; (b) $(\theta_C\beta_C +\theta_I\beta_I)$ reflects the over-all productivity of new investment; (c) since α and $Y(0)$ are the initial conditions and as β_C and β_I would be technologically determined, the growth equation given in eq. (3.33) can be assumed to have only one independent policy parameter, i.e., θ_I, because given the fact that: $\theta_I + \theta_C = 1$; θ_C would be determined once the parameter θ_I is fixed.

From eq. (3.33) it is clear that high values of θ_I would be associated with lower growth rates in the initial stages since the reduction in the ratio $\{\theta_C\beta_C+\theta_I\beta_I\}/\theta_I\beta_I$ brought about by a rise in θ_I would be larger than the increase in $(1 + \theta_I\beta_I)^t$ for small values of t (provided, of course, $\beta_I < \beta_C$). But with the passage of time, $(1 + \theta_I\beta_I)^t$ would tend to dominate the solution of eq. (3.33) so that a higher value of θ_I would imply a higher growth rate of income in the future. Thus the policy prescription to emerge from the growth equation was that priority should be given to the development of the investment goods industry if the rate of growth of consumption was to be higher in the long run and that this strategy was to be pursued even though the consumption goods industry had the higher output-capital ratio.

The two-sector model of Mahalanobis was an extension of the one-sector Harrod-Domar model, and the deficiencies of the latter were carried over to the two-sector model. The major point of criticism was the oversimplified treatment of the economy in the sense of excluding trade from consideration, ignoring lags between investment and production, dividing the economy into two mutually exclusive sectors with little interaction between them. While the two-sector model dealt with the intertemporal allocation of investment, the four-sector model [Mahalanobis, 1955] was related to the intersectoral allocation of investment. The four sectors considered were investment goods (I), factory production of consumer goods (C_1), household production of consumer goods (C_2) and services (C_3).

For a given fixed target level of incremental income (δY^0), the one-sector Harrod-Domar model yields the necessary aggregate investment (I^0) based on a global ICOR. The decision problem in this model was the allocation of this investment level among the four sectors so as to achieve the targeted levels of incremental income (δY^0) and additional employment (δN^0).

The given parameters for the model were β_I, β_1, β_2 and β_3, (i.e., the sectoral output-capital ratios) and ϕ_I, ϕ_1, ϕ_2 and ϕ_3, (i.e., the sectoral incremental labour-capital ratios). The instruments were θ_I, θ_1, θ_2 and θ_3 (i.e., the sectoral investment shares). The exogenously given variables were the initial level of investment (I_o) and the target variables: additional income creation (δY^0) and employment generation (δN^0). Thus the problem essentially involved solving the following system of equations:

$$\delta Y^0 = \theta_I\beta_K I^0 + \theta_1\beta_1 I^0 + \theta_2\beta_2 I^0 + \theta_3\beta_3 I^0 \quad (3.34)$$

$$\delta N^0 = \theta_I\phi_K I^0 + \theta_1\phi_1 I^0 + \theta_2\phi_2 I^0 + \theta_3\phi_3 I^0 \quad (3.35)$$

$$1 = \theta_I + \theta_1 + \theta_2 + \theta_3 \quad (3.36)$$

This system has three equations in four unknowns, θ_I, θ_1, θ_2 and θ_3, rendering it indeterminate. In order to solve the system, the two-sector model was initially invoked in order to obtain a prior "optimal" solution for θ_I (=0.33). Given this value for θ_I, the system was uniquely

solved for the remaining three unknowns.

While the four-sector model involved greater detailing than the two-sector model, this disaggregation was confined to the consumer goods sector whose investment share was obtained, and allocated "optimally" amongst the three subsectors, only after the requirements of the priority sector, i.e., the capital (or investment) goods sector, had been met.

This "optimality" conjecture was later challenged by Komiya [1959] who proved, using a linear programming approach, that the resulting solution would have yielded a growth rate of income higher than the one envisaged by Mahalanobis. But it would be simplistic to dismiss the Mahalanobis solution on this account because the solution of Komiya would have implied zero investment in two of the sectors which was politically unacceptable.

However, whichever model or formulation is used, the key policy parameter is the investment share of the capital goods sector, θ_I, and for different values of this parameter the models ground out alternative intertemporal growth patterns. An important consequence is that changes in the savings rate, and hence in the rate of investment, are not necessarily feasible and become conditional upon the composition of the existing capital stock; hence, optimal programmes of capital accumulation worked out under the assumption of nonshiftability differ crucially from those derived from models with complete shiftability of capital stock [see Chakravarty, 1969]. More flexible schemes are also possible but this whole family of models suffers from the fact that at reasonable levels of aggregation, there are no 'pure' sectors and it is very difficult to segregate industrial statistics into the FMD capital and consumption classes.

The many limitations of the FMD class of models led to the conception of the "wage-goods" model of Vakil and Brahmananda [1956]. Their approach constituted in some ways the polar opposite of the position taken by Mahalanobis. While the latter's entire emphasis was on the role of fixed capital, the former emphasized the role of wage-goods as capital.

The operational part of this approach was derived from the assumption that there existed massive overpopulation and, consequently, a reserve army of labour in agriculture as envisaged by Rosenstein-Rodan. They further assumed *a la* Nurkse that the disguised unemployed must possess considerable savings potential since labour could be transferred from agriculture without lowering production and employed in the production of capital goods by paying wages, entirely in the form of food.

Problems arose however with some of the assumptions of their model, notably in considering a simple "Austrian" type production process of the form: labour -> capital goods -> consumer goods. If the production scheme dictated a circular model of the form analyzed by Leontief and others, the mere availability of labour alone would not have solved the problem of higher capital formation and the extra capital equipment needed would either have to be domestically produced or imported, raising once again the complex issues posed by the FMD class of models.

However, it needs to be noted that the truly novel feature of the wage-goods model was its implicit social welfare function which emphasized the need to minimize the time required to reach full employment. Neither the Mahalanobis model nor the subsequent planning models have paid any attention to this facet whatsoever.

3.4 The Third Five Year Plan Model: 1961-66

Due to this limitation in system design, the logic of increasing investment in the heavy goods industries for the Indian economy, which was a natural corollary of the Mahalanobis principle, was found to be flawed. The resulting controversy ended in abandoning the optimization framework and switching over to open disaggregative models which represented the next phase in the evolution of the systems approach to planning in India.

Unlike the first two plan models which were essentially adapted from growth models existing in the literature, the model for the third plan (1961-66) was constructed by Professor Sukhamoy Chakravarty with Indian conditions specifically in mind. The system was a decision model implying that it had more unknowns than

equations. By exploiting the ensuing positive "policy degrees of freedom", the planner was able to discriminate between the results of alternative policy constellations.

While Mahalanobis had interpreted optimization as a means of using up the excess degrees of freedom, Chakravarty realized that once the rigid assumptions of the FMD class of models are relaxed, excess degrees of freedom can arise from many sources: excess capacity, the possibility of substituting capital for labour along production functions, and so on. Arguing that it was thought both logical and necessary to modify the original Mahalanobis formulation, the model constructed for the third plan examined a variety of methods to specify enough additional model- closing conditions which, apart from making the quantity solution of the planning model determinate, would accord an explicit priority to agriculture unlike the second plan model.

Chakravarty's original model was published in Rosenstein-Rodan [1964] and what follows is a reformulated version of it. This has been to the extent that while the actual version was concerned with the behaviour of the economy over the entire plan period, the present orientation is towards a year-to-year variation. Needless to say, no essential features of the model are lost by such a form of presentation.

The unknowns, exogenous variables and parameters in the third five year plan model are set out in Tables 3.1 and 3.2.

TABLE 3.1. UNKNOWNS IN THE THIRD FIVE YEAR PLAN MODEL

I	= Investment
S	= Savings
F	= Net foreign aid
Y	= Gross Domestic Product (GDP)
D_A	= Demand for agricultural output
Y_A	= GDP from agriculture
T	= Total tax revenue
T'	= Component of tax revenue dependent on income
Y_{NA}	= GDP from sectors other than agriculture
C	= Private Consumption
E	= Total government expenditure
δD	= Increase in govemment debt (market borrowings) with tax rates remaining unchanged
I_A	= Investment in agriculture
I_{NA}	= Investment in sectors other than agriculture
Γ	= annual increment in savings

TABLE 3.2. EXOGENOUS VARIABLES AND PARAMETERS IN THE THIRD FIVE YEAR PLAN MODEL

Exogenous Variables

P	= Population
E_c	= Current expenditure of the govemment
R	= Operating surplus from govemment enterprises
T''	= Component of tax revenue independent of income

Parameters

β	= Global incremental output-capital ratio
β_A	= Incremental output-capital ratio in agriculture
θ	= Proportion of investment by the government
$\pi(i)$	= Proportions in which tax revenue is earned from: (1) current consumption, (2) current agricultural income and (3) current non-agricultural income; i = 1,2,3
μ	= Income elasticity of demand for agricultural production

The model comprised the following set of equations. (It must be noted that the time index, t, is implicit in all cases).

Investment equals domestic savings plus net foreign aid:

$$I = S + F \tag{3.37}$$

Investment determines incremental output (δY) as follows:

$$\delta Y = \beta I \tag{3.38}$$

Savings is a linearly increasing function of time given by:

$$S = S(0) + \Gamma t \tag{3.39}$$

The demand for agricultural output is assumed to depend upon population, per capita income and the income elasticity of demand for agricultural output. The functional form is given by:

$$D_A = P[Y/P]^{\mu} \tag{3.40}$$

The maintenance of equilibrium between incremental demand for agricultural output and its incremental supply implies that:

$$\delta Y_A = \delta D_A \tag{3.41}$$

In order to determine the extent of investment that will be needed to finance this level of agricultural output, we have:

$$I_A = \delta Y_A / \beta_A \tag{3.42}$$

Both, income as well as investment in the non-agricultural sector are determined as residuals:

$$Y_{NA} = Y - Y_A \tag{3.43}$$
$$I_{NA} = I - I_A \tag{3.44}$$

Total tax revenues comprise taxes related to income and those which are autonomous with respect to income, i.e.,

$$T = T' + T'' \tag{3.45}$$

That part of tax revenue dependent on income is assumed to be a function of consumption, agricultural income and non-agricultural income, weighted by the respective proportions in which existing tax revenues is earned from these three sources. The functional form is given by:

$$T' = C^{\pi(1)} Y_A^{\pi(2)} Y_{NA}^{\pi(3)} \tag{3.46}$$

Total government expenditure is equal to the sum of current expenditure plus the proportion of total investment expenditure that is undertaken by the government (θ), i.e.,

$$E = E_c + \theta I \tag{3.47}$$

where θ is a policy parameter.

Change in government debt over the year (i.e., borrowings during the year) is the difference between government expenditures and total revenues (i.e., tax revenues plus operating surplus of public enterprises). Thus, we have:

$$\delta D = E - (T + R) \tag{3.48}$$

Private consumption is obtained as a residual from:

$$C = Y - S \tag{3.49}$$

Thus, it is seen that the model has 15 unknowns and 13 equations. The resulting two degrees of freedom implies that the value of any two unknowns may be arbitrarily set from outside the system. Once this is done, the remaining variables can be determined from within the system. This gave the planners a number of alternative policy constellations from which a choice could be made. Three important possibilities considered were:

(1) δY is given and F is prescribed from outside. In this case, I would be determined as a consequence and so also Γ.

(2) δY is given and the savings programme (Γ) is prescribed. In this case, I and F appear as derived magnitudes.

(3) I and F are given from outside. In this case, δY and Γ would be determined as a consequence.

In the Pant-Little case, which was the most acceptable version, these two open ends were filled up by assuming I and F to be given from outside, and thus the targeted growth rate of income was derived endogenously, unlike in the

earlier plans.

While the third plan model was an attempt to rectify certain lapses of the earlier model, in retrospect it was possibly "over-successful" in this regard. While Mahalanobis erred by giving too much importance to the non-agricultural sector, Chakravarty erred by giving it too little importance. This is apparent from eqs. (3.43) and (3.44) where it is seen that both Y_{NA} as well as I_{NA} are determined only as residuals. Moreover, it is also seen that I_{NA} has no role to play in determining any other variable.

Striking a right balance between these two diametrically opposed strategies would have been possible if both sectors had been accorded equal importance during the modelling process.

One way to do so would have been to formulate sector-specific savings and production functions of the form:

$$S_A = s_A Y_A \qquad S_{NA} = s_{NA} Y_{NA} \tag{3.50}$$

$$\delta Y_A = \beta_A I_A \qquad \delta Y_{NA} = \beta_{NA} I_{NA} \tag{3.51}$$

where

s_A and s_{NA} $(s_A < s_{NA})$;

are the sectoral savings propensities while β_A and β_{NA} are the sectoral output-capital ratios ($\beta_A > \beta_{NA}$).

The model closing identities would now be given by:

$$S = S_A + S_{NA} \tag{3.52}$$

$$I = S + F \tag{3.53}$$

In such a formulation, with $Y_A(0)$ and $Y_{NA}(0)$ being given, we would require F to be prescribed implying that initially only I(0), and not δY, would have appeared as a derived magnitude.

The ensuing problem of distributing this investment between the agricultural and non-agricultural sectors would then have to take into account the relative output-capital ratios β_A and β_{NA}; the relative savings propensities,

s_A and s_{NA};

as well as the equilibrium condition given by eq. (3.41).

The agricultural sector could, if so desired, have been accorded a slightly higher priority by assuming I_A to be a policy variable so that I_{NA} would have been determined residually as:

$$I_{NA} = I - I_A \tag{3.54}$$

It is *this* policy choice that would have determined δY from:

$$\delta Y = \delta Y_A + \delta Y_{NA} = \beta_A I_A + \beta_{NA} I_{NA} \tag{3.55}$$

The resulting analysis would have yielded a far more realistic and equitable intersectoral distribution of investment. Yet another way by means of which the model could have been improved would have been to specify it around a "two-gap" framework where foreign trade is brought into the model via the identity that capital inflows (i.e., the difference between imports and exports) add to investible resources, so that the savings-investment *restriction* (and not savings-investment *balance* as assumed in the third five year plan model) becomes:

$$I \leq sY + F \tag{3.56}$$

where I is total investment, Y is national income, F is the amount of capital inflow and s is the average (assumed equal to the marginal) propensity to save. Eq. (3.56) is called the savings constraint or "gap".

Now, if investment has a marginal import share of h and production of a unit of GDP requires imports to the amount of m, then the trade constraint or "gap" facing the economy is:

$$hI + mY - X \leq F \tag{3.57a}$$

where X is the level of exports.

Eq. (3.57a), when written in terms of I, becomes:

$$I \leq (1/h)F + (1/h)(X - mY) \tag{3.57b}$$

The term F enters both these inequality constraints and is the key to the entire analysis. Along with Y and X, it is given from outside. Typically when this is done, only one of eqs. (3.56) and (3.57b) will be binding, i.e., investment (and therefore the growth rate) will be restricted to a lower level by either one of the inequality constraints. This dichotomy provides a basis for assigning foreign aid, since the impact of increased capital inflow on investment is greater when the trade constraint rather than the savings constraint is binding.

The generalization of the two-gap specification for application implies that imports are strictly

linked with output and investment; savings strongly depend on output; while exports and net capital inflows are invariably exogenous. As trying to alter many of these so-called "fixed" parameters forms the very essence of development planning strategies in an LDC experiencing structural change, such a "two-gap" approach would have been the ideal model choice for the Indian economy.

Although incorporating such a framework would have greatly strengthened the structure of the third plan model, the fact that it was not can in no way be construed as a criticism because at the time of the formulation of the third plan in 1961, the "two- gap" model of Chenery and Strout [1966] had not yet appeared in the literature. Nevertheless, the fact remains that such a specification would have taken into account resource shortfalls, foreign trade bottlenecks, absorptive capacity limits and other disequilibrating phenomena which were especially inherent in the Indian economy at that time. Moreover, such a two-gap model would have generalized the Harrod-Domar model in a robust manner and would have been consistent with the categories in which national accounts data are usually arranged in India.

In conclusion, the framework of the third five year plan did make a clean break from the shackles of the earlier development planning strategy although Chakravarty felt that it was not very clear from the third plan documents and discussions around that time "whether the planners had fully comprehended the nature of the changed priorities and their lack of congruence with the Second Five Year plan strategy" [Chakravarty 1987, p. 20].

3.5 The Fourth Five Year Plan Model: 1969-74

The models used so far were basically aggregative and designed to make projections about the evolution of only certain key variables. However, from the viewpoint of realistic planning, it was felt that more disaggregated forecasts were desirable.

Thus, the next phase in the evolution of the systems approach to macroeconomic planning comprised an advancement to multi-sectoral consistency models which focused attention on establishing intersectoral consistency of production targets based on the static Leontief input-output (IO) methodology.

The basic demand-supply balance in the static IO accounting framework is as follows (for sector i);

$$X_i + M_i = \sum_j X_{ij} + F_i \tag{3.58}$$

where:

X_i = the volume of gross output from sector i,

M_i = competitive imports into sector i,

X_{ij} = intermediate sales from sector i to sector j,

and F_i = total final demand from sector i.

Applied IO analysis invokes one additional assumption:

$$X_{ij}/X_j = a_{ij} \tag{3.59}$$

where aij is a constant. On the basis of this, eq. (3.58) can be rewritten in matrix notation as:

$$(I - A)\,X + M = F \tag{3.60}$$

which is the basis for almost all the standard computations.

Application is based on inverting the (I-A) matrix to determine gross output requirements contingent on a forecast of final demands and imports. Thus, we have:

$$X = (I - A)^{-1}(F - M) \tag{3.61}$$

The above IO model can be used as a basis for wide-ranging discussions on trade-offs and policy options. Such a model is static in the sense that it makes just one-period ahead forecasts considering only the demand-creating effects of investment. In some contexts, it is useful to accumulate sectoral investment into capital stocks and take into account the capacity limits these place on production. This can be done through the dynamic Leontief model which will be discussed formally in Section 4.1.

The fourth plan (1969-74) model which was formulated on the lines of the IO framework outlined above was based on the efforts of Manne and Rudra [1965]. Designed to cover the period 1960-70, the 30-sector IO model projected the principal components of gross domestic expenditure, translated them into final demands for individual components and then derived an internally consistent set of sectoral outputs, imports and investment requirements in the terminal year of the plan.

Consumption, private as well as public, was treated exogenously, as were exports. Both imports as well as investment were treated as part endogenous and part exogenous. While the bifurcation of the former on these lines was carried out in a more or less *ad hoc* manner, such a treatment of capital formation was grounded on important institutional considerations. The fact that a combination of the two conventional approaches, i.e., the static IO approach where investment is fully exogenous and the dynamic IO approach where investment is wholly endogenous was preferred, was based on the recognition that a significant part of investment (especially those with respect to social overhead capital) could not be directly related to any output targets.

Computational considerations played an important role in the choice and ordering of sectors so that the transactions matrix was, by and large, triangular. Such a pattern of input dependence for the Indian economy seemed to suggest that "everything does not depend on everything else" [see Rudra, 1975]. The ordering of the sectors and the consequent positioning of the non-zero elements in the transactions matrix indicated that the bulk of the transactions in the economy revolved around two virtually independent complexes: one based upon agriculture and the other upon mining, metals and machinery. A third and smaller complex known as 'universal intermediates', i.e., fuel, power, transport and chemicals, produced raw materials for all the sectors.

We shall illustrate the planning consequences of the quasi-triangularity proposition stated above with the help of the aggregated (3x3) IO table given in Table 3.3 which refers to the inter-industrial transactions in the Indian economy for 1960-61 [see Manne and Rudra, 1965]. The three sectors referred to above were distinguished as metals and machinery (MM); food and fibre (FF); and universal intermediates (UI).

TABLE 3.3 (3 X 3) INPUT-OUTPUT MODEL FOR INDIA: 1960-61

Receiving Sector	MM	FF	UI	Final Demand	Gross Output
Producing Sector					
MM	1,063.3	26.7	44.1	2,138.2	3,272.3
FF	10.5	2,057.3	38.5	7,753.4	9,859.7
UI	136.6	171.3	335.9	939.0	1,582.8
Value added	2,061.9	7,604.4	1,164.3	10,830.6	0.0
Gross output	3,272.3	9,859.7	1,582.8	0.0	14,714.8

The matrix of coefficients A can be derived from Table 3.3 by dividing the items in every column in the indented matrix by the gross output level of the corresponding sector. Thus:

$$A = \begin{bmatrix} 0.325 & 0.002 & 0.028 \\ 0.003 & 0.209 & 0.024 \\ 0.041 & 0.017 & 0.212 \end{bmatrix} \qquad (3.62)$$

The inverse of (I-A) is given by:

$$(I-A)^{-1} = \begin{bmatrix} 1.484 & 0.007 & 0.053 \\ 0.009 & 1.350 & 0.041 \\ 0.079 & 0.032 & 1.273 \end{bmatrix} \qquad (3.63)$$

Thus, the gross output levels X's can be written as:

$$X_1 = 1.484\, f_1 + 0.007\, f_2 + 0.053\, f_3 \qquad (3.64a)$$
$$X_2 = 0.009\, f_1 + 1.350\, f_2 + 0.041\, f_3 \qquad (3.64b)$$
$$X_3 = 0.079\, f_1 + 0.032\, f_2 + 1.273\, f_3 \qquad (3.64c)$$

where the f's denote levels of final demand.

We notice that the pattern of inter-connectedness for the Indian economy in 1960-61 was such that a one rupee increase in final demand for metals and machinery would imply an increase in gross output level for the same sector of 1.48 rupees, a negligible increase (0.009 rupees) in the demand for output of food and fibre and a slightly higher increase (0.079 rupees) in the output level of the sector producing universal intermediates.

Since investment is largely equivalent to final demand for the metal and machinery sector, it may be argued that investment was largely autonomous in character for the Indian economy. The same applies to food and fibres. Thus, one may feel like concluding that raising investment or consumption demand were largely independent questions given the structure of the economy.

However, such a conclusion would be unwarranted since the model, being open in character, disregards the question of incremental wave demand, which creates additional demand for consumer goods [see Chakravarty, 1969]. Furthermore, in such a static version, we have overlooked the possibility of capital formation which would establish an additional linkage between the MM sector and the other sectors. Despite these qualifications, Table 3.3 shows the weaknesses of the linkages between the sectors in the Indian economy on the chosen lines of aggregation.

Yet another weakness was that although the Manne-Rudra model derived the gross production vector under alternative assumptions regarding import coefficients as well as the growth of aggregate consumption and investment, the model generated only terminal year projections, without providing the transition paths from given initial conditions to the desired terminal solutions. To overcome this deficiency, an almost-consistent intertemporal planning model was developed by Bergsman and Manne [1966], covering the period 1966-75 which highlighted the implications of alternative growth paths for the Indian economy. Considering that, due to the 'plan holiday' from 1966-69, the fourth plan was finally implemented over the period 1969-74, the Bergsman-Manne model could have proved to be more relevant than the Manne-Rudra model as it covered the entire fourth plan period, unlike the Manne-Rudra model which covered only the period 1960-70.

In retrospect, the most important consequence of the fourth plan model was that the inter-sectoral consistency approach to planning was accorded official sanction and thereafter all modelling efforts were carried out by the Planning Commission.

3.6 The Fifth Five Year Plan Model: 1974-79

The fifth plan (1974-79) model was the first official plan model of the Government of India and was constructed by the Planning Commission. The strategic objective of the plan was essentially 'redistribution with growth'.

The model integrated three sub-models: (i) a macroeconomic model specified largely on the lines of the Harrod-Domar growth model, (ii) a static IO model ensuring inter-sectoral consistency of target outputs, and (iii) a consumption model providing the sectoral distribution of private consumption expenditure.

The logic of the framework was as follows: The macroeconomic model initially translated the target growth path for real GDP into aggregate as well as phased investment requirements on the basis of a global ICOR. The sectoral distribution of gross output as well as imports (those which were to be used as inputs in the production process) were estimated endogenously on the basis of the IO model. The excess of imports (plus external aid which was deemed exogenous) over exports (projected exogenously), in conjunction with the desired level of investment, yielded savings (via the two-gap model). The excess of income over savings determined aggregate consumption, as well as private consumption, given the exogenously determined level of government consumption.

The consumption sub-model, which was the most novel feature of the fifth plan model, was then used to derive aggregate demands for individual consumer commodities, both for rural as well as urban areas, on the basis of a log-normal expenditure distribution function, so as to provide a minimum standard of living for the poorest 30 per cent of the population.

In Table 3.4 below, we have provided a listing of the endogenous variables in the fifth plan model.

TABLE 3.4. LISTING OF ENDOGENOUS VARIABLES IN THE FIFTH PLAN MODEL

	Endogenous Variables
Y	= GDP at factor cost
YM	= GDP at market prices
CM	= Private consumption at market prices
S	= Gross domestic savings
IM	= Gross investment at market prices
F	= Net imports of goods and services
M	= Total imports of goods and services
C	= Private consumption at factor cost
G	= Public consumption at factor cost
I	= Gross investment at factor cost
ΣIM	= Total investment at market prices over the plan period
X_i	= Output at factor cost of sector i
C_i	= Private consumption at factor cost of sector i
ST_i	= Changes in stock of sector i
M_i	= Imports of sector i
TC	= Total indirect taxes on private consumption
TINT	= Total indirect taxes on intermediate inputs

In Table 3.5 below, we have provided a listing of the exogenous variables in the fifth plan model.

TABLE 3.5. LISTING OF EXOGENOUS VARIABLES IN THE FIFTH PLAN MODEL

	Exogenous Variables
GM	= Public consumption at market prices
IM(0)	= Gross investment at market prices in the base year
T	= Total indirect taxes
E	= Total exports of goods and services
I_i	= Total investment goods delivered by sector i at factor cost
TG	= Indirect taxes on public consumption
TE	= Export duties
TI	= Indirect taxes on capital goods
G_i	= Public consumption at factor cost in sector i
E_i	= Exports at factor cost by sector i
Pr	= Population in the rural area
Pu	= Population in the urban area

The parameters of the model are provided in Table 3.6 below.

TABLE 3.6 LISTING OF PARAMETERS IN THE FIFTH PLAN MODEL

	Parameters
g	= Annual growth rate of GDP at factor cost
B(t)	= Amount of annual investment phasing
v	= Aggregate incremental capital output ratio (ICOR)
s_i	= Stock coefficient in sector i
a_{ij}	= Inputs of sector i per unit output of sector j
a_{ij}^m	= Imported inputs of sector i per unit output of sector j
d_{ij}	= Magnitude by which import coefficient a_{ij}^m is reduced due to import substitution
c_i^m	= Proportion of private consumption in sector i coming from imports
g_i^m	= Proportion of public consumption in sector i coming from imports
m_i^m	= Proportion of investment goods in sector i coming from imports
ED_i	= Excise duties per rupee of output in sector i
n_i	= Import duties per unit of imports in sector i
b	= Ratio of per capita (aggregate) consumption in urban area to that in rural area
p_{ij}^r	= Proportion of private consumption of sector i to the total consumption of the *jth* expenditure class in the rural area: $\sum_{i=1}^{66} p_{ij}^r = 1$
p_{ih}^u	= Proportion of private consumption of sector i to the total consumption of the *hth* expenditure class in the urban area: $\sum_{i=1}^{66} p_{ih}^u = 1$

We now present the structural equations of the fifth plan model with the macroeconomic model being considered first, followed by the IO model and finally by the consumption model. While the original model appeared in Planning Commission, Government of India, 1973, *A Technical Note on the Approach to the Fifth Plan of India: 1974-79*, in the reconstructed version which follows, we have re-organized certain equations of the system so as to bring about greater clarity and consistency in the mathematical framework of the model. As before, it needs to be noted that the time index (t) is implicit in each variable.

3.6.1 The Macroeconomic Model

The time path of GDP at factor cost (Y) was given by:

$$Y = (1+g)\, Y(-1) \tag{3.65}$$

where Y(-1) indicates GDP in the previous period and g was the target annual growth rate of income which was set at 5.5 percent.

GDP at market prices (YM) was given by the identity:

$$YM = Y + T \tag{3.66}$$

where total indirect taxes (T) was given exogenously.

Total investment at market prices over the plan (ΣIM) was:

$$\Sigma IM = \sum_{t=1}^{5} IM = v(YM_5 - YM_0) \tag{3.67}$$

where YM_0 and YM_5 denote GDP at market prices in the base year and final year of the plan, respectively; and v was the global ICOR which was assumed to be 3.34.

Gross investment at market prices (IM) was given by:

$$IM = IM(0) + B(t)t \tag{3.68}$$

where the B(t) were chosen to ensure that the ΣIM derived from eq. (3.68) was consistent with that obtained from eq. (3.57).

Total imports (M) was given by:

$$M = \sum_{i=1}^{66} M_i \tag{3.69}$$

where M_i denotes imports of sector i with the summation extending over the 66 sectors considered by the IO model.

Net imports of goods (F) was given by:

$$F = M - E \tag{3.70}$$

where exports (E) were specified exogenously.

Gross domestic savings (S) was obtained as a residual from the savings constraint of the two-gap model and was given by:

$$S = IM - F \tag{3.71}$$

Private consumption at market prices (CM) was derived as a residual from the national income accounting identity as follows:

$$CM = YM - (GM + S) \tag{3.72}$$

where public consumption at market prices (GM) was exogenous.

Private consumption at factor cost (C) was given by:

$$C = CM - TC \tag{3.73}$$

where TC was total indirect taxes on private consumption.

Public consumption at factor cost (G) was set out similarly:

$$G = GM - TG \tag{3.74}$$

where indirect taxes on public consumption (TG) was exogenous.

Gross investment at factor cost (I) was given as follows:

$$I = IM - TI \tag{3.75}$$

where indirect taxes on capital goods (TI) was exogenous.

Given indirect taxes on inputs (TINT), endogenized by the IO model, and export duties (TE), set exogenously, indirect taxes on private consumption (TC) was derived residually, as follows:

$$TC = T - (TG + TI + TINT + TE) \tag{3.76}$$

3.6.2 The Input-output Model

The disaggregated IO balance equation for determining the output of sector i (X_i) in an open economy was set out as under:

$$X_i = \sum_{j=1}^{66} a_{ij}X_j + C_i + G_i + I_i + ST_i + (E_i - M_i) \quad (i = 1, 2, ..., 66) \tag{3.77}$$

where the a_{ij}'s are technologically given; C_i, ST_i and M_i are private consumption, changes in stocks and imports of sector i, respectively (all determined endogenously); and G_i, I_i and E_i are public consumption, investment and exports of sector i, respectively (all determined exogenously).

Changes in stocks of the i^{th} sector (ST_i) were given by:

$$ST_i = s_i [X_i - X_i(0)] \tag{3.78}$$

where the s_i's are stock coefficients; and $X_i(0)$ is the base year level of output of sector i (historically given). The above equation implies that changes in stocks (in sector i) in time period t are some proportion (determined by s_i) of the difference between the level of output (in sector i) in time period t and the corresponding base year level of output.

The import requirements of sector i (M_i) were given by:

$$M_i = \sum_{j=1}^{66}(a_{ij}^m - d_{ij})X_j + c_i^m C_i + g_i^m G_i + m_i^m I_i \quad (i = 1, 2, ..., 66) \tag{3.79}$$

where the coefficients a_{ij}^m, c_i^m, g_i^m, and m_i^m are the corresponding sectoral import components of output, private consumption, public consumption and investment, respectively. Import substitution was carried out through the d_{ij}'s which were set equal to zero in the absence of any import substitution.

Private consumption in the i^{th} sector (C_i) was given by:

$$C_i = f_i (C) \tag{3.80}$$

where the $f_i(.)$ were estimated through the consumption sub-model which is discussed in the next section.

Indirect tax collections from inputs (TINT) was given by:

$$TINT = \sum_{i=1}^{66}\sum_{j=1}^{66}(a_{ij} + d_{ij} - a_{ij}^m)X_j ED_i + \sum_{i=1}^{66}\sum_{j=1}^{66}(a_{ij}^m - d_{ij})X_j n_i \tag{3.81}$$

where ED_i and n_i refer to excise duties per unit of output and import duties per unit of imports, in sector i, respectively.

3.6.3-The Consumption Model

Total private consumption expenditure (C), obtained from eq. (3.73) of the macroeconomic model, was bifurcated as follows:

$$C = C_r + C_u \tag{3.82}$$

where C_r and C_u refer to private consumption in rural and urban areas, respectively.

In order to derive the above break-up endogenously, the following methodology was adopted. Initially, the following three definitional equations were given:

$$v_r = C_r/(12P_r) \tag{3.83a}$$
$$v_u = C_u/(12P_u) \tag{3.83b}$$
$$v_u = b\, v_r \tag{3.83c}$$

where v_r and v_u refer to monthly per capita aggregate consumption in rural and urban areas, respectively; P_r and P_u (given exogenously) refer to population in rural and urban areas, respectively; and b (given exogenously) is the desired ratio of per capita aggregate consumption in urban areas to rural areas.

Substituting eqs. (3.83a) and (3.83b) into eq. (3.83c) and eliminating C_r in the resultant using eq. (3.82) yields:

$$C_u/P_u = b(C - C_u)/P_r \tag{3.84}$$

which can be used to solve uniquely for C_u as the remaining variables/parameters in eq. (3.84) are all known. Thus, v_r and v_u also become determinate.

Private consumption for sector i in rural areas (C_{ir}) and in urban areas (C_{iu}) is given by:

$$C_{ir} = \sum_{j=1}^{27} p_{ij}^r W_j^r \tag{3.85a}$$

$$C_{iu} = \sum_{j=1}^{27} p_{ij}^{u} W_j^{u} \qquad (3.85b)$$

(i=1,...,66 sectors)
(j=1,...,27 expenditure classes)

The W_j^r and W_j^u which refer to total private consumption in rural and urban areas, respectively, by the j^{th} expenditure class were obtained by the following relations which have been derived on the assumption that the distribution of monthly per capita (aggregate) expenditure, x, is log-normal:

$$W_j^r = 12P_r v_r[\phi(z_j) - \phi(z_{j-1})] \qquad (3.86a)$$

$$W_j^u = 12P_u v_u[\phi(z_j) - \phi(z_{j-1})] \qquad (3.86b)$$

where ϕ stands for the log-normal distribution with zero mean and unit variance.

We now derive the estimate W_j^r, with that for the urban case being obtained analogously. To do so, we define the following:

$$y_j = (1/\alpha)\log(x_j/v_r) + \frac{1}{2}\alpha \qquad (3.87a)$$

$$z_j = y_j - \alpha \qquad (3.87b)$$

x_j = upper limit of the j^{th} expenditure class (3.87c)

α = parameter of the log-normal distribution (3.87d)

Since the expenditure class limits x_j are given, the estimate W_j^r can be obtained if α is known. The value of α was assumed to be the same as in the base year (1973-74) of the plan if no reduction in the expenditure inequality was envisaged. Otherwise, α was determined on the basis of the desired level of monthly per capita (aggregate) consumption of the poorest 30 per cent of the population, v_{30}, from the following relations:

$$v_{30} = (v_r/0.30)\,\phi(z_{30}) \qquad (3.88a)$$

$$z_{30} = y_{30} - \alpha \qquad (3.88b)$$

$$\phi(y_{30}) = 0.30 \qquad (3.88c)$$

Using the desired value, v_{30}, of the per capita monthly consumption of the poorest 30 per cent of the population (which was assumed to be Rs 20 at 1960-61 prices) and of the aggregate per capita consumption in the rural areas, v_r, we can derive z_{30} from eq. (3.88a); while from eq. (3.88c), we can derive y_{30}. Both these solutions, when substituted in eq. (3.88b), yield α.

The estimated value of α, when substituted into eq. (3.87a), yields y_j which, in turn, from eq. (3.87b) helps to determine z_j, thereby determining W_j^r from eq. (3.86a). Thus, C_{ir} is estimated and, in a similar manner, C_{iu} from eqs. (3.85a) and (3.85b).

Thus, total private consumption of sector i is given by:

$$C_i = C_{ir} + C_{iu} \qquad (3.89)$$

which defines eq. (3.80) and completes the consumption sub-model.

Needless to say, the consistency condition must hold:

$$\Sigma C_{ir} + \Sigma C_{iu} = C_r + C_u = C \qquad (i=1,\ldots,66) \qquad (3.90)$$

i.e., the sum of sectoral consumption (both rural and urban) as determined by the consumption model must equal total consumption as obtained from the macroeconomic model.

3.6.4 A Summing-up

While the fifth plan model was a highly comprehensive one and, in retrospect, probably the most technically elegant of all Indian plan models so far, several shortcomings in the methodology did manage to manifest themselves.

One major flaw was that the IO model for the base year of the fifth plan (1973-74) was constructed by updating the 66-sector IO table of 1965-66 using available information on output levels, exports, investment, imports and public consumption, consistent with national income data of 1970-71. The updated IO table of 1970-71 was then recast to correspond with sectoral output and final demand information for 1973-74, as well as with the national income estimates for that year. Considering that the plan framework hinged crucially on the IO model, it would have been advisable to have constructed the entire (66 x 66) matrix *de novo* instead of reconstructing it from an updated IO matrix. Even if updating was found to be inevitable, the techniques suggested by Carter and Brody [1970] should have been followed rather than the *ad hoc* methods used by the Planning Commission to extrapolate the technical coefficients.

Furthermore, no attempt was made to incorporate manpower planning techniques into the model, i.e., to determine whether the necessary sectoral allocation of labour force exists to generate the desired final demand vector, D, in eq. (3.77) where:

$$D_i = C_i + G_i + I_i + ST_i + (E_i - M_i) \qquad (3.91)$$

The desired sectoral labour force (L_i) for each of the 66 sectors could have been computed on the basis of primary (labour) input technical coefficients, a_{0j}, defined as follows:

$$a_{0j} = 1 - \sum_i a_{ij} \qquad \begin{matrix}(i = 1, ..., 66)\\(j = 1, ..., 66)\end{matrix} \qquad (3.92)$$

The desired labour force in sector i would be given by:

$$L_i = (a_{0i} X_i)/w_i \qquad (3.93)$$

where a_{0i} is the primary input coefficient in sector i, w_i is the average wage rate in sector i and X_i is the output level of sector i, with X being given by: $X = (I-A)^{-1}D$.

Thus, the desired aggregate labour force would be equal to:

$$L = \sum_i (a_{0i}X_i)/w_i = \sum_i L_i \qquad (i = 1, ..., 66) \qquad (3.94)$$

As unemployment and sectoral manpower shortages do co-exist in India, the above exercise would have provided a consistency check on the feasibility of final demand in terms of the sectoral as well as aggregate availability of labour force.

Yet another flaw was in the investment phasing equation, eq. (3.68), of the macroeconomic model. While it is true that the investment phasing parameters, B(t), were chosen so that total investment was equal to that estimated by eq. (3.67), the model design implies that there is no choice whatsoever and that B(t) is endogenized once g and v are given. This is because the plan assumes an accelerator relationship given by:

$$I = v\,[Y - Y(-1)] \qquad (3.95)$$

Subtracting Y(-1) from both sides of eq. (3.65), multiplying the result by v and linking it up with eq. (3.95) above yields:

$$I = v\,[Y - Y(-1)] = vg\,Y(-1) \qquad (3.96)$$

Given that the plan assumed v = 3.34 and g = 0.055, we have:

$$I = 0.1837\,Y(-1) \qquad (3.97)$$

implying that investment is uniquely determined once Y(-1) is known and the question of choosing B(t) just does not arise.

The consumption model was introduced specifically with the notion of ensuring a monthly per capita consumption of Rs 20 at 1960-61 prices for the lowest 30 per cent of the population. Even though this sub-model was the most novel feature of the fifth plan, it was severely criticized by Tendulkar [1974] and Rudra [1975] who doubted its economic feasibility in practice.

The indictment was due to the difficulty in operationalising the objective of poverty alleviation because no policy measures were outlined for income generation by the targeted segment of the population to afford the minimum consumption levels specified for them. This was because investment was merely related to the planned change in GDP and there was no feedback postulated between the detailed consumption targets as set out by the consumption sub-model and sector-specific investment levels. The underlying reason for this was that consumption was defined only residually by the macroeconomic model and not projected behaviourally on the basis of either disposable income or the postulated income distribution between the rural and urban areas.

In a sense, the consumption sub-model tried to implement the 'Garibi Hatao' slogan of the government in power then. While this was a commendable objective, it can be said that from this time onwards political considerations, often in conflict with economic logic, started intruding into the planning process. This is all the more evident if one considers the backdrop against which the fifth plan was terminated prematurely in 1977-78, replaced by the draft sixth five-year plan (1978-83) which was itself over-turned in 1979-80 and substituted by a new sixth plan which fortunately, unlike its predecessors, was allowed to run its full course.

3.7 The Sixth Five Year Plan Model: 1980-85

The sixth plan model, which appeared in

Planning Commission, Government of India, 1981, *A Technical Note on the Sixth Plan of India: 1980-85*, sought to remove some of the lacunae of the fifth plan model by integrating both the Harrod-Domar and the IO approaches in a demand-supply framework. Thus, for the first time an investment planning model was developed and incorporated into the existing IO system, implying that the static IO model was now converted into a dynamic Leontief model.

While this conversion was not a complete success for reasons elaborated in Section 4.1, it did imply that it was now possible to provide an intersectoral as well as intertemporal check on demand-supply balances not merely in the commodity and services market, but also in markets dealing with primary inputs like labour, capital and other non-renewable resources. Equally important, unlike stipulating the desired growth rate of output exogenously as done hitherto, this plan model endogenized the growth rate and estimated it from the structure of the system.

In order to do so, the structure of the model was reformulated so as to identify growth constraints that had bedeviled the aspirations of earlier plans. In addition to such identification, specific provisions were devised to deal with certain ubiquitous growth-inhibiting factors like: (1) the high uncertainty in the international climate regarding trade and aid, (2) the ever-increasing deterioration in the terms of trade originating mainly from the high price of crude oil, and (3) the rising domestic inflation rate with special reference to that part of it which could not be explained by rising import prices.

3.7.1 Salient Features of the Model

There were three salient features of the sixth plan model:

(1) A system of supply equations, which was an extended and modified version of the Harrod-Domar equation, primarily meant to accommodate: (i) sectoral disaggregations, (ii) gestation lags for investment and (iii) the existence of a foreign trade sector.

The key equation in this system indicated that the total feasible supply of output in any year of the plan was equal to capacity output already in existence before the plan plus capacity output created over the plan period until then. Thus:

$$X_i(t) = c_i X_i(T - k_i L_i) + \sum_{m=1}^{k_i} I_i(T - mL_i)\left[v_i(T) \cdot ICOR_i^{-1}\right] \quad (3.98)$$

where:

$X_i(t)$ is the supply of the ith sector in time t,
c is the capacity utilization factor in sector i,
L_i is the gestation lag for sector i,
k_i is any integer such that $(T-k_iL_i)$ is minimum negative,
I_i is investment in sector i, and
v_i is the ratio of value added to output in sector i.

(2) A system of demand equations which was once again an extended version of the Leontief IO system. This time, however, apart from consumption and imports, even investment was endogenized.

The conventional Leontief model and the manner in which it was reformulated in the fourth, fifth and sixth plans can be presented illustratively in a very simplified form as follows:

$$\text{Conventional: } X = (I-A)^{-1}(C+I+G+X-M) \quad (3.99)$$

$$\text{Fourth Plan: } X = (I-A^*)^{-1}(C+I+G+X) \quad (3.100)$$

$$\text{Fifth Plan: } X = (I-A^{**})^{-1}(I+G+X) \quad (3.101)$$

$$\text{Sixth Plan: } X = (I-A^{***})^{-1}(G+X) \quad (3.102)$$

where C, I, G, X, and M refer to private consumption, investment, public consumption, exports and imports, respectively; and where:

$(I-A)^{-1}$ is the conventional LI,
$(I-A^*)^{-1}$ is the extended LI with M endogenized,
$(I-A^{**})^{-1}$ is the extended LI with C and M endogenized,
$(I-A^{***})^{-1}$ is the extended LI with C, I and M endogenized,
where LI indicates the Leontief inverse.

(3) A set of inequality constraints with given upper bounds as: $MX \leq R$ to ensure that demand should not exceed supply in any of the markets; and a set of inequality constraints with lower bounds given as: $M^*X^* \leq R^*$ to ensure the

attainment of minimum welfare targets of the community. Here, R and R* refer to the resources available and the welfare targets; while M and M* are technological and behavioural coefficients.

3.7.2 Structure of the Model

The sixth plan model comprised a core model and several sub- models which were primarily designed to process the inputs (as exogenous variables) for the core model. The sub-models were:

(1) *Agriculture:* This provided estimates of capacity outputs in agriculture under alternative weather scenarios. (2) *Exports:* This provided sector-wise exports over time. (3) *Demography:* This worked out demographic relations, population and labour force. (4) *Autonomous investment:* This quantified the effects of time-bound welfare programmes, including public consumption. (5) *Long-term objectives:* This was concerned with reducing the number of people below the poverty line to a minimum. (6) *Material balances:* This was used to disaggregate the sectoral dimensions into their physical units and to check for overall consistency. The core model was composed of the following blocks:

(1) *Input-output block:* The output projections for the sixth plan, with 1979-80 as the base year, were based on an (89 x 89) sector extended Leontief system where output was determined by the exogenous elements of demand and the extended "dynamic" Leontief inverse. The Leontief inverse was extended by endogenizing both consumption and imports and was made dynamic by endogenizing the investment vector through inter-temporal links. The extended aspect of the Leontief matrix implied that gross output was dependent on consumption and import propensities apart from the conventional production technology and the exogenous elements of final demand; while the dynamic aspect of the Leontief matrix implied that gross output was made especially dependent on the growth rate stipulated over the plan.

(2) *Investment block:* An important aspect of this block was the estimation of sectoral ICORs, along with their associated gestation lags, which were then used to determine the optimal phasing and allocation of investment between sectors contingent upon the desired expansion of output. An added dimension was the estimation of a capital coefficients matrix which was then used to test the inter-industry consistencies between sectors.

(3) *Import block:* Imports were estimated according to the import coefficient matrix which was derived from past data and adjusted according to projected future requirements. The import matrix had two parts, the first of which corresponded to an (89 x 89) technological matrix indicating the amount of imports used as current inputs in production while the second corresponded to final use of a sector which was being met by imports.

(4) *Private consumption block:* This block was used for estimating consumption demands, separately for rural and urban areas, on lines broadly similar to those adopted for the Fifth Plan.

The key difference was that in this model consumption demand was endogenized. The consumption model comprised a Linear Expenditure System (LES) of 13 groups of commodities and a set of Engel curves within each LES group and covering 89 sectors of the IO model. The LES system used by the sixth plan was given by:

$$U(x_1, \ldots, x_n) = \sum_{i=1}^{n} b_i \log(x_i - a_i), \quad x_i > a_i \tag{3.103}$$

Eq. (3.103) is maximized subject to the budget constraint:

$$\Sigma x_i p_i = C \tag{3.104}$$

to yield a complete demand system given by:

$$C_i = p_i x_i = a_i p_i + b_i(C - \Sigma a_i p_i) \tag{3.105}$$

where: U(.) is a utility function; x_i and a_i are the quantity consumed and subsistence consumption of commodity i; b_i are the weights ($\Sigma b_i = 1$) indicating the proportion of the i^{th} group in aggregate consumption after accounting for committed consumption on commodity i which is given by $a_i p_i$; C_i and C are monthly per capita expenditure on commodity i and total monthly per capita expenditure; and pi is the price of commodity i.

Various functional forms of Engel curves were then fitted for the relationship: $C_i = f(C)$. Consumption demand was estimated by the two approaches and the parameters were appropriately adjusted so that the estimates of these demand functions agreed with the one estimated independently by the commodity flow approach which was used separately for urban and rural areas and then aggregated to arrive at total consumption demand.

(5) *Financial resources block:* This block estimated the domestic savings generated in the economy, both in the public and private sectors. Private sector savings were separated into the: (i) household sector, (ii) corporate sector and (iii) cooperative sector; while public sector (government) savings were divided into: (i) government budgetary savings, (ii) public enterprises (non-financial) savings and (iii) public enterprises (financial) savings. Household savings were further sub-divided into physical and financial assets and, both, the former as well as two important components of the latter, i.e., currency and household deposits (both demand as well as time), were projected on the basis of multiple regression techniques. For certain other forms of savings or taxes collected by the government, projections were based on certain assumptions about their rates of growth.

(6) *Employment block:* This block initially specified the total sector-wise availability of manpower in the economy. Individual labour coefficients were then worked out for each sector of the economy and employment projections were made for the agricultural, manufacturing and services sector, in terms of a new concept referred to as standard person years (SPY) which was defined to be 8 hours of work per day for 273 days in a year.

(7) *Perspective planning block:* Total production capacities available for 1994-95 were estimated on the basis of gross output levels for 1984-85 and the post-terminal growth rates which were estimated to match the sixth plan sectoral growth rates. From the demand side, sectoral production levels were estimated by an IO model given post-terminal final demands. Employment generation and the extent of poverty alleviation were finally estimated.

3.7.3 The Algebra of the Model

The structure of the core model was divided into 17 blocks of equations, given below, where each block represented either a class of constraints or a set of definitional equations.

A. *Demand constraint:*

Total gross output (at factor cost) equals the sum of total intermediate demands and final demands less imports.

B. *Investment phasing constraint:*

The time-phasing of sectoral investment depends upon sectoral growth rates, output levels, ICORs and gestation lags.

C. *Aggregate resources constraint:*

Total investment must not exceed total available resources.

D. *Supply/capacity constraint for activity sectors:*

Total feasible output at any point of time is determined by the productivity of existing capital stock.

E. *Demand/supply balancing constraint:*

Gross output in any period must satisfy demand and must not exceed productive capacity.

F. *Consistency between plan and post-plan growth rates:*

The aggregate value added growth rate during the plan and post-plan periods are assumed to be consistent when the relative sectoral growth rates are the same in the two periods.

G. *Definitional relations:*

The growth rate of gross domestic product is determined by the sectoral growth rates weighted by their value added ratios.

H. *Foreign exchange constraint:*

Total imports must not exceed total foreign exchange availability (including withdrawal of reserves).

I. *Land and natural resources constraint:*

Total land used must not exceed land availability (This is true for all major natural resources, including crude petroleum).

J. *Manpower constraint:*

The total demand for labour as inputs for production cannot exceed its total availability.

K. *Welfare programme constraint:*

The time-bound welfare programme of the plan must not exceed the total investment fund of the plan.

L. *Public sector financing constraint:*

The total investment in the public sector cannot exceed its savings (including borrowing from the public) and foreign borrowing (including withdrawal of foreign exchange reserves).

M. *Public sector contribution constraint:*

The contribution of the public sector to sectoral investment must not fall below a certain floor.

N. *Tax/fiscal constraint:*

The direct tax rate must not exceed an upper limit.

O. *Private sector investment constraint:*

The investible fund available to the private sector must equal or exceed the intended investment in the private sector.

P. *Gross output at market prices:*

It equates intermediate inputs at market prices and value added at factor cost.

Q. *Perspective plan:*

The requirement of output in 1994-95 should be consistent with the long-term objectives of the economy and should match the growth potential developed in the sixth plan.

3.7.4 Solution Sequence

(1) The model starts its simulation with initialized values of the post-plan sectoral growth rates ($\bar{g}_i$).

(2) By using systems (A), (G) and (P), the sectoral growth rates over the plan (g_i) and the GDP growth rate are computed.

(3) By further iteration, it arrives at successive pairs of ($g_i, \bar{g}_i$) which satisfy the constraints given in system (F). At this stage of convergence, we have achieved a consistent set of plan and post-plan sectoral growth rates, with the relative growth structure being the same in both periods.

(4) By using system (B), i.e., by assuming a given phasing of investment, the total investment over the plan is assessed.

(5) This total investment requirement is examined against system (C) in order to assess the feasibility of the investment programme against resource availability. A scalar operator is used to either increase or decrease the post-terminal growth rates so that the constraints given by system (C) are satisfied.

(6) Systems (D) and (E) are used at this point to estimate the availability of capacity over the plan period so as to ensure the fulfilment of the targets that have been developed.

(7) If the constraints specified by systems (D) and (E) are not satisfied, then, to ensure the feasibility of output in terms of available capacity, the post-terminal sectoral growth rates are iteratively reduced until all constraints are satisfied. Convergence can also be achieved by changing two major parameters: (i) the marginal propensity to consume which affects the relation between plan and post-plan growth rates, and (ii) the tax/subsidy rate, subject to system (N).

(8) If, as a result of such parametric changes, aggregate resources are affected, then the feasibility of the investment programme *vis-a-vis* system (C) has to be ensured all over again.

(9) Within the agreed feasibility ranges suggested by systems (C) and (N), alternative scenarios are computed and the one which maximizes the overall GDP growth rate is selected.

(10) At this stage, the estimated outputs are passed through system (H) in order to establish the binding constraint. The existence of a savings constraint does not pose any problem. On the other hand, if the presence of any binding trade constraints are indicated, then the entire iteration has to start afresh by adopting a lower growth profile until system (H) is satisfied.

(11) Subsequently, the model simulates systems (I), (J), (K), (L), (M), and (O), in order to check the feasibility constraints of the different forms of resources.

(12) Finally, we come to the long-term perspectives of the plan in terms of poverty, unemployment and self-reliance. This is done by system (Q): if any of its constraints are not satisfied, then the iteration proceeds afresh from system (A). An upward revision in the growth rates will only be possible if none of the constraints in the subsequent iterations are violated. If they are, then the planner has two options, either to reduce the long-term goals of the plan which are deemed as too ambitious or to reduce the sixth plan growth rates (i.e., the short-term goals) by changing the propensities to consume or the tax rates or some other relevant policy variable. In the present exercise, it was found that the policy degrees of freedom were limited, given the existing resource constraints in the economy.

3.7.5 A Summing-up

While the sixth plan model was a highly technical one, it would be appropriate, at this stage, to highlight some of its major analytical deficiencies. The most important amongst these was that although it managed to possess a dynamic structure, by endogenizing investment, it was unable to extract the optimal growth rate of output from the structure of the model. This was primarily because the estimated capital coefficients matrix which was used to endogenize investment turned out to be singular and therefore a forward recurrence relationship for output could not be generated. This point will be elaborated in greater detail in Section 4.1 where we discuss the dynamic Leontief model.

Because the system was highly nonlinear, an analytical programming solution was found to be impossible to obtain. Therefore, the model was solved recursively, and not simultaneously, by imputing alternative sets of values to the key policy variables until the system was reduced to a state with just one policy degree of freedom, i.e., the post-plan sectoral growth rates. Based upon these values, a maximum growth path was chosen which satisfied all the constraints; theoretically, the growth rate was dictated by the full utilization of the most constraining sector. Thus, the solution sequence implied that the maximum growth path could only be selected by iteration and, due to the nonlinearity of the system, it was impossible to determine whether the resulting growth rates had converged to a global or local maximum. Described in this form, the model became a hybrid of a dynamic IO model and a static LP model with the inherent deficiencies of both cropping up in this mutation.

The corollary was that the "quasi-dynamic" model could only be run for the terminal year although it is well known that the feasibility of a production target and that of a demand-supply balance in the market can be tested only when examined as a flow over time. As an exercise based on annual phasing is a minimum requirement for ensuring a feasible planning structure, an *ad hoc* attempt was made in this direction by assuming an exponential spread of investment between the base and the terminal year of the plan. As this was bound to create further problems of IO imbalances when checked on an annual basis, a very rough check was carried out by selecting some sectors of final demand once again on an *ad hoc* basis to act as the balancing factors. To sum it up, the initial flaw in the dynamic structure of the IO model transmitted itself right down the line because every attempt to overcome it resulted in further complications.

Moreover, there was no explicit functional relationship between income distribution and the production structure of the economy, nor was private consumption treated on a "closed loop" basis. Equally important, the model paid scant regard to the role of the private sector, the impact of changes in relative prices and the problems of spatial allocation of resources.

In conclusion, the sixth plan model did make a heroic attempt to solve the planning problem in India through the brute force application of technical know-how although, in the end, it was forced to come to terms with the sheer complexity of the issues it faced and resort to "value judgments" to choose an optimal solution: the non-technical finish, in effect, rendering the original quest for technical perfection rather quixotic.

3.8 The Seventh Five Year Plan Model: 1985-90

The seventh plan used a model frame which was an extension of the ones used both during the fifth as well as the sixth plan formulations, with adaptations being carried out to incorporate the three objectives of the seventh plan: food, work and productivity. As the basic model structure is the same as in the earlier two plans, we highlight here only the major areas where the model was modified in order to meet its desired objectives.

The model comprised a core model and ten sub-models. The core model comprised: (1) a macroeconomic model, (2) an IO model and (3) an investment model; while the individually classified sub-models were: (1) agriculture, (2) industry, (3) consumption, (4) investment, (5) financial resources, (6) exports, (7) imports, (8) demography, (9) employment and (10) poverty.

The core model was concerned with the model structure and was presented in the form of a system of equations which estimated the inter-relationships between all the major plan variables and the different policy instruments of the government. On the other hand, the sub-models dealt mostly with econometric estimation procedures which were adopted for determining various parameters or forecasts (to be used as inputs in the core model) either based on technology or observed behaviour.

It is thus seen that the macroeconomic model is reinstated here and once again forms part of the core as in the fifth plan model. On the other hand, the consumption, financial resources, imports and employment models which were formerly components of the core are now relegated as sub-models; with the perspective planning block of the earlier model vanishing altogether.

3.8.1 Interactions Between the Sub-models and the Core Model

Given the identification of blocks of equations in a quasi- recursive system as a prologue, core, loop and epilogue [see Rao, 1987], three of the sub-models formed the prologue of the system, providing inputs directly to the core model. These were: financial resources (providing projections of savings behaviour); exports (providing export projections on the basis of supply constraints and world demand); and demography (providing population projections, both rural as well as urban).

Five of the sub-models formed the loop of the system, possessing an interactive feedback with the core model. These were: agriculture (providing the supply potential of the agricultural sectors which was balanced with the demand for agricultural output emanating from the IO model); industry (providing the material balances available during the planning period to assess the feasibility of targets stipulated by the IO model); consumption (providing forecasts of the demand for different goods and services which was fed into the core model and corrected by changes in policy variables in case of demand- supply mismatches); investment (providing estimates of sectoral ICORs as well as projections of investment by destination which, after being converted into investment by sources through the use of a capital flow matrix, were dovetailed into the IO model to check their consistencies); and imports (providing independent projections of certain categories of non-bulk imports on the basis of the availability of foreign exchange which had to be consistent with aggregate imports computed by the macroeconomic model and bulk imports determined by the IO model).

The remaining two sub-models formed the epilogue of the system which implied that their solutions could be obtained only after the core and the loop had been resolved. These were:

Employment (which estimated employment generation given output projections of the IO model); and Poverty (which captured the income distribution process on the basis of the solution of the IO model as well as the consumption sub-model).

The sub-models were constructed to go into the details of certain phenomena which were complementary to the core model. Even though there was greater detailing of the sub-models in this plan, essentially their structure remained the same *vis-a-vis* the earlier plan model because, by their very specification, they were supposed to incorporate those factors which are technically important but which could not be integrated into the core model.

3.8.2 The Core Model and the Solution Sequence

The core model comprised a macroeconomic model, an IO model of 115 sectors and an investment model. The macroeconomic model consisted of a number of national income and expenditure identities on the lines of the fifth plan model which, in combination with the IO model, determined investment in the terminal year endogenously. Further, given a target rate of growth as well as base year estimates of GDP, savings and consumption in the public and private sectors, in conjunction with certain other exogenous variables, including sectoral ICORs and savings propensities as well as aggregate exports, the macroeconomic model determined the resources necessary for investment, the resources available for investment and the necessary capital flows to correct imbalances, if any.

In the light of earlier experiences, the seventh plan model recognized the problems involved in invoking complex solution sequences and, as a result, opted for a far simpler procedure.

In the IO model, vectors were developed which corresponded to scalars in the macroeconomic model for government consumption, gross fixed investment and changes in stock. The private final consumption vector was obtained by making use of the consumption sub-model. Adding together the private final consumption vector, the export vector and the public consumption vector (the last two given exogenously) enabled the IO model to derive sectoral output, imports (originating) and value added profiles.

Net indirect tax rates in the base year were pro-rated to match indirect tax targets given by the macroeconomic model. The crucial link between the macroeconomic model and the IO model was provided by the value of total imports. The iterative process between these two blocks of the core model terminated when the value of investible resources in the terminal year converged to identical levels for both these models.

Once convergence was obtained, the investment model was used to derive investment requirements at broad aggregate sector levels and convert investment by destination into that by origin. In case of a mismatch between available resources and required resources for investment, the latter was adjusted by moderating the post-terminal growth rates. At the end of such an adjustment, investment by type of assets was obtained and this was fed back into the IO model for a re-run. The iterative process for the core model terminated only when both aggregate investment and the sum of its asset composition converged to identical levels.

3.8.3 A Summing up

The seventh plan model did overcome one major deficiency of the sixth plan model as it decided to have a separate investment sub-model in view of the problems encountered while completely endogenizing investment. This greatly simplified the solution procedure as investment estimates, based upon this sub-model, helped provide the crucial consistency check on the system.

The seventh plan model also reformulated the poverty sub-model by isolating all activities relating exclusively to poverty alleviation programmes with a view of giving special treatment to the targeted low-income groups. It also introduced the notion of a 'basic needs' sub-model (which was a composite of the consumption and employment sub-models and helped to

formalize the three objectives of the seventh plan: food, work and productivity) with a view of assessing the impact of plan expenditures on a set of socioeconomic indicators which were supposed to reflect the quality of life.

The seventh plan model did address itself to the concept of inflation adjustment of resource estimates in the financial resources sub-model. Resource planning in all the earlier plans was in terms of constant (base year) prices and was grounded in the belief that balancing the sources and uses of investible resources at constant prices during plan formulation would automatically ensure their balance at current prices during plan implementation. This was based upon two assumptions: (i) the price elasticity of government revenue and expenditure would be the same over the plan; and (ii) the prices of broad categories of commodities would follow more-or-less similar patterns.

However, the actual experience of the 1970s and 1980s indicated that the price elasticity of government expenditure exceeded that of government revenue [see Jadhav, 1989]. Moreover, it was seen that during the same period, the prices of capital goods rose much faster than those of consumption goods. Consequently, the real size of planned investment was subject to an erosion during plan implementation, especially during periods of high inflation. The seventh plan model did make an attempt to address this problem by examining alternate approaches for protecting the targeted plan size in the face of inflation.

Although Gupta [1989] states that recommendations were made to net out any increase in input costs subsequent to a revision in administered prices while estimating the savings of the public sector enterprises, there is no reference to this in Planning Commission, Government of India 1986, *A Technical Note on the Seventh Plan of India: 1985-90,* leading us to believe that the plan model, apart from merely stating the problem, made no attempt whatsoever to estimate inflation-adjusted resources.

In conclusion, the most important facet of the seventh plan model was that it incorporated econometric techniques extensively and used them for providing inputs to the core model, in terms of parameter estimates and forecasts of exogenous variables. Its basic flaw however was that, rather than make any serious efforts to reduce ICORs, it defended their inexorable rise on grounds that such phenomena were commonplace occurrences as it reflected the interdependences in the production system, totally overlooking the developmental experience of several LDCs who have succeeded in lowering their ICORs through interactive planning.

3.9 The Eighth Five Year Plan : 1992-97

Given the worsening economic scenario at the end of the seventh plan *vis-a-vis* the availability of foreign exchange and the burden of external debt, several corrective monetary and fiscal policy procedures were promulgated in order to contain and overcome the crisis. The painful process of structural adjustment which followed implied a period of uncertainty and as such it was decided to declare a 'plan holiday' for the period 1990-92, by which time the Indian economy had partially recovered, and thus the eighth plan is now expected to cover the period 1992-97. While the technical note on the formulation of the eighth plan model is not yet officially available, its executive summary, prepared by the Planning Commission, appeared in the *RBI Bulletin* of June 1993, and we present some of its macroeconomic dimensions.

3.9.1 Macroeconomic Dimensions

The eighth plan aims for an annual growth target of 5.6 per cent for GDP. This is based on the assumption of a global ICOR of 4.1 and an average investment rate of 23.2 percent. On the other hand, the seventh plan achieved a higher average annual growth rate of 5.8 per cent with a lower investment rate of 22.7 per cent entirely because the ICOR was just 3.9 during the last plan. As steadily rising ICORs erode growth rates, the eighth plan model must make every effort to contain, if not reverse, this trend. The investment rate of 23.2 per cent is expected to be financed by

an average domestic savings rate of 21.6 per cent and an average foreign savings rate of 1.6 percent. These projections represent an improvement in the savings rate and a decline in the current account deficit *vis-a-vis* the seventh plan.

The projected savings rate is based on achieving a rather high marginal savings rate of 23.7 per cent over the eighth plan. As it is quite possible that the savings of the household sector, which is the prime determinant of the savings rate, could be adversely affected by the larger availability of consumer goods as a result of the current 'liberalization' phase, the eighth plan model should implement appropriate fiscal policies that will prevent an erosion of the savings rate without, in any way, affecting the pace of the reforms that have been initiated.

Similarly, the projected current account deficit is based on a rather tenuous premise that the percentage of exports to GDP will almost double from 5.2 per cent over the seventh plan to 9.6 per cent over the eighth plan. As a reduction in this deficit is absolutely imperative because of its favourable impact on foreign debt accumulation and the debt service ratio, the eighth plan model, unlike the earlier plan models, can no longer afford to treat exports as an exogenous variable. In order to achieve this quantum jump, exports will have to be endogenized and treated as a target variable and appropriate policy measures conducive for such a 'take-off' would need to be incorporated.

Given production patterns, which yield a global employment elasticity of 0.47, the employment potential is expected to grow at about 2.6 per cent per year implying, in absolute terms, a generation of about 43 million jobs over the eighth plan period. In order to accommodate labour absorption of this order of magnitude without adversely affecting productivity, an optimal strategy of industrialization as well as choice of techniques would have to be clearly spelt out in the eighth plan model.

The development experience of the recent past has indicated the importance of well-coordinated macroeconomic policies for achieving rapid growth with reasonable price stability, a sustainable balance of payments and an acceptable burden of debt. In attempting to attain these rather conflicting targets, the following policies have been accorded priority in the eighth plan: (i) Policy regimes governing trade, technology and capital flows, (ii) Industrial deregulation and administered price policy, (iii) Financial sector reform and (iv) The stance of demand management as reflected in monetary and fiscal policies.

With the implementation of these policies, the process of reforms has already begun and the technical approach to the eighth plan model will have to take up the very challenging task of ensuring that it sustains the pace of these reforms.

3.9.2 The Tasks Ahead

Ever since the fourth plan, the Indian planning framework has essentially revolved around an IO model. Such models are expressed in real terms and thus are more appealing in a planning context in which a "real-minded" entity such as the Ministry of Industry dominates (which had been the case in India until lately). However, if planning is dominated by a "money-minded" entity such as the Ministry of Finance (which is the case currently in India), the focus is generally on interest rates, budget deficits, money growth, inflation, and such like, which are not easily handled by IO techniques. Thus, the eighth plan model must attempt to incorporate alternative design structures, notably econometric models, supplemented by time series techniques, which are capable of handling such phenomena.

However, even if future models intend to focus on financial planning and IO systems, which are largely oriented towards real planning, are still expected to play a role in the modelling process, by making demand-oriented forecasts of industrial output levels and reconciling them with supply constraints as well as capital and labour availability, then the price theory implicit in an IO system has to be invoked: something which has never been done before in the Indian context.

If P_i is the price of good i, and if the average wage rate and the user cost of capital are denoted, respectively, by w and r, then competitive behaviour in sector i implies that:

$$P_i = \sum_{j=1}^{n} a_{ji} P_j + wl_i + rv_i \qquad (3.106)$$

where a_{ji} are the technical coefficients, and l_i and v_i are the sector's labour-output and capital-output ratios, respectively.

In terms of matrix notation, eq. (3.106) can be written as:

$$P = (wL + rK)(I - A)^{-1} \qquad (3.107)$$

which expresses goods prices in terms of factor prices. Given exogenous forecasts of the latter, it has been shown that the resulting forecasts of goods prices often track observed prices fairly well. This type of cost-push price forecast clearly can be used in the formation of monetary policy, as indeed it was, with considerable success in Chile during the 1960s [see Cauas, 1972].

In practice, the price forecasts could also be used in conjunction with quantity projections to say something about government revenues, tax receipts and so on, and although this has very rarely been done in practice, the future success of Indian planning depends entirely upon such a modification.

3.10 Economic Problems, Development Strategy and Policy Choice

As mentioned earlier, planning models should be designed to fit the overall development strategy of a country as well as its principal economic concerns. Strategy, in this context, refers to a chosen development path, which would vary greatly amongst countries depending upon their economic problems and which would, in turn, determine the choice of macroeconomic policy.

The earlier Indian development strategy focused attention on increasing savings and investment which were regarded as the major constraints on economic growth. In this context, the policy constellation attempted to determine resource allocation with respect to investment, bank credit, foreign exchange, amongst others, in the priority sectors earmarked by the planning process with the objective of achieving growth with equity. Moreover, price controls in many industries were at the firm level, the attempt being to relate prices to the allocation regime. The government was considered to be the main engine of growth and the public sector was expected to generate sufficient investible surplus for ensuring rapid economic growth. The emphasis on import substitution coupled to the ubiquitous controls on foreign exchange, foreign investment and foreign technology, implied that the underlying theme of the development strategy was essentially: "growth with equity and self-reliance".

Such a development strategy, which was dictated by perceived economic problems, implied that all Indian plan models were geared to working out the narrow policy choices specific to the areas of concern, unfortunately neglecting in the process the broader implications of these options over the long run.

This over-emphasis on "real" planning led to the neglect of "monetary" planning and, as a result, a series of 'soft' policy choices were exercised with respect to large fiscal and trade deficits, high rates of monetary expansion, low interest rates and pegged exchange rates. Inevitably, the Indian economy went into a tail-spin in the early 1990s with a rising inflation rate, mounting external debt and a foreign exchange crisis.

Underlying the overall crisis were two implicit facts [see Dandekar, 1993]: first, in the absence of domestic and foreign competition, industry, both in the public and private sector, grew in an environment conspicuous by an almost total lack of cost and quality consciousness. Second, the cost of physical and social services provided at public cost were not recoverable from the beneficiaries even when they were clearly identifiable.

The new development strategy addresses itself to solving these new issues, without losing track of the old ones. Controls in the fields of industry and trade have been liberalized with the objective of allocating resources through a market mechanism with sufficient government intervention

being envisaged to ease the painful transition process, particularly as far as employment generation is concerned. Increasingly larger resources will now be available to the private sector through the process of lower government expenditures, lower statutory liquidity requirements on financial institutions and with the faster development of the money and capital markets. Outward looking policies are now being adopted with a gradual reduction in tariffs and relaxation of exchange controls and foreign investment is being made more attractive than ever before [see Alagh *et al*, 1993].

The implementation of such a strategy would involve economic policies that include, amongst others, limited budget deficits, realistic interest rates and intersectoral consistency. As far as the first one is concerned, it is difficult to say whether the ensuing changes in the national savings rate (brought about by extending the concept of the two-gap model into its associated three-gap version) will be reflected primarily in investment levels or in the external balance. This is a policy issue of very great practical relevance because the results of Feldstein and Horioka [1982] suggest that cutting the budget deficit will only raise investment in the short run with very little impact on the external front. However the Feldstein-Horioka findings, which are still being researched, need not be taken seriously [see Rao, 1993] as, to date, the literature has not provided a convincing explanation of this apparent empirical regularity.

As the earlier factor price ratio did not reflect the true factor endowment in the country, the resulting high wages and low interest rates implied the use of capital intensive techniques resulting in rising ICORs and large unemployment. This would need to be corrected by setting more realistic interest rates.

Intersectoral consistency, which hitherto involved only the real sector of the economy, will now need to be widened to include the real, monetary, government, banking and external sectors as well. In this context, some of the issues discussed by Rangarajan [1993] with respect to the autonomy of central banks will need to be seriously considered as the argument, which strengthens the consistency postulate, rests on the premise that monetary stability is essential for macroeconomic stability.

In any case, external sector issues can no longer be considered separate from either macroeconomic policy or sectoral investment decisions as they have been hitherto. The entire trade regime will need to be reformed [see Singh, 1990] by examining a wide variety of assumptions with regard to the competitiveness of imports and exports, the costs and constraints associated with foreign borrowing, tariff policies, amongst others. In this context, various foreign trade issues such as comparative advantage calculations, impact multipliers for foreign assistance and effective protection rates will need to be evaluated.

Although problems relating unemployment and underemployment to labour skill creation have become increasingly important in the Indian context in recent years, they have not yet been systematically evaluated in any planning model. Some of the more important aspects that need to be discussed are sectoral employment projections, educational and manpower planning, surplus labour and bottlenecks in skilled labour markets.

In contrast to these specific problem areas, there are several important general issues in planning which are only of late being introduced into models. These largely deal with the pursuit of multiple social and economic objectives, the construction of various objective functions (or "social welfare functions" as they are usually called) based on economic theory, and the design of nonlinear systems developed by mathematicians. Largely untested in the specification and construction of economy-wide planning models, these techniques, some of which will be reviewed shortly, show considerable promise as future tools for investigating a wide range of macroeconomic problems.

4. Alternative Designs: Optimizing Systems
4.1 Dynamic Input-output Models

All the IO models discussed above have been essentially static in the sense that they are capable of making only one- period-ahead forecasts by considering only the demand-creating effects of investment. However, in many cases, it is useful to accumulate sectoral investment into capital stocks and take into account the capacity limits these place on production. This can be done formally through the dynamic Leontief model which was partially applied in the Indian context during the sixth plan.

This model incorporates an accelerator-type investment theory in which current demands for investment goods depend on future expected growth of output, i.e.,

$$J(t) = Hk\,[X(t+1) - X(t)] = B\,[X(t+1) - X(t)] \qquad (4.1)$$

where B is the product matrix Hk, J is investment demands by origin, H is a distribution matrix for investment demands and k is a vector of incremental capital-output ratios written along the principal diagonal of an otherwise null matrix.

This formulation permits explicit inclusion of capital accumulation in the forecasting exercise although it needs to be recognised that the matrix H and vector k are often of dubious quality. By combining eqs. (3.60) and (4.1), the dynamic Leontief system can be expressed as:

$$X(t) = AX(t) + B[X(t+1)-X(t)] + F(t), \quad X(0) = \bar{X}, \quad t = 0, 1, 2, \ldots \qquad (4.2)$$

where F is now to be interpreted as a vector of final demand totals by origin, excluding (including) investment (imports).

This equation defines a forward recurrence relationship for X(t) if the matrix B could be inverted, However, because B has many zero rows corresponding to non-capital goods producing sectors, often this inversion cannot be done and one must work with a reduced system of equations in which only "state" (stock) variables corresponding to outputs of the capital goods sectors evolve over time [see Kendrick, 1972]. If we assume, however, that B is of full rank, this would imply that eq. (4.2) can be written in the following difference equation form:

$$X(t+1) = [I + B^{-1}(I-A)]\,X(t) - B^{-1}F(t), \quad X(0) = \bar{X}, \quad t = 0, 1, 2, \ldots \qquad (4.3)$$

whose general solution for any given time period takes the form:

$$X(t) = [I + B^{-1}(I-A)]^t\,\bar{X} + X^*(t) \qquad (4.4)$$

where the first term on the right is the complete solution of the "homogeneous" equation for a Leontief system in which all output surplus over input requirements is reinvested, i.e., in eq. (4.3) the exogenous term F(t) is set equal to zero, and X*(t) is a particular solution of eq. (4.3) based on a given final demand.

The behaviour of the solution to this homogeneous equation hinges on the magnitudes of the characteristic values of the matrix $[I+B^{-1}(I-A)]$. One of these will correspond to a balanced growth path for the system along which elements of the vector X(t) stay in fixed proportions to each other and grow at equal constant rates. Whether output levels will converge to balanced growth from arbitrary initial conditions depends on the other characteristic values; if any correspond to growth rates exceeding that of the balanced growth characteristic value, the system will diverge and generate negative sectoral output levels.

Theoretically, it is impossible to state when this will occur. With "realistic" matrices, it appears that the unbalanced growth characteristic values predominate and even when they do not, the rate of balanced growth will often be improbably high (Essentially this is because the model of eq. (4.3) without final demands F(t) resembles a Harrod-Domar model in which the savings rate equals one). Because such growth would dominate the solution, eq. (4.4), of the nonhomogeneous equation even when a "reasonable" growth of exogenous final demand is built into the particular solution, X*(t), forecasting output increases from arbitrary initial conditions on the basis of eq. (4.3) is not possible. This is referred to as the instability problem of the Leontief dynamic model [see Chakravarty, 1969].

This often constitutes a sound reason against extending the static IO model into a dynamic framework. The dynamic model is most interesting only when there is a significant capital goods industry in the country and planners from small, capital goods importing countries are best advised not to take the dynamic Leontief model too seriously since it is somewhat irrelevant to their problems [Taylor, 1977]. None the less, when there is a significant national production capacity for capital goods and high investment rates are anticipated or planned, as in India, a prima facie case exists for treating investment as an endogenous variable via the dynamic Leontief model. Such a treatment would automatically endogenize the growth rate, thereby pre-empting any arguments regarding its choice: a fact of vital importance as the selection of a "desired" growth rate for the Indian economy has very rarely been motivated on purely economic considerations. We shall numerically illustrate all the propositions stated above with the help of a simple (3 x 3) dynamic input-output model for the Indian economy. As far as the inter-industry transactions matrix is concerned, we use the table constructed by Manne and Rudra [1965] which was referred to in Section 3.5.

Therefore the A matrix is given by:

$$A = \begin{bmatrix} 0.325 & 0.002 & 0.028 \\ 0.003 & 0.209 & 0.024 \\ 0.041 & 0.017 & 0.212 \end{bmatrix}$$

As far as the B matrix was concerned, we used the (28 x 28) capital coefficients matrix constructed by Mathur *et al* [1967] and aggregated it into a (3 x 3) matrix in a manner which would render the resulting B matrix compatible with the A matrix provided above. It needs to be clearly noted that the aggregation was carried out using certain simplifying assumptions with regard to the manner in which the 28 sectors considered by Mathur *et al* ought to be distributed amongst the 3 sectors considered by Manne and Rudra and therefore the results are to be considered from the viewpoint of an illustrative, rather than a definitive, nature.

The estimated B matrix was given as:

$$B = \begin{bmatrix} 0.143 & 0.832 & 0.924 \\ 0.265 & 0.013 & 0.044 \\ 0.625 & 0.210 & 0.341 \end{bmatrix}$$

In order to examine the nature of the instability problem for the dynamic IO model specified above, we re-write eq. (4.2) as follows by dropping the time index and introducing the forward difference operator δ defined as $\delta X(t) = X(t+1)-X(t)$. This yields:

$$X = AX + B\,\delta X + F \qquad (4.5)$$

If the growth rate of the i^{th} commodity is $g_i = \delta Xi/Xi$, then we have, at an aggregative level, $g = \delta X/X$, which implies that

$$\delta X = gX \qquad (4.6)$$

where g is a diagonal matrix with the g_i's being elements of its principal diagonal. Substituting eq. (4.6) into eq. (4.5) yields:

$$[I - A - Bg]\,X = F \qquad (4.7)$$

$$\text{or: } X = [I-A-Bg]^{-1}F = [I - gB(I-A)^{-1}]^{-1}(I-A)^{-1}F \qquad (4.8)$$

For eq. (4.8) to be economically meaningful, X should be non-negative for every non-negative F. This can be ensured only if the matrix $[I - gB(I - A)^{-1}]^{-1}$ is non-negative, i.e., if

$$g_i\,|B(I-A)^{-1}| < 1 \qquad (4.9)$$

As both $(I-A)^{-1}$ and B are non-negative matrices, $B(I-A)^{-1}$ is also non-negative. If eq. (4.9) holds good, then $[I-gB(I-A)^{-1}]^{-1}$ can be expanded into an infinite series as follows:

$$I+gB(I-A)^{-1}+g^2B^2(I-A)^{-2}+\ldots+g^kB^k(I-A)^{-k} \qquad (4.10)$$

As k becomes increasingly larger, $B^k(I-A)^{-k}$ will approximate μ^k, where μ is the greatest eigen value of the matrix $B(I-A)^{-1}$. Therefore, the series in eq. (4.10) will be convergent only if $g_i < 1/\mu$. This gives an upper limit to the exogenously given rate of growth that can be planned for any current requirement vector.

In the limit, when $g_i = 1/\mu$, F must be zero so that X might have a finite value. This implies that eq. (4.8) reduces to:

$$[I-(1/\mu)B(I-A)^{-1}]\,X=0$$

or: $$[\mu-B(I-A)^{-1}]\,X=0 \qquad (4.11)$$

As μ is the greatest eigen value of the matrix $B(I-A)^{-1}$, eq. (4.11) will be satisfied if and only if X is proportional to the corresponding eigen vector which will be non-negative by virtue of the Frobenius theorem which states that a non-negative matrix will have a dominant real positive eigen value which will be the only eigen value with a corresponding non-negative eigen vector.

The above results are confirmed by the calculation of the eigen values and eigen vectors of $B(I-A)^{-1}$. They are:

Eigen value:	1.6566	0.0147	-0.8867
Corresponding eigen vector:	0.6161	0.1563	-0.7293
	0.6332	1.3784	0.7419
	0.7868	-0.6554	0.6870

We are interested only in the dominant eigen value which has a non-negative eigen vector (μ = 1.6566) since it is the inverse of this root which places the upper bound on the economy's growth rate. The result implies that the maximal growth rate for the Indian economy in 1960 was 0.6036 (= 1/1.6566) or 60.36 per cent!

As mentioned earlier, this rate of balanced growth will often be improbably high because the Leontief model without final demands, i.e., F = 0, resembles a Harrod-Domar model in which the savings rate equals one. In this context, we note that with a savings rate of 9.3 per cent, as was the case in 1960-61, the optimal growth rate that Indian planners could have aimed for is about 5.6 per cent (= 0.093 x 60.36) which is a very reasonable estimate. It is in this manner that dynamic IO models help to endogenize target growth rates of output.

Our numerical example so far has centred on the eigen values of the matrix $B(I-A)^{-1}$. We now turn our attention to the eigen values of the matrix $[I+B^{-1}(I-A)]$. As mentioned before, one of these will correspond to a balanced growth path for the system along which elements of the vector X stay in fixed proportions to each other and grow at equal constant rates. This implies that, if we use the A and B matrices referred to above, one of the eigen values will be 1.6036 (which represents a growth rate of 60.36 per cent) with a corresponding non-negative eigen vector.

Whether output levels will converge to balanced growth will then depend on the other eigen values; if any correspond to growth rates exceeding that of the balanced growth characteristic value, the system will diverge and generate negative sectoral output levels which is the essence of the instability problem.

The above results are confirmed by the calculation of the eigen values and eigen vectors of $[I+B^{-1}(I-A)]$. They are:

Eigen value:	68.8858	1.6036	-0.1278
Corresponding eigen vector:	0.1096	0.6094	-0.6064
	0.9839	0.5132	0.5650
	-0.4401	0.6578	0.5120

It is thus seen that one of the eigen values does correspond to the balanced growth path for the system with a corresponding non-negative eigen vector. However, there is an eigen value which is larger than the balanced growth eigen value. As the behaviour of eq. (4.4) will ultimately be dominated by its largest eigen value, the results indicate that our dynamic model is unstable.

It needs to be noted that the sixth plan did make a significant, if short-lived, change in modelling methodology by switching over to a dynamic IO system. Based upon the works of Mathur *et al* [1967], Koti [1967], amongst others, it used a B matrix which was compatible with the 89-sector A matrix used for the plan. However, because the disaggregated B matrix had many zero rows corresponding to non-capital goods producing sectors, the matrix was singular. In order to overcome this problem, work in estimating a composite flow and capital coefficients matrix is currently in progress [see Prasad, *et al*, 1992*a*] and, if successful, future plan models might be able to specify dynamic IO models which pre-empt the instability problem altogether.

4.2 Linear Programming Models: Static and Dynamic

A natural complement to the IO production specification is optimisation of some welfare function to select the "best" pattern of final demand and resource allocation from the many

that are possible. Since IO technological assumptions are all of a constant coefficients (linear) type, linear programming (LP) is the most appropriate computational means for doing this. Since LP can do everything that IO can, and quite a bit more, Indian planners have often relied upon this technique to semi-officially supplement IO projections although, as yet, there is no official plan model specifically constructed around an LP framework.

There are two great advantages of applying LP optimisation techniques in planning. The first is that this programming method provides an efficient and systematic exploration of the frontiers of the choice set of an economy (as delimited by IO and other constraints), as long as it can be described in terms of linear (in)equalities. The LP simplex algorithm is an effective means to get to the boundaries of this set which IO models cannot do.

Besides providing a useful means to consider trade-offs implicit in the IO system, LP may also be used for decentralised planning (a concept towards which the Indian economy is being irrevocably committed) since solution of the model provides a set of dual or shadow prices with a Walrasian interpretation. This implies that an LP model has the ability to simulate a general equilibrium or competitive resource allocation, complete with the prices from the dual solution. While this interpretation cannot always be maintained in a strict sense, the shadow prices from an LP model still have a useful "broad-spectrum" economic meaning.

A variety of LP model specifications have been made in the literature and all of them have focused on the problem of making medium-term forecasts for the economy [see Manne, 1974]. The ensuing results have also indicated that parametric variations of the solution can provide details on the slope and curvature of the choice frontier, which can have useful policy implications. For example, LP models can reveal how much growth can be expected from additional foreign aid or, in a similar vein, if the shadow cost of rapid development of a lagging region is high, it can indicate that such a goal will probably be difficult to achieve in the real economy. These and other benefits of LP make it one of the most acceptable planning techniques by any standards.

The first static LP model constructed for the Indian economy was by Sandee [1960]. The time horizon (1960-70) of the model was aimed at covering the periods of the third and fourth five-year plans. It was constructed by using an IO matrix of the Indian economy and was based on the requirement to maximise the change in the levels of consumption between the terminal and the initial years, where the terminal year investment was determined by a so-called stock-flow conversion factor. Despite its importance as the first LP model for the Indian economy satisfying the basic requirements of a plan model, the underlying assumptions like zero gestation lag, constant capital-output ratios in all the sectors of the economy and a weak data base rendered the model ineffective. Moreover, the limitation of this static modelling technique, also used by Weisskopf [1967], was that it did not tell us anything regarding the transition path from historically given initial conditions to the desired terminal solution.

In order to overcome this, the intertemporal LP procedures developed by Chakravarty and Lefeber [1966] and Eckaus and Parikh [1967], jointly referred to as the CELP model, used a linear optimisation model over time subject to satisfying boundary conditions that sustain indefinite post-terminal consumption growth at stipulated rates subject to meeting an upper bound restriction on the post-terminal growth rate. These models, along with the one constructed later on by Manne and Weisskopf [1970], illustrated alternative aspects of the problems of Indian planning and indicated that there were no simple solutions, such as "heavy industry" or "high investment" *a la* Mahalanobis, that necessarily lead to optimal programmes.

These dynamic models can be basically conceptualised as static programming models which repeat themselves over time. Successive periods are linked together through capital accumulation equations. In linear models, these usually take the accelerator form discussed in Section 4.1; in nonlinear optimal growth models, the accelerator is somewhat relaxed by the possibility of within-period capital-labour substitution, but next period's capital stock is still the sum of this

period's capital stock and net investment. These simple hypotheses impose a distinctive time structure on the solutions of dynamic LP models which proves useful in designing solution algorithms.

In order to obtain important insights into the working of such intertemporal planning models, as well as their associated limitations, the following one-dimensional maximisation problem is considered [see Chakravarty, 1969]. The objective is to maximise the discounted sum of consumption over T years given by:

$$\text{Maximize: } \sum_{t=1}^{T} C(t)/(1+\tau)^t \qquad (4.12)$$

(where τ is the rate of time preference) subject to:

$$C(t) + I(t) = bK(t), \quad t=1,...,T. \qquad (4.13)$$
$$K(t+1) = K(t) + I(t), \qquad (4.14)$$
$$K(T) = C(T)/b\text{-}r, \quad K(1) = \bar{K} \qquad (4.15)$$

Eq. (4.13) states that consumption plus investment equals output which is produced by a fixed coefficient production function. Eq. (4.14) is merely definitional while eq. (4.15) provides the condition on terminal capital stock that would ensure a post-terminal consumption growth of r per cent per annum.

Eq. (4.15) ensures that terminal investment will be equal to rC(T)/(b-r) and I(T)/C(T) = r/(b-r). Thus, eq. (4.15) constrains I(T) but leaves C(T) free. The value of C(T) will be determined by the optimising mechanism together with C(t), t=1,2,....,T-1. If $[1/(1+\tau)^t]=1$, then we could say that C(1)=C(2)=....=C(T-1)=0 and C(T) would be maximised subject to satisfying the condition that I(T)/C(T)=r/(b-r), provided that b > 0. Thus, we get an extreme corner solution. Suppose that $1/(1+\tau) < 1$. Then the above result would hold whenever $\tau < b$. The opposite would be true whenever $\tau > b$. Thus, in any event, the above linear model would push us to a corner unless we were in the singular situation where $b = \tau$.

All the CELP-type multisectoral models, which in certain intertemporal respects behave similarly to the one-dimensional model just discussed, suffered from the above deficiency in as much as the time path of consumption, if left unconstrained, displayed a flip-flop behaviour: a limitation which could have been avoided if the decomposition algorithm of LP had been used.

Of late, LP models, some of them using the decomposition principle of Dantzig [1961], have been constructed for the Indian economy in order to reconcile conflicting macroeconomic and microeconomic objectives at multiple levels of decision making. The macroeconomic studies [see Prasad, *et al* 1990, 1992], based on an integrated LP and dynamic IO modelling approaches, have broadly indicated that a planned five per cent rate of growth for the Indian economy, largely unfulfilled due to low productivity, restrictive government policies and uncertain foreign exchange earnings, can be achieved by holding inventories (including buffer stocks) more optimally (thereby reducing ICORs) as well as by reducing the intersectoral imbalances in production; while the microeconomic studies [see Prasad, *et al* 1992*b*, 1993], based on goal programming and the decomposition principle, have suggested the optimal educational and manpower planning strategy to be adopted in order to avoid a serious mis-match between fields of specialisation and the employment opportunities that are likely to arise as a result of the current structural reforms.

In most dynamic LP models, to keep the problem manageable, it is necessary to impose strict limits on the number of sectors and time periods. Typical dynamic LP exercises involve about a dozen sectors and, at most, five or six periods (artificially elongated to encompass several years each). This degree of aggregation has often vitiated practical planning because highly aggregated sectoral forecasts do not provide a good basis for planning and compressing two or three years in one time period implies that the model overlooks short-term changes. These limitations of dynamic LP models have vitiated their usefulness.

4.3 Dynamic Optimizing Models: Optimal Control Theory

As a result, many Indian academicians have switched over to optimal control models which have largely circumvented most of the above drawbacks [see Nachane, 1986, Rao, 1991]. Essentially an optimal control problem consists of: (i) A set of difference (or differential) equations that represents the system; (ii) A set of constraints (including boundary conditions) on the variables of the system; and (iii) A cost functional which is to be minimised. The optimal control model set up below is in terms of discrete time but can easily be generalised to continuous time.

Assume a discrete dynamical linear system described by:

$$x(t+1) = Ax(t) + Bu(t) \tag{4.16}$$

where x(t) and u(t) are the state and control vectors at time t; and A and B are appropriately dimensioned matrices. Given an initial state x(0)=E and the terminal time N, the problem is to determine the control sequence $\{u^*(t), t=0,1,...,N-1\}$ and the corresponding state sequence $\{x^*(t), t=1,2,...,N\}$, such that:

$$x^*(0)=E, \tag{4.17}$$
$$x^*(t+1) = Ax^*(t) + Bu^*(t); \quad t = 0,1,...,N-1 \tag{4.18}$$
$$R\{x^*(t),u^*(t),t\} \geq 0; \quad t = 0,1,...,N-1 \tag{4.19}$$
$$X^*(N) \in S \tag{4.20}$$

(where R is a vector-valued function indicating the constraint set and S is a target subspace) and the cost functional given by:

$$J = K\{x(N)\} + \sum_{t=0}^{N-1} L\{x(t),u(t),t\} \tag{4.21}$$

is minimised at $u^*(t)$ and $x^*(t)$ from amongst all u(t) and x(t) satisfying eqs. (4.17)-(4.20). The sequence $u^*(t)$ is called the 'optimal control' and $x^*(t)$ is called the 'optimal trajectory'.

The transliteration of the generalised control formulation provided above into an optimisation problem in development planning is quite straightforward. The control system is represented by the state-space formulation of a planning model. A set of constraints on the variables might be postulated; for example, consumption levels might not be allowed to drop below a certain floor. The boundary conditions are the initial values of the variables and perhaps desired values for some of these variables, say, capital stock, at some terminal time. Finally, the cost functional is based on the assumption that the objectives of planning are to force certain target variables, such as consumption or GNP, to follow pre-specified 'ideal' paths as closely as possible throughout a given period.

Consider the following control formulation of a planning model where the objective is to maximise some welfare function based on consumption. In the discrete case with, say, n sectors (i.e., i=1,2,...,n), we use the discounted criterion function:

$$J = Q_i\{K_i(T)\} + \sum_{t=0}^{T}(1+\tau)^{-t}U[C_i(t)] \tag{4.22}$$

where τ is the discount rate, and it is assumed that the terminal level of sectoral capital stock, $K_i(t)$, also enters the maximand.

Capital (K) and labour (L) generate output (X) as follows:

$$X_i(t) = X_i[K_i(t), L_i(t), t] \tag{4.23}$$

where time (t) is used as a proxy for technical progress.

Capital accumulation is not set equal to investment (I) but rather a declining function of it, in order to capture the absorptive capacity phenomenon. Using the accelerator approach, see eq. (4.1), this yields:

$$K_i(t) = \varnothing_i[I_i(t)] = \varnothing_i[B_i\,\delta X_i(t)] \tag{4.24}$$

where δ represents the forward difference operator.

Material balances are similar to the dynamic IO model, eq. (4.2), from which we obtain:

$$C_i(t) = (I-A)X_i(t) - B_i\delta X_i(t) \tag{4.25}$$

Total discounted "surplus" in the economy is given by:

$$H(t) = Q_i'(t)K_i(t) + \sum_{t=0}^{T}(1+\tau)^{-t}U[C_i(t)] \tag{4.26}$$

where $Q_i'(t)$ is a vector of valuations assigned to increases in capital stocks, $K_i(t)$. When applied in such an optimal control framework, the maximum principle of Pontryagin (1962) states the necessary conditions for eq. (4.22) to be maximised

subject to the constraints, eqs. (4.23)-(4.25). These are:

(i) The surplus H(t), usually called the Hamiltonian, should be maximised at each point in time with respect to the technological restrictions, eqs. (4.23)-(4.25). This will determine all flow variables, including investment.

(ii) Capital stocks are determined by eq. (4.24), running forward in time from initial conditions: $K_i(0) = \overline{K}_i$.

The computational advantages of optimal control models are numerous. In particular, the state space approach allows a tremendous flexibility as far as disaggregation into sectors and time periods are concerned. However, any attempt to solve a general stochastic control problem that tries to include all aspects of the random nature of the economic system is to attempt the impossible. This does not imply that uncertainty is to be ignored because uncertainty is a pervasive characteristic of invariably all dynamic economic problems.

The following types of uncertainty can be analysed within the LQD (linear-quadratic-deterministic) framework of the optimal control problem set up above: (i) Additive errors in the system equations, (ii) Parameters which are constant but unknown, (iii) Parameters which are time-varying and (iv) Measurement errors.

Type (i) uncertainty assumes that the only random processes are the additive error terms associated with each behavioural equation. The study by Rao [1979] which dealt with this type of uncertainty was the first one to apply control theory in order to derive optimal strategies for the Indian economy. The results, using the maximum principle, indicated that the extent of constraints placed on the economy pre-empted a simultaneous realisation of all the targets suggested by the sixth plan. The study was extended by Rao [1984] in order to critically evaluate the consistency approach of the Indian planning framework.

Since then, several important studies have appeared. Most of them have assumed type (i) uncertainty and addressed themselves to macroeconomic issues. These include Fernandes [1988, 1990] who, by establishing the Mundellian hypothesis about instrument-target pairing, was able to extract optimal policy response functions; Karnik [1990, 1991] who modelled the energy sector and showed that reduction in budget deficits cannot be achieved by increasing administered energy prices; Pethe and Karnik [1992] who suggested an optimal policy mix which would maximise government revenue subject to minimal inflation; Singh [1993] who examined the feedback between budget deficits, money supply and prices to determine the critical size of the deficit beyond which an inflationary spiral could be triggered off; amongst others.

At a more problem-specific level, several macroeconomic issues have been analysed for the Indian economy assuming type (i) uncertainty. These include Rao [1989] who used feedback theory to determine an optimal savings rate as well the trade-off between current and future consumption; Pethe and Pethe [1990] who discussed specific control theoretic issues within the context of modelling socioeconomic systems; Rao [1990] who showed that even a moderate time lag in the processing of information can convert a stable control system into an unstable one; Karnik [1992] who proved that changes in public sector pricing could be destabilizing; Singh [1992] who evaluated the performance of alternative feedback rules in order to determine the most suitable one for controlling money supply; amongst others.

Type (ii) uncertainty assumes that the system coefficients are stochastic. This type of multiplicative uncertainty involves the use of numerical methods for solving the problem. One such method used by Rao [1979] was sensitivity analysis in which optimal policies were recomputed after shocking parameters around their means. As the resulting optimal policies did lie within a preset tolerance band around their original trajectories, it was inferred that the model was 'robust'. More rigorous definitions of robustness were provided by Pethe [1986, 1987, 1988] who constructed alternative model variants and was able to differentiate, on the basis of welfare losses, between a robust model and a robust strategy. Rao [1993] was able to provide an alternative approach to designing robust systems which, by incorporating deadbeat control within a PID (proportional- integral-derivative) system, was able to eliminate target offset.

In type (iii) uncertainty, the solution of the optimal control problem is considerably complicated because of the time-varying nature of the state transition equation. While not much work has been done on estimating time-varying control systems for the Indian economy, the study by Nachane [1990] which uses the Byrne-Burke trajectory sensitivity method in order to estimate time-varying parameters seems to hold considerable promise as the method directly incorporates robustness considerations in the objective function of the control formulation.

Type (iv) uncertainty is appropriate for economic problems in which the state can only be measured through noisy measurement processes. This implies that the system equation, eq. (4.16), needs to be coupled to an observation equation given by:

$$z(t) = Cx(t) + Du(t) + \varepsilon(t) \qquad (4.27)$$

where $z(t)$ is the observation vector at time t; and $\varepsilon(t)$ is a white noise process. For such stochastic control systems, an optimal state reconstruction is possible using the Kalman filter.

Rao [1985, 1987] and Pethe [1986] were the first to construct large-scale nonlinear macroeconometric control systems of the Indian economy incorporating the Kalman filter which was used along with the maximum principle to determine optimal policies in the presence of random shocks and observation errors.

At a more specific level, Rao [1992, 1992a] used the Kalman filter to show that using 'quick estimates' of macroeconomic aggregates which have a high noise-to-signal ratio could lead to over-predicting growth rates and that this could be avoided by deriving steady-state Kalman gains which could yield final estimates of variables from their corresponding quick estimates.

It is however possible to simultaneously tackle type (ii) and type (iii) uncertainty using the concept of active learning in which the control variables are chosen on the basis of their effects on the system as well as on parameter estimation. It is for this reason that this control scheme is referred to as dual control. Pethe [1992, 1993] applied dual control within a model of the Indian economy and showed that, in the presence of several uncertain parameters along with measurement error, dual control (closed loop feedback) was distinctly superior to both sequential certainty equivalence as well as open loop feedback.

Although these studies have succeeded in unravelling several interesting features of the Indian economy, we have to realise, especially in the current decentralisation phase, that it will be necessary to incorporate hierarchical multi-level features into the problem if control methods are ever to gain acceptance. The resulting task of coordinating such systems could be an extremely complex one especially in the presence of conflicting objectives. While various coordination principles have been proposed in the literature on hierarchical control, Nachane [1984] has shown that the Interaction Prediction Principle and the Internation Balance Principle could be the most appropriate for the Indian economy. Optimisation methods for multilevel systems based on these two principles generally assume LQG (linear-quadratic-gaussian) systems in view of their empirical tractability although many of the results generalise to nonlinear dynamic systems as well. However, much more needs to be done in this area before we can obtain a sound theoretical underpinning of how hierarchical multi-level control systems operate under Indian conditions.

It is interesting to note that in 1976, the Financial Secretary to the Treasury of the U.K., by command of Her Majesty, created a "Committee on Policy Optimisation" which was chaired by Professor Richard Ball, whose terms of reference were:

> "To consider the present state of development of optimal control techniques as applied to macroeconomic policy. To make recommendations concerning the value of applying these techniques within Her Majesty's Treasury".

The Committee, which obtained evidence from some of the most eminent specialists in the areas of economic forecasting, modelling, policy formulation and control theory, submitted its report in 1978. The findings indicated that [see Ball, 1978]:

> "The application of optimal control techniques to economic problems presupposes that it is possible to construct and operate a plausible mathematical model of the economy. There is a *prima facie* case for applying optimal control to such a model of the economy, based on the analogy between the structures of certain economic and physical problems. ... Thus, in formulating policy, one might hope to construct an ideal compromise between competing objectives, the 'optimum path' and its associated 'optimal policies'. This is one of the most important advantages of considering macroeconomic policy-making within an optimal control framework".

As the essence of the optimal, as opposed to the automatic, control problem, is that one does not know what exactly one would like to happen; and since economic analysis is concerned mostly with the exercise of choice, given constraints, the possibility of transferring optimal choice technology from physical to economic systems via control theory seems appealing *provided one can construct a plausible model of the economy*. It is with this caveat in mind that we shall now discuss the efforts made towards constructing alternative plausible models of the Indian economy.

5. Alternative Designs: Non-optimizing Systems

5.1 Macroeconometric Systems

While optimisation can be interpreted as a device for either using up the excess degrees of freedom in a model specification or for exploring the choice set of the economy, non-optimising systems are those which come up with additional conditions to make the solution of a planning model determinate.

A non-optimising economic system may be defined as a set of n mathematical relationships linking together (n + m) economic variables; n of which are classified as endogenous and m as exogenous. Such economic systems can be divided into: (i) macro systems where the set of variables relate to the economy as a whole, and (ii) micro systems where the set of variables relate to individual economic agents, e.g., households, firms.

Macro systems can be sub-divided into: (i) analytical and (ii) econometric. A macroanalytical system forms the theoretical base for macroeconometric systems and attempts to convert the propositions of macroeconomics into an algebraic set of difference (or differential) equations which can help provide valuable insights into the working of an economy [see Fair, 1984].

By contrast, a macroeconometric system seeks to integrate the theoretical propositions of macroanalytical systems with the assumed features of the economy being modelled by means of a set of equations which have a precise mathematical form characterised by various parameters, where all such parameters appear as specific numbers, having been either estimated on the basis of statistical data or calibrated on the basis of structural information or imputed on the basis of policy assumptions.

5.1.1 Types of Macroeconometric Systems

A variety of macroeconometric systems have come into being since the late 1940s when Professor Lawrence Klein developed one of the earliest examples of a macroeconometric system to try and explain fluctuations in the US economy [Klein, 1950]. The taxonomy of macroeconometric systems [see Challen and Hagger, 1983] yields the following classification: (i) KK (Keynes-Klein) partial equilibrium systems, (ii) PB (Phillips-Bergstrom) disequilibrium systems, (iii) MS (Muth-Sargent) rational expectations systems, (iv) WJ (Walras-Johansen) general equilibrium systems and (v) WL (Walras-Leontief) input-output systems. The first name in each label belongs to the economist who provided the theoretical framework; the second name being that of the econometrician who used this framework to produce the prototype model.

While a detailed look at the features of these various types of macroeconometric systems would take us too far afield, it would be useful to discuss some of their distinguishing features.

Keynes-Klein (KK) systems have the following distinguishing characteristics. They assume that the product market always clears economy-wide,

i.e., a balance exists at all times between the aggregate desired expenditure on currently produced goods and services and the aggregate supply of such goods and services. Typically, in such systems, the demand side has been modelled in much greater detail than the supply side although, of late, the latter has been accorded far more emphasis than was formerly the case. Moreover, all such systems have invariably been formulated in discrete time, with the estimated relationships of the system being dynamic, nonlinear and stochastic.

Phillips-Bergstrom (PB) systems resemble KK systems in two main respects. In the first place, such systems are demand- oriented. Second, they introduce a variety of nonlinearities, which are of an even more complex kind than those that are found in KK systems. On the other hand, there are several important differences between them. Firstly, PB systems are formulated in continuous time. Secondly, in a PB system, one usually encounters a pair of relationships associated with each endogenous variable: one of them explains the desired (or long- run equilibrium) value of the variable, while the other specifies the process of adjustment of the actual value of the variable to its desired value, with the adjustment process being typically 'partial' in character. Finally, PB systems contain one or more policy-response functions which is a relationship specifying the manner in which a particular policy instrument is adjusted in response to changes in certain other variables.

Muth-Sargent (MS) systems resemble KK systems in several important respects. In particular, they are formulated in discrete time, with the estimated relationships being dynamic, nonlinear and stochastic. The most important manner in which they differ from KK systems is in their treatment of expectations. In MS systems, there is an explicit assumption of 'rational' expectations, a feature which is completely absent in KK systems. This assumption implies that every expectations variable throughout the system is replaced by the appropriate expected value of the variable concerned as determined by the system as a whole on the basis of all information available at the time of the formation of expectations.

Walras-Johansen (WJ) systems view the macroeconomy as some sort of a general equilibrium system. These systems have the following broad features: (1) They disaggregate the economy into sectors, in particular industrial sectors. (2) They relate to an equilibrium situation, implying that all the endogenous variables are consistent with the values of the pre-determined variables throughout the disaggregated economy. (3) They feature relationships which focus on the links that exist between sectors. (4) They also include production and consumption relationships which allow for substitution possibilities among factors in production and between commodities in consumption. (5) They include equilibrium prices and outputs throughout the disaggregated system amongst the list of endogenous variables. (6) They impose perfect competition, i.e., all firms and consumers are assumed to be price takers. (7) They view all economic agents as optimisers in some sense.

Walras-Leontief (WL) systems, commonly referred to as input- output systems, are a class of general equilibrium systems and tell us what the values of the endogenous variables (the n outputs) would be if the economy were to react to a given set of predetermined variables (the n final demands). These systems play a very important role in macroeconomic planning in LDCs and, as shown in Section 3, currently form the basis of Indian plan models. Since we have already discussed their distinguishing features, we do not elaborate on them except to point out that dynamic WL systems, like the KK, PB and MS systems, portray an economy which is on the move but which has not yet reached a state of rest relative to a given set of predetermined variables.

5.1.2 Indian Macroeconometric Systems

The history of constructing macroeconometric models for the Indian economy is at least four decades old and its genesis can be traced back to Narasimham [1956]. Since then, research on this front has yielded almost four generations of models, the first three of them belonging almost exclusively to the KK class of systems, although there have been some exceptions, notably Agarwala [1970] whose system was built around an explicitly non-Keynesian framework on the lines

suggested by the two-sector growth model of economic development with unlimited supplies of labour [see Lewis, 1954].

The first generation models of the Indian economy roughly covered the period of the 1950s and 1960s. All the models in this class essentially focused on specifying the real sector of the economy along KK lines. The government and foreign sectors were either non-existent or rudimentary while money supply was usually considered as exogenous implying that there were very weak linkages between the monetary, fiscal and external sectors.

The second generation models which roughly covered the period of the 1970s witnessed an elaboration in model specification. The monetary and government sectors were endogenised with feedbacks between deficits, monetary expansion and inflation being clearly highlighted. However, by and large, most of the models were still specified in terms of a generalised KK framework and very little experimentation with alternative specifications was attempted. Moreover, most of the models were explanatory in character with their role being confined merely to simulation, counter-factual analysis and (point) forecasting.

Having attained theoretical sophistication during the second phase, the third generation models which roughly covered the period of the 1980s started striving for analytical perfection. Adjustment mechanisms, expectational variables, filtering procedures, amongst other concepts, began to enter the modelling process which, apart from conducting stability analysis, attempted to re-cast such systems into an explicit optimisation framework. Moreover, model specifications began to be widened and several theoretical issues, including the monetarist- structuralist debate, began to be actively analysed.

Currently, the fourth generation models, whose proliferation into the literature can be traced back roughly to the end of the 1980s, have begun to analyse some of the hitherto unexplored frontiers of model specifications, including general equilibrium analysis, rational expectations, disequilibrium adjustment paths, amongst others. Most of these models take a disaggregated approach to price formation placing emphasis on monetary as well as structural factors. Linking up the government, monetary and foreign sectors has implied an important feedback between prices and exchange rates. The inclusion of a highly disaggregated banking sector along with money and bond markets is yet another novel feature of the current generation of models.

In Table 5.1 below, we present the salient features of twenty macroeconometric models constructed for the Indian economy, with a representative sample of five models being selected from each generation. The first fifteen of these belong exclusively to the KK class of systems, while the remaining five to either the WJ, MS or PB class of systems.

The key endogenous variables in the model have been split up into 3 blocks: Block 1 denoting the real sector; Block 2 denoting the price, monetary, banking and government sectors; and Block 3 denoting the external sector. This classification is based upon the perceived evolution of Indian macroeconometric systems with the real sector being specified in great detail right from the initial stages of modelling, and evolving slowly to encompass the price, monetary, banking, government and external sectors.

The sparseness of variables in Block 3 suggests that not much efforts have been devoted to specifying the external sector in models and, apart from including exports and imports, there have been few attempts to incorporate variables such as capital flows, reserves, foreign investment, amongst others; although the sector-specific studies of Kannan [1985, 1988, 1989], Sundarajan [1986], Panchamukhi and Mehta [1989], Sarma and Mehta [1993], amongst others, have paid attention to some of these aspects.

It needs to be noted that as far as the listed variables are concerned, although they are denoted merely by a single symbol, in most cases, they include sectoral disaggregations as well. The sequencing of variables in Block 1 correspond broadly to the links established by theory between output, capital stock, investment and savings; between disposable income and consumption; and between wages and employment. In a similar vein, the sequencing of variables in Block 2 correspond to the price sector, the monetary and banking sectors (both from the demand as well as supply viewpoints), and the government sector; while in Block 3, they correspond broadly to the trade account with spillovers, if any, into the capital account.

TABLE 5.1(A). KK SYSTEMS: FIRST GENERATION

Author (Year)	Scope	Key endogenous variables			Focus
		Block 1	Block 2	Block 3	
Narasimham (1956)	1923-48 18 eqns OLS E,P	Y C W,E	P T	IM	Analysed in terms of consumption goods and investment goods; import prices and employment considered.
Choudhry (1963)	1930-55 22 eqns OLS,LIML E,P	Y,K,I YD,C	P	IM	Components of GNP explained; liquidity preference analysed; price level explained in terms of excess demand for goods.
Krishnamurty (1964)	1948-61 21 eqns OLS,2SLS E,F	Y,K,I YD,C W,E,POP	 R	IM	Population growth endogenised; Production function for agriculture specified; money market incorporated via interest rates.
Marwah (1964)	1947-60 9 eqns OLS,2SLS E,F	Y,I C W	P M,R		Aggregate price behaviour explained in terms of excess demand and the quantity theory; disaggregated price behaviour also analysed.
Mammen (1967)	1948-64 24 eqns OLS,2SLS E,F	Y,I C W,E	P M,R T	IM	Price level explained in terms of agricultural prices and a wage cost mark-up equation; money demand analysed with reference to interest rates, portfolio behaviour of banks and excess reserves.

TABLE 5.1(B). KK SYSTEMS: SECOND GENERATION

Author (Year)	Scope	Key endogenous variables			Focus
		Block 1	Block 2	Block 3	
Gupta (1973)	1949-68 42 eqns 2SLS E,P	Y,K,I YD,C	P M,R T	IM,BOP	Monetary policy issues discussed by studying the links between financial variables, GNP, prices, employment and the balance of payments.
Pani (1977)	1950-70 81 eqns OLS E,P	Y,I,S YD,C, W,E	P M,R,BO T	EX,IM	Duality in production structure considered; effects of government operations on economic activity analysed; links between foreign trade, prices, money and financial behaviour modelled.
Pandit (1978)	1950-75 11 eqns OLS E,P	Y	P M,R T,GE		Links between deficits, monetary expansion and inflation analysed; the interaction between agricultural output and inflation considered.
Rao (1979)	1960-73 12 eqns 2SLS E,P,F	Y,K,I YD,C W,E	P R	EX,IM	Employment and change in stocks endogenised; supply constraints on investment considered; crowding-out modelled; wage-price feedback specified.
Ahluwalia (1979)	1950-73 67 eqns OLS,2SLS E,P	Y,CU,I W	P M T	EX,IM	Behaviour of prices and output analysed from the standpoint of the structuralist and monetarist views on inflation; cost-push and demand-pull theories of inflation studied; linkages between the external sector and the monetary sector modelled.

TABLE 5.1(C). KK SYSTEMS: THIRD GENERATION

Author (Year)	Scope	Key endogenous variables			Focus
		Block 1	Block 2	Block 3	
Bhattacharya (1984)	1951-76 121 eqns OLS E,P	Y,K,S YD,C, W,E	P M,R T,GE PD	EX,IM FX ED	Public sector expenditures and revenues analysed; links established between money supply, prices, wages and employment; sectoral growth and trade examined.
Pani (1984)	1969-82 79 eqns OLS E,P,F	Y,K,I YD,C	P M T,GE,GR BD,PD	EX,IM	Factors determining output, demand, government and fiscal operations analysed; quantity theory framework invoked for establishing links between money and prices.
Krishnamurty (1985)	1962-80 77 eqns OLS E,P	Y,K,I,S YD W,E	P M GE,GR BD,PD		Focus on growth and inflation; role of the government and supply-side factors emphasised; complementarity versus crowding-out of government investment analysed.
Pethe (1986)	1960-82 25 eqns OLS E,P	Y C	P M,BO T,GE,GR BD		Links between real and monetary sectors analysed; detailed modelling of the real, monetary, banking and government sectors; prices explained in terms of cascade effects.
Rao (1987)	1961-82 40 eqns OLS E,P	Y,K,I,S YD,C	P M,BO T,GE,GR BD	IM,CAD	Feedbacks established between real, monetary and banking sectors; links between taxes, deficits, money and prices examined; imports analysed by relative prices; two-gap model used to relate real and external sectors.

TABLE 5.1(D). WJ, MS AND PB SYSTEMS: FOURTH GENERATION

Author (Year/Class)	Scope	Key endogenous variables			Focus
		Block 1	Block 2	Block 3	
Mohan (1982/WJ)	1950-81 62 eqns OLS E	Y,K,I,S YD,C W,E,POP	P		Focus on the effect of population growth, the pattern of demand and of technological change on urbanisation in the Indian context; endogenous adjustment of wages and prices; use of an IO matrix to link up sectors; agricultural and industrial sectors assumed to be specific to the rural and urban areas, respectively.
Sarkar and Kadekodi (1988/WJ)	SAM of 1983-84; 121 eqns OLS E,P	Y,ID,I,S C W,PR	P GE,GR	CAD	Specification of a disaggregative system for modelling energy prices; separate blocks for income, energy and industrial sectors; consumption and government sectors dichotomised; links specified between the rest of the economy and energy prices; focus on revenue mobilisation via raising energy prices.
Sarkar and Panda (1989/WJ)	SAM of 1985-86; 114 eqns OLS E,P	Y,I,S C	P M GE,GR BD	EX,IM,CAD	Focus on determining agricultural and non-agricultural output; links established between trade, savings and investment; government revenue, expenditure and deficit endogenised; feedback between money and deficits (both internal and external) spelt out; macroeconomic effects of changes in exchange rates and food prices studied in detail.

(Contd.)

TABLE 5.1(D). (Concld.)

Author (Year/Class)	Scope	Key endogenous variables			Focus
		Block 1	Block 2	Block 3	
Rastogi (1991/MS)	1950-88 43 eqns IV,OLS E,P	Y,K W,E	P,INF M,R GE PD	EX,IM ER	Focus on a 2 sector - 3 agent new classical RATEX model; emphasis on supply side aspects; effects of taxes, subsidies and government intervention on production studied; trade sector, money and bond markets modelled; portfolio allocation among agents considered.
Sen *et al* (1993/PB)	1970-89 17 eqns OLS E,P	S C	 BO T	IM	Household sector and commercial bank sector modelled with reference to their flow of funds and demand for assets; effects of contractionary monetary policy and deflationary fiscal policy studied.

Note: SCOPE in column 2 refers to: (i) period under study, (ii) number of equations in the model, (iii) method of estimation: OLS (Ordinary Least Squares), 2SLS (Two Stage Least Squares), LIML (Limited Information Maximum Likelihood); IV (Instrumental Variables), and (iv) Purpose of the model: E = explanatory, P = Policy prescriptions, F = forecasting.
Abbreviations: Block 1: Y = output, ID = income distribution, K = capital stock, CU = capacity utilisation, I = investment, S = savings, YD = disposable income, C = consumption, W = wages, E = employment, POP = population.
Block 2: P = prices, INF = expected inflation, M = money supply, R = rate of interest, BO = banking operations, T = taxes, GE = government expenditure, GR = government revenue, BD = budget deficits, PD = public debt.
Block 3: EX = exports, IM = imports, CAD = current account deficit, BOP = balance of payments, ER = exchange rate, FX = foreign exchange, ED = external debt.

5.1.3 A Summing Up

Anticipating the question, a dispassionate view of the results of the above exercises seems to suggest that all these models should be viewed as explorations in search of appropriate specifications of valid economic relationships for the Indian economy. However, despite the fact that Indian macroeconometric systems are currently in their fourth generation, the theoretical framework most appropriate for the Indian economy remains elusive even till today. As such, the specification for most of the models constructed so far has been eclectic and, although specified mostly around a generalised KK framework, have combined features of monetarist [Ahluwalia, 1979], structuralist [Pani, 1984] and neoclassical [Bhattacharya, 1984].

The importance of the distinction between the Keynesian methodology and the policy recommendations following from this methodology when combined with specific empirical assumptions was quite effectively brought out by Chakravarty [1979]. The logical corollary is that one may accept the assumptions but not necessarily the policy recommendations emanating from any of the above models, although Rakshit [1982] has argued that the various assertions made about the nature of markets and the scarcity of information in LDCs strengthen the case for Keynesian quantity adjustments rather than that for classical price adjustments.

Be that as it may, an alternative methodology for the Indian economy has yet to be spelt out, although the recent work by Goyal [1993] based on Taylor [1980, 1987] seems to be quite capable of generating a scenario - partly structuralist and partly monetarist - which could be valid for the Indian economy.

Such a synthesis is needed because monetarists advocate the so-called "Bank-Fund style" policy recommendations [see Mills and Nallari, 1992] which include reduced deficit financing, curbs on monetary expansion, wage restraints, devaluation and, in general, a policy-induced increase in the role of market forces in order to counter low growth, high inflation and chronic external sector disequilibrium. On the other hand, structuralists maintain that such policies are contra-indicative because the existence of sociopolitical parameters, power groups, imperfect markets and other factors imply that inflation control by such

conventional fiscal and monetary policies would only lead to stagflation. With the Indian economy currently responding to "monetarist treatment" but at the same time exhibiting symptoms of "structuralist side- effects", it would imply that a synthesis of both doctrines would be needed to solve the current malaise.

Since the eighties, the Planning Commission has shown an interest in the construction of econometric models in order to provide inputs to the core model during the formulation of the plans [see Roy and Rao, 1980]. While this is encouraging by itself, the recent switch in emphasis from "real" planning to "financial" planning implies that unless the Ministry of Finance and the RBI, which from henceforth will be primarily responsible for conducting macroeconomic policy in the country, follow suit and construct a plausible model for the Indian economy, which is still conspicuous by its absence, and use the results as inputs in policy formulation, the future of macroeconomic planning could still be bleak because of the acknowledged failure of IO techniques to handle the many complexities of financial planning.

It would be useful, at this stage, to recall some of the salient features of LDCs which appear to be relevant to macroeconomic modelling [see Krishna, *et al.*, 1989]. First, governments in most LDCs, besides formulating and executing economic policies, also predominate as producer, investor and consumer. This implies that the government sector must form one of the components of the model, although such governmental activity could be subject to a budget constraint. Thus, the specification should entail government behaviour that is neither fully exogenous nor fully endogenous.

Second, partly because of the predominance of government intervention by way of administered prices and partly because of market imperfections, prices may cease to be flexible in a large segment of the market, implying a considerable role for quantity adjustments. Third, since interest rates are policy-determined in the organised sector, money market equilibrium would partly be attained through price changes although the possibility of sectoral money demand functions would imply that the effects of prices would vary across sectors.

Fourth, if credit plays a vital role in investment, the rate of interest would be an important component of the unit cost of production, and consequently, a credit squeeze would adversely affect output. This interdependence between monetary and fiscal policies should clearly be borne in mind during the model specification. Finally, while supply bottlenecks may arise due to several factors, supply inflexibility should not be overexaggerated as this constraint is unlikely to be equally binding on all sectors simultaneously.

An evaluation of all the different analytical and empirical issues raised in this context leads one to conclude that future model building exercises for the Indian economy will need to incorporate some, if not all, of the following premises:

(1) It is easier to modify and extend the Keynesian model in order to incorporate various features of the Indian economy than it is to modify the neoclassical model with the same objective;

(2) The monetarist and structuralist methodologies should not be viewed as mutually exclusive alternatives and one should think of combining the desirable features of both types which could eliminate their individual deficiencies;

(3) Such a policy-oriented model would need to incorporate expectations and its role in influencing disequilibrium adjustment paths of several key macroeconomic variables;

(4) Given that several key variables would be exogenous in any estimated econometric model, time series techniques would be needed to extrapolate the values of these pivot variables in order to forecast the endogenous variables of the system.

Thus, the search for an acceptable alternative to the WL and KK approaches to systems modelling has begun in India. While the WJ approach has been further extended by Chitre and Naik [1990] and Narayana, Parikh and Srinivasan [1991] in order to explain satisfactorily certain pertinent Indian macroeconomic phenomena, work on using the MS and PB approaches has just about started and the preliminary results are quite heartening. Hopefully, an integration of the above three systems approaches, along with time series

analysis, would be able to specify a meaningful theoretical framework for the Indian economy in the near future.

5.2 Time Series Models

The approach to specifying macroanalytical systems is beset with hurdles especially with respect to the choice of exogenous variables while the use of macroeconometric systems, given the prior selection of exogenous variables, for forecasting purposes runs into problems especially with respect to obtaining prior forecasts of these exogenous variables. In this context, time series analysis has provided certain techniques for overcoming both these problems. While the primary evolution of this powerful statistical technique was initially governed by the need to employ it as a forecasting device, the ensuing methodological breakthroughs which paved the way for using it in the context of causality testing have implied that it is possible to employ it even at the stage of formulating macroanalytical systems.

5.2.1 Time Series Forecasting

Even though time series analysis has ancient and venerable antecedents [see Yule, 1927, Wold, 1954], the modern approach can be traced to Box and Jenkins [1970]. While a comprehensive account of modern time series analysis would be beyond the scope of this study, the interested reader would do well to refer to either Judge *et al* [1985] or Pindyck and Rubinfeld [1991].

Briefly speaking, a time series model is one where a variable y(t) is related to its own past values or lagged random disturbances or to both. The first specification refers to an autoregressive (AR) process, the second one to a moving average (MA) process and the last one to a mixed autoregressive-moving average (ARMA) process, which can be extended into an integrated autoregressive-moving average (ARIMA) process.

In the moving average process of order q, MA(q), the current observation y(t) is generated by a weighted average of random disturbances (ε) going back q periods. This process is given by:

$$y(t) = \varepsilon(t) - \theta_1\varepsilon(t-1) - \theta_2\varepsilon(t-2) - \ldots - \theta_q\varepsilon(t-q) + \mu \quad (5.1)$$

where the parameters $\theta_1,\ldots,\theta_q$ may be positive or negative; and where μ is the mean of the process.

In the autoregressive process of order p, AR(p), the current observation y(t) is generated by a weighted average of past observations going back p periods, together with a random disturbance term in the current period. Thus, we have:

$$y(t) = \varnothing_1 y(t-1) + \varnothing_2 y(t-2) + \ldots + \varnothing_p y(t-p) + \delta + \varepsilon(t) \quad (5.2)$$

If the process is stationary, then its mean (μ) must be invariant with respect to time, i.e.,

$$E[y(t)] = E[y(t-1)] = E[y(t-2)] = \ldots = \mu \quad (5.3)$$

Applying eq. (5.3) to eq. (5.2) implies that:

$$\mu = \varnothing_1\mu + \varnothing_2\mu + \ldots + \varnothing_p\mu + \delta \quad (5.4)$$

or:
$$\mu = \delta/(1 - \varnothing_1 - \varnothing_2 - \ldots - \varnothing_p) \quad (5.5)$$

The logical extension of these two models is the mixed autoregressive-moving average process, ARMA(p,q), which is a combination of the AR and the MA processes. This is given by:

$$y(t) = \varnothing_1 y(t-1) + \varnothing_2 y(t-2) + \ldots + \varnothing_p y(t-p) + \delta + \varepsilon(t) - \theta_1\varepsilon(t-1) - \theta_2\varepsilon(t-2) - \ldots - \theta_q\varepsilon(t-q) \quad (5.6)$$

where we assume that the process is stationary so that its mean is constant over time and is given by eq. (5.5). This provides a necessary condition for the stationarity of the process, i.e.,

$$\varnothing_1 + \varnothing_2 + \ldots + \varnothing_p < 1 \quad (5.7)$$

One of the earliest Indian attempts of employing the Box-Jenkins approach to time series forecasting was by Nachane *et al* [1981] where the objective was to forecast freight and passenger traffic on the Indian railways using a generalised adaptive filtering approach. In this study, the series was homogeneous of order d implying that the time series data had to be differenced d times

before it became stationary. The resultant differenced series was then modelled as an ARMA(p,q) process. In time series analysis, such a case is referred to as a mixed autoregressive integrated moving average process and is denoted by ARIMA(p,d,q).

The study was extended by Rao *et al* [1982] where the objective was to forecast energy consumption by the Indian railways. Single equation regression models for energy consumption by each traction (i.e., coal, diesel and electricity) were specified with freight and passenger traffic as explanatory (exogenous) variables. Forecasts of these variables, obtained using the time series approach, were then used to estimate future energy requirements of the Indian railways. Karnik [1989] subsequently extended this approach to other modes of transport in order to formulate an energy policy for the transport sector.

Of late, several studies applying time series methods in other fields, notably monetary economics and international economics, have appeared in the literature. The reason as to why these two subjects have attracted the largest share of empirical work in time series analysis has been the inadequacy of econometric models to forecast certain key variables in these areas as well as the availability of a large number of observations which is a *sine qua non* for time series analysis.

The studies in monetary economics have attempted to unravel the complexities involved in nominal GDP targeting via control of the monetary base. As this involves two separate effects, i.e., the primary effect of high powered money on money supply via the money multiplier and the secondary effect of money supply on nominal income via velocity, time series methods have been used basically to predict the velocity [see Kamaiah and Paul, 1987] as well as the money multiplier [see Nachane and Ray, 1989, Ray and Madhusoodanan, 1992].

The studies in international economics have attempted to forecast exchange rates which, because of their excessive volatility, have proved notoriously difficult, if not impossible, to predict using conventional macroeconometric systems. In this context, the studies by Paul and Ashtekar [1984] and Kamaiah *et al* [1988] who used univariate ARIMA models and proved that the out-of-sample forecasts of exchange rates were fairly accurate deserve special mention.

Closely related to the issue of exchange rate forecasting is the question of whether any market subset can form superior expectations about exchange rate movements which lead to profitable foreign exchange positions. In this context, swaps have become an important transaction in the foreign exchange market and their profitability is contingent upon the swap rate, i.e., the difference between the forward and the swap rate. While no study exists as yet on the forecasting of foreign exchange swap rates for the Indian economy, the possibility of doing so by combining time series models and discriminant analysis [see Mahajan and Santhanam, 1993] seems quite promising.

5.2.2 Testing for Causality

As mentioned earlier, one of the basic problems encountered in specifying a macroanalytical system pertains to the choice of exogenous variables. Even though the economic theory underlying the system can be a good guide in most cases, very often large gaps do remain because rarely will any theory explicitly list all the variables that should enter the model. Under the circumstances, the econometrician tends to rely upon his intuition which very often would reflect his subjective biases. The various causality testing procedures that have been developed imply that the subjective element in specifying a system can be replaced by more objective and statistically rigorous criteria.

Even though philosophical notions of causality can be traced back to Bacon and Hume, statistical causality testing has more recent origins which stem from the seminal paper of Granger [1969]. The subsequent contributions of Sims [1972, 1974], Sargeant [1976] and Geweke [1982, 1984] have now been fused together to develop a powerful methodology capable of rigorously testing for causality between a pair of time series.

The central axiom of Granger causality is the impossibility of an "effect" preceding its "cause". Given a pair of time series, X and Y, if X can be predicted better on the basis of the past histories

of both X and Y, than by the past history of X alone, then Y is said to "cause" X. Granger also defined the concepts of instantaneous causality from X to Y and feedback between X and Y. Granger assumed X and Y to be covariance stationary and used least-squares predictors, adopting the Mean Square Error (MSE) norm for forecast comparisons.

Taxonomically speaking, four types of causality tests may be distinguished: (1) Sims' original [1972] test (OS test); (2) Sims' modified [1974] test (MS test); (3) Granger's [1969] test (GR test); and (4) Geweke's [1982] test (GW test).

Suppose that X and Y are two (possibly vector) time-series of interest and the null hypothesis being considered is that "Y does not cause X". The various tests negotiate this null hypothesis as follows (see Nachane 1991):

(1) In the OS test, Y is regressed on current, past and future values of X, and the null hypothesis is rejected if the future coefficients are significant as a group.

(2) As the OS test is likely to be plagued by the problem of serial correlation, the MS test enlarges the set of regressors in the OS test to include past values of Y as well, thereby dampening the effects of serial correlation. The rejection of the null hypothesis once again hinges upon the significance of the group of future coefficients.

(3) The GR test appeals directly to the definition of Granger causality: X is regressed on its own past values and the past values of Y, and the null hypothesis is rejected if the group of past coefficients of Y is significant.

(4) The GW test, being complicated, merits a more elaborate treatment. Initially, the following two regressions are executed:

$$X(t) = \sum_{s=1}^{p} A_{1s} X(t-s) + u_1(t) \tag{5.8}$$

$$X(t) = \sum_{s=1}^{p} A_{2s} X(t-s) + \sum_{s=1}^{q} B_{2s} Y(t-s) + u_2(t) \tag{5.9}$$

where A_{1s}, A_{2s} and B_{2s} are constants; and p, q are lag lengths.

Let s_1 and s_2 be the (unbiased) estimates of the variances of u_1 and u_2, respectively. The estimated measure of causal dependence (or linear feedback) from Y to X is defined as:

$$F_{Y \rightarrow X} = \ln(|s_1| / |s_2|) \tag{5.10}$$

which establishes the equivalence of the null hypothesis (Y not causing X) with the true feedback measure $F_{Y \rightarrow X}$ being zero.

Based upon all possible relationships between X and Y, it is analogously possible to define explicit quantitative measures, indicating the "strength of causality", of linear feedback from X to Y, ($F_{X \rightarrow Y}$), instantaneous linear feedback between X and Y, ($F_{X.Y}$), and linear dependence between X and Y, ($F_{X,Y}$).

The first rigorous Indian study on causality testing was in monetary economics where the links between money, output and prices were examined by Nachane and Nadkarni [1985]. Their conclusions suggested a unidirectional causality from money stock to prices with very little effect of money supply on real output. Since then, a series of studies have appeared in this area including Ray and Namboodiri [1987], Patil and Ramanathan [1989], Singh [1989], Nachane [1991], Jadhav *et al* [1992], amongst others, and most of their subsequent conclusions have only served to reinforce the original ones. Causality testing procedures have also been used in public economics for verifying the Wagnerian and the Keynesian hypotheses regarding the links between government expenditures and national income [Karnik, 1988]; in development economics for examining the robustness of the energy-GDP relationship [Nachane, *et al.*, 1988]; and in financial economics for analysing the linkages between stock prices at the major stock exchanges in India [Karnik, 1992*a*]; amongst others.

5.2.3 Unit Roots and Co-integration

Nonstationarity of time series has always been regarded as a major problem in econometric analysis. It has been shown in a number of theoretical works [see Phillips, 1986] that, in general, the statistical properties of regression analysis using nonstationary time series are dubious.

It is often necessary to difference a series more than once to achieve stationarity. In this context, it is convenient to use the concept of an integrated series [see Engle and Granger, 1987]: A nonstationary series, X(t), which can be transformed to a stationary series by differencing d times is said to be integrated of order d and is denoted by: $X(t) \sim I(d)$.

Before any sensible regression analysis can be performed, it is thus essential to identify the order of integration of each variable. Suppose that we wish to test the hypothesis that a variable X(t) is integrated of order one, i.e., to test for $\alpha = 1$ in the autoregressive equation:

$$X(t) = \alpha X(t-1) + \varepsilon(t) \qquad (5.11)$$

If $\varepsilon(t)$ in eq. (5.11) is a white noise process, then this equation represents a random walk when $\alpha = 1$ and such a process generating X(t) is nonstationary (see Charemza and Deadman 1992).

However, if $|\alpha| < 1$, then the process generating X(t) is integrated of order zero and is stationary, i.e., $X(t) \sim I(0)$.

While it may be tempting to estimate eq. (5.11) by using OLS and to test the hypothesis that $\alpha = 1$, such a procedure is never carried out as the OLS estimate of α would be substantially biased in an autoregressive equation and little is known about the distribution of the t-statistic where X(t) is nonstationary.

The appropriate method of testing the order of integration of a time series was proposed by Dickey and Fuller [1979], called the DF test or the "unit root test" where the hypothesis that $\alpha = 1$ is tested by estimating an equivalent of eq. (5.11) given by:

$$X(t) - X(t-1) = \delta X(t) = \beta X(t-1) + \varepsilon(t) \qquad (5.12)$$

which can be re-written as:

$$X(t) = (1+\beta)X(t-1) + \varepsilon(t) \qquad (5.13)$$

which is the same as eq. (5.11) with $\alpha = (1 + \beta)$. Hence, if $\beta < 0$ in eq. (5.12), it implies that $\alpha < 1$ in eq. (5.11). The DF test consists of testing the negativity of β in the OLS regression of eq. (5.11). Rejection of the null hypothesis: $\beta = 0$ in favour of the alternative: $\beta < 0$ implies that $\alpha < 1$ and that $X(t) \sim I(0)$.

The first major Indian study on testing for unit roots was by Krishnan *et al* [1992]. Four macroeconomic time series, M1, M3, CPI for industrial workers and the index of industrial production (IIP), were tested for nonstationarity using the DF test. While unit roots were observed to be present for M1, M3 and CPI, it was found that IIP was stationary which implied that aggregate demand disturbances played a large role in explaining the movements in industrial production with supply factors like technical progress and capital accumulation being relatively insignificant. Since then, quite a few important studies have appeared in this area including Upadhyay [1992] and Ray and Kanagasabapathy [1992] who extended the earlier study by encompassing a larger set of time series in an effort to explain several pertinent aspects of the Indian economy including industrial inflation; and Barman and Madhoosoodanan [1993] who distinguished between the permanent and temporary components of Indian stock market returns.

The underlying theme of unit root testing is that trended data can be regarded as a potential source of problems for empirical econometrics as trends often give rise to spurious regressions leading to goodness-of-fit measures which are "too good to be true". Hence, testing the order of integration of a time series, i.e., differencing a series successively until stationarity is achieved, is often suggested as a remedy.

Nevertheless, this does not seem to be an ideal solution as often a model in difference form has neither a long run solution nor long-run properties. However, economic hypotheses usually posit equilibrium relations between variables which are assumed to be valid in the long-run, with deviations from equilibrium in the short-run recognised as a distinct possibility.

Co-integration theory is designed to address itself to specifying models which combine both short-run as well as long- run properties while, at the same time, maintaining stationarity in all the variables. If there is a long-run relationship between two (or more) nonstationary variables, the idea is that deviations from this long-run path are stationary. If this is the case, the variables in question are said to be co-integrated.

A non-deterministic pair of time series X(t) and Y(t) are said to be co-integrated of order (d, b), $d \geq b \geq 0$, written as:

$$X(t), Y(t) \sim CI(d,b) \tag{5.14}$$

if: (1) both series are integrated of order d, and (2) there exists a linear combination of these variables, given by:

$$\alpha_1 X(t) + \alpha_2 Y(t) = Z(t) \tag{5.15}$$

which is integrated of order (d-b). The vector $[\alpha_1, \alpha_2]$ is then called the co-integrating vector (see Engle and Granger 1987). The case of d=b=1 is of considerable practical importance as it implies that both X(t) and Y(t), being I(1), have dominant long-run components, while Z(t), being I(0), will be free of any long-run components. Furthermore, the relationship:

$$X(t) = -(\alpha_2/\alpha_1)Y(t) \tag{5.16}$$

obtained by setting Z(t)=0 in eq. (5.15), may be regarded as the long-run equilibrium for the system where Z(t) indicates the extent by which the system is out of equilibrium. When co-integration obtains, Z(t) is I(0), implying that the system cannot drift too far from the equilibrium in the long run.

The first major Indian study on using co-integration theory was by Nachane *et al* [1988] who analysed the long-run energy-GDP relationship for a sample of 25 countries and found that India was one of the 3 countries where energy shortages had longer inhibitory effects on economic growth implying a possible inability of the manufacturing industries to adapt themselves rapidly to energy-saving techniques. Since then, quite a few important studies have appeared in this area including Balakrishna [1991] who modelled the anatomy of Indian inflation and showed that it is crucially dependent upon the pattern of wage and price determination with agricultural (industrial) prices responding to changes in demand (costs); Nachane [1992] who showed that the structural breaks in the money multipliers were merely temporary aberrations with all relations displaying a strong tendency to revert back towards long-run equilibrium; and Karnik [1992a] whose results, using Geweke measures, indicated that stock prices at the major stock exchanges in India were co-integrated with those existing at the Bombay Stock Exchange.

5.2.4 Vector Autoregressions

While the estimation of macroeconometric systems attracted a lot of attention in the initial stages, its by-and-large poor forecasting ability sparked off widespread criticism which was directed especially towards its assumption of zero restrictions (i.e., the deletion of certain variables from the system) and the *a priori* endogenous-exogenous classification of variables.

Moreover, the theoretical restrictions imposed on such macroeconometric systems were viewed as 'incredible' in a seminal paper by Sims [1980], where a basis for a new methodology of vector autoregressive (VAR) modelling was first introduced whose salient features were: (1) There is no *a priori* division of variables into endogenous and exogenous; (2) There is no imposition of zero restrictions; and (3) There is no strict (and prior to modelling) economic theory on which the model is based.

The above principles were quite revolutionary and led critics to dub it as "atheoretical macroeconometrics". However, it needs to be stressed that these "atheoretical" postulates are regarded as testable hypotheses and that further inference in such Sims-type systems often lead to a model form which is consistent with even highly detailed economic theories.

The VAR methodology consists of regressing each of the current (non-lagged) variables in the model on all the variables in the model lagged a certain number of time periods. Thus, if there are n variables in the model with each of them being lagged k times, then the unrestricted VAR model will be given by:

$$Z(t) = \sum_{i=1}^{k} A_i Z(t-i) + \epsilon(t) \tag{5.17}$$

where Z(t) is a column vector of observations, in time period t, on all the n variables in the system given by:

$$Z(t) = [x_1(t) \quad x_2(t) \ldots x_n(t)]' \tag{5.18}$$

and where $\varepsilon(t)$ is a column vector of random errors and the matrices A_i do not contain any zero elements.

The specification of VAR models can be extended to include intercept terms, deterministic trends, seasonal dummy variables as well as time varying elements in A_i.

One straightforward application of an unrestricted VAR model is for forecasting and probably the earliest Indian study in this area was the one by Paul and Ashtekar [1990] who used a VAR model to forecast several exchange rates (the Indian rupee *vis-a-vis* the U.S. dollar, the British sterling, the German mark, the Swiss franc and the Japanese yen) on a quarterly basis and showed that the past lags of the exchange rates were more important in this respect than other variables, including the interest rate, current account deficit and money supply. Other important studies include Sen and Vaidya [1993] who used a four equation VAR model and proved that the post-Keynesian theory of inflation, which argues that industrial prices are determined by profit mark-ups, money wages and labour productivity, was superior to the structuralist and the monetarist models; Nag and Upadhyay [1993] who proved the existence of a fairly stable money demand function with the yield on shares emerging as a good proxy for the opportunity cost of holding money; and Hatekar [1993] who estimated a VAR model with three variables, i.e., output, money and reserve money, and showed that shocks to monetary magnitudes can give rise to damped oscillations in real output.

5.3 Chaos and Nonlinear Dynamics

One of the most important scientific developments in the last three decades has been the discovery of chaotic behaviour in simple, nonlinear, deterministic dynamic systems whose essential characteristic is that even though all time paths are bounded, trajectories which start close together diverge exponentially over time. The implication of such chaotic behaviour is that long-range forecasting is impossible because models displaying chaotic behaviour generate an intrinsic randomness which cannot be reduced over time. However, if events are governed by a not-too-complex chaotic process, it should have short-term predictability and, in such cases, traditional forecasting methods would fail and nonlinear models would have to be used.

Modern methods of qualitative analysis of dynamic systems go back a century to Poincare [1892]. However, chaotic behaviour was first observed by Lorenz [1963] in computer simulations of a nonlinear model of atmospheric dynamics. Since the work of Smale [1967], it has become clear that very complicated trajectories can arise in certain dynamical systems and that such complicated trajectories can persist in spite of small perturbations to the underlying system. Such a phenomenon, known as "chaos", is one in which a deterministic dynamic mechanism yields a time path so complicated that it will invariably pass nearly all tests of randomness. The seminal contributions of Li and Yorke [1975], May [1976], Feigenbaum [1983], Guckenheimer and Holmes [1983], amongst others, have greatly facilitated an exploration of the pertinence of such complicated dynamics, arising in dynamic nonlinear systems, to a variety of fields, including economics.

Chaos is a nonlinear deterministic process which "looks" random and it is interesting because of its intrinsic capability of generating plausible macroeconomic scenarios. For example, in the business cycle literature, there were hitherto only two ways to generate output fluctuations.

The first of these owed its genesis to Frisch [1933] and Slutzky [1937] who used linear stochastic macroeconometric models with random shocks to mimic business cycle behaviour. Using this methodology, which was discussed in Section 5.1, Chitre [1982, 1991] was able to show that the growth cycles in Indian non-agricultural income could be decomposed into three primary causes: the fluctuations in agricultural income, the gross fixed investment in the public sector and the world industrial cycle. The results also indicated that private sector fixed investment either lags the turning points of the world industrial cycle by one year or else coincides with them.

The other type of model, referred to as VARs, was introduced into the literature by Sims [1980]

who used monthly data on the U.S. economy to estimate a business cycle model with four variables, i.e., output, prices, money and interest rates, in order to obtain empirical evidence on how these variables evolved and influenced each other over time. Based upon this methodology, which was discussed in Section 5.2, Hatekar [1994] estimated a business cycle model for the Indian economy with four variables, i.e., agricultural output, industrial output, wholesale prices and time deposits, using filtered data and was able to reject the hypothesis that time deposits and wholesale prices do not matter for output fluctuations.

However, many researchers believe that the proportion of cyclical movements that can be explained *ex-post* by econometric models is quite low; and that VAR statistics are very sensitive to even minor modifications in the VAR's random and non-random components implying that any evidence provided by a VAR model on the dynamic relationships amongst its variables is suspect.

These drawbacks in the earlier approaches have led to the emergence of chaotic growth models, popularised by the works of Rossler [1979] and Goodwin [1990], where the economy follows nonlinear dynamics which are self-generating and never die down. The fact that fluctuations can be internally generated has a certain intuitive appeal which the earlier two approaches lacked.

It so happens that chaotic dynamics is necessarily nonlinear which gives it a second appeal because such models can generate much richer types of behaviour unlike linear models which, no matter how large or complex, can generate only four types of behaviour: oscillatory and stable; oscillatory and explosive; non-oscillatory and stable; and non-oscillatory and explosive.

It is difficult to provide a precise description of chaos without using technical terms such as positive topological entropy, positive Liapunov exponents, existence of a strange attractor, amongst others. Informally, chaos occurs when the time path of a variable generated by a nonlinear deterministic process looks random in the sense that there is aperiodic motion as well as sensitive dependence on initial conditions. The latter is a more problematic one since it implies that it is virtually impossible to predict the system. To obtain some ideas regarding the behaviour of chaotic processes, we consider the following models.

One of the most commonly used models is the *logistic map* where we initially select x(0) between 0 and 1, and generate the sequence of x(t) using the nonlinear difference equation:

$$x(t) = rx(t-1)[1 - x(t-1)] \tag{5.19}$$

where $0 < r \leq 4$. For $r < 3$, the trajectories of x(t) are stable and will converge to its equilibrium solution: $x^* = 1-(1/r)$. But as r approaches 3.57, the system becomes chaotic. There are four important properties of the logistic map: (i) {x(t)} fills up the interval [0,1] uniformly as $t \to \infty$, implying that the fraction of points in {x(t)} falling into an interval [a,b] is (b-a) for any $0 < a < b < 1$; (ii) Any small error in measuring the initial state, x(0), will be compounded exponentially fast in forecasts of x(t); (iii) x(t) appears stochastic even though it is generated by a deterministic process; and (iv) The dynamics of a chaotic process are governed by certain parameters. Properties (ii)-(iii) which are true for all chaotic processes create the illusion of randomness making prediction extremely difficult.

As compared to the logistic map, the Hénon map [Hénon, 1976] is a bivariate chaotic system described by the pair of equations:

$$x(t) = y(t-1) + 1 - Ax(t-1)^2 \tag{5.20}$$

$$y(t) = Bx(t-1) \tag{5.21}$$

whose solution yields chaotic trajectories for x(t) and y(t) for a large set of parameter values, e.g. A=1.4 and B=0.3.

Unlike the earlier two discrete-time models, the *van der Pol model* is expressed in terms of differential equations. The two-variable system is given by (where $\dot{x} = dx/dt$):

$$\dot{x} = y \tag{5.22}$$

$$\dot{y} = -A(x^2 - 1)y - Bx \tag{5.23}$$

yielding the *van der Pol* equation:

$$\ddot{x} + A(x^2 - 1)\dot{x} + Bx = 0 \tag{5.24}$$

The *van der Pol model* produces a limit cycle, being unstable for any $|x| < 1$ and stable for any $|x| > 1$. The quadratic nonlinearity produces special behaviour: for small values of A, the cycle is approximately sinusoidal; but for large values, the result approaches a square wave known as a relaxation oscillator.

Unlike the Henon and van der Pol two-variable systems, the Lorenz map is a trivariate chaotic system given by:

$$\dot{x} = A(y - x) \tag{5.25}$$

$$\dot{y} = -y - xz - Bx \tag{5.26}$$

$$\dot{z} = xy - Cz \tag{5.27}$$

Lorenz [1963] set A=10; B=28 and C=8/3 while simulating atmospheric dynamics and obtained chaotic system trajectories: a result responsible for most of the later studies in chaos theory.

Just like the Lorenz map, the *Rössler band* [see Rössler, 1979] is also a three-variable model which is given by:

$$\dot{x} = -Dy - Ez \tag{5.28}$$

$$\dot{y} = +Hx + Fy \tag{5.29}$$

$$\dot{z} = +B + Gz(x - C) \tag{5.30}$$

The coefficients of x and y in eqs. (5.29) and (5.28) being +H and -D, respectively, the solutions are oscillatory and are in deviations from the fixed-point equilibrium which represent a steady-state growth. Setting $z(0) = 0$, we obtain the results: $\dot{x} = -Dy$ and $\dot{y} = +Hx + Fy$, so that:

$$\ddot{x} - F\dot{x} + DHx = 0 \tag{5.31}$$

If $F < 0$, the result is a stable cycle around steady growth. With all parameters positive, an unstable cycle results.

Based upon the above nonlinear systems, a few researchers have attempted to model certain aspects of the Indian economy as a chaotic process in order to try and understand how macroeconomic fluctuations can be endogenously generated.

In this context, Rao and Bhogle [1990] were the first to explicitly use chaos theory in order to analyse the feedback between budget deficits, money growth and prices for the Indian economy. Based on the mathematical theory that chaotic trajectories can be obtained for a wide class of families of functions, provided these are single-peaked, possess a negative Schwarsian derivative, and are increasing in a given parameter, they specified an *exponential map* which is a univariate chaotic system and described the dynamics of the inflation rate (c) by:

$$\pi(t) = \varnothing - \theta\pi(t\text{-}1) \quad \exp[-\beta\pi(t\text{-}1)] \tag{5.32}$$

where $\varnothing$ is the ratio of government expenditure to money supply; θ is the product of α (the coefficient linking money growth rates and inflation rates) and v (the income velocity of money); and β is the elasticity of real money demand with respect to the inflation rate. The existence of three controlling parameters and the possibility of three equilibrium solutions yielded certain interesting insights into the dynamics of hyperinflation as well as the structure and pattern of bifurcations: the uniqueness of temporary (or virtual) equilibrium; the stability of trajectories contingent upon initial conditions; and the existence of a critical value of $\varnothing$ beyond which level a temporary equilibrium (usually a moderately high but stable inflation rate) would explode exponentially towards a much higher fixed point attractor (usually a hyperinflationary spiral).

Based on a similar map, Swami [1993] was able to provide an alternative (to the Dornbusch overshooting theory) hypothesis, using a cobweb model with a nonlinear import demand function, to explain why exchange rates are so excessively volatile. The results, apart from suggesting a plausible factor for the observed instability of export-led growth, indicated that chaotic trajectories can arise if the coefficient of adjustment (to excess demand) in the exchange rate exceeds a critical limit.

Currently efforts are being made to construct bivariate and trivariate chaotic systems to study cyclical fluctuations. While a preliminary framework for analysing business cycles behaviour was proposed [see Rao, 1991a] by specifying the dynamic linkages between output,

inflation, interest rates and money supply in terms of a Rossler Band coupled to a van der Pol model, the very complexity of the model has rendered its calibration difficult.

In this context, the first empirically calibrated chaotic growth model for the Indian economy was constructed by Goyal [1993] who worked within a two-sector general equilibrium framework and showed that endogenous parameter changes can lead to growth cycles that are often characterised by the existence of steady-state non-market clearing multiple equilibria.

Research on calibrating the "Rossler Band" for the Indian economy is currently in progress and, if successful, it would be possible, by integrating control and chaos theory, to prescribe policy that is necessary to stabilise the deterministic-chaotic component of the economy. Such models of "controlled chaos" would be able to offer guidelines on the approach to be adopted as far as designing models for the Indian economy is concerned.

Economics essentially contains one important paradox. In microeconomics, all economic variables are seen to be generated by the rational decisions of maximising agents, thereby implying that all microeconomic variables can be assumed to be completely deterministic. However, in macroeconomics, most of these aggregated variables are frequently viewed as being random. The problem is to reconcile the fact that the same variables are deterministic and random at the same time - a paradox which may be explained if the economic system is chaotic.

Currently, a transition towards a chaotic regime has been witnessed in several macroeconomies around the world. Many industrialised countries seem to have suddenly switched from conditions of steady-state growth (which was predominantly the domain of traditional economic theory) towards those exhibiting erratic fluctuations. As a result, it has become very difficult to predict several key macroeconomic indicators, notably exchange rates. While it is still not certain that what we are observing is chaotic dynamics because there are too many independent sources of noise which affect economic data, it is possible to conjecture that some of the observed noise is not extrinsic noise independent of the economic system but is intrinsic noise generated by the chaotic dynamics of the system itself.

It is because of such a reconciliation between microeconomics and macroeconomics; between extrinsic noise and intrinsic noise; and, ultimately, between chaos and order that leads one to believe that nonlinear dynamic systems theory can provide a far better description of economic behaviour than that which is currently possible using alternative paradigms.

6. Conclusions

Planning efforts in India have mostly concentrated on the theoretical side with building consistency models which fit into a framework of specified overall targets. Thus, the concern of the Planning Commission has been invariably to specify short-run five-yearly targets of national income growth rate, requisite aggregate investment and other macroeconomic magnitudes; all of which have then been dove-tailed into a long-run perspective plan. The planning exercises have therefore consisted of working within a highly disaggregated static IO model, given these targets. However, forty years of planning have indicated, beyond the shadow of any doubt, that the actual performance of the Indian economy has almost always fallen short of these targets. This has led to a growing awareness amongst many Indian economists that consistency planning models need to be supplemented by other types of planning models which, by incorporating the technological, behavioural and institutional relationships existing in the Indian economy, can help in identifying bottlenecks, constraints and lags in the system, besides generating the actual achievable growth rate.

Protagonists of consistency models have argued, however, that a successful *ex-post* prediction of shortfalls in the planning target by, say, an econometric model does not *per se* vindicate its specifications since it may be a case of spurious correlations because these simulations, by extrapolating past trends, may only be indicating that each successive plan has required lifting the economy onto a path higher than that predicted by previous experience [see Desai, 1973]. But this

may be equally consistent with saying that the growth targets of most of the five-year plans were chosen with scant regard to shortfalls during previous planning periods. Thus, econometric models, being descriptive of these shortfalls, estimate the lower bound of the potential growth of the economy. Thus, while a successful prediction by econometric models can be taken as an indicator of a flaw in plan design, its logical corollary would imply that the degree of success in designing, formulating and executing a plan can be measured by the extent to which econometric models underpredict real variables, especially output growth rates, over successive plan periods [see Rao, 1984].

One position sometimes articulated is that some of the more pertinent socioeconomic features of the Indian economy cannot be appropriately captured by means of the systems approach to macroeconomic modelling, and consequently it would be dangerous to base policy decisions on such models. First of all, decision makers in the government do, in fact, consider the reactions of the economy while making decisions, however imperfect their knowledge of these reactions may be. The use of systems methods, by aiding in the quantification of these dynamic responses, forces a decision-maker to explicitly make a stand while considering an issue. It is more dangerous for decision-makers to hide their assumptions, regarding the economy, on which they base their policies, than it is for macroeconomic systems designers to quantify the economy by means of a mathematical model and advise policy makers on the correct strategy. Most decisions in practice are made in the face of uncertainty, but uncertainty does not justify discarding a perfectly rational quantitative approach.

In concluding, we must note that the word model is often used in two different senses. To many, a mathematical model is any set of equations that adequately describes the behaviour of the system in question. In some fields, however, where the equations governing the behaviour of the system are precisely known but are so complex as to be practically impossible to handle, the word 'model' is reserved for a mathematical scheme that never pretends to describe the system in its entirety, but is expected to be effective for a certain set of parameters in a certain range of applications. Thus, the Navier-Stokes equations for fluid dynamics are a model in the first sense, while the Prandtl-Kolmogorov equations for turbulence only in the latter sense. In economics, the problem is to try and explain observed phenomena, which can yield trajectories more complicated than either fluid flows or turbulence, without recourse to any known economic equations of motion and it is this that has proved to be the major drawback facing macroeconomic systems designers.

This has implied that the evolution in the designing of systems for the Indian economy has been governed by a faithful adherence to the Darwinian principle of "survival of the fittest" reflected in the progress made from the now-extinct Mahalanobis growth model used nearly forty years ago to the control and chaotic systems currently in vogue. Hopefully, this quest for perfection will continue for when planners, aided by their intuition, fail to provide guidelines on the macroeconomic strategies to be adopted, it is the systems theorist alone who, by attempting to come to terms with seemingly irreconcilable objectives, can assist them in making the final diagnosis.

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EXCHANGE RATE BEHAVIOUR OF INDIAN RUPEE IN A CONTROLLED FOREIGN EXCHANGE REGIME: A COINTEGRATION APPROACH

Sukumar Nandi

Whenever a currency is subject to control regarding its exchange rate and trading, a parallel market develops and a second exchange rate, popularly known as black market rate, is established in the market. The interaction of this with the official rate is conditioned by the domestic fiscal and monetary policies and international scenario. The comovement of these two rates reflects the nature and the degree of the disequilibrium of domestic economy. The nature of this relationship in a historical perspective has been explored in this paper by using a sophisticated econometric approach.

The role of the government in the regulation of the economic activities has been debated in the literature for a long time and the debate still continues. The main focus seems to be not the desirability of the government regulations but the optimum degree of it. A subtle distinction also emerges in the literature between the 'Governance' and 'control' on the part of the state machinery [Banuri, 1992, p. 219]. While the responsibility of the government lies in regulating the activities of the different economic agents so that the latter can utilise their full potential in the development process, strict regulations with a view to 'control' the activities of the economic agents may stifle the spontaneous enthusiasm of the players in the field and this may induce them to bypass the regulations which they think unnecessary for the normal process of economic activities. But the set of priorities of the government may be different from what the economic agents think proper and in this perspective the government comes forward with elaborate control mechanism to guarantee that the priorities are adhered to. The argument for control are reinforced when some economic agents are not the citizens of the country but they participate in the domestic economic process as the economy opens up through international trade.

The above paragraph explains, in brief, why each country, irrespective of the level of economic development, exercises widespread control on the external transactions of the country. The developing economies suffer from more complex problems: their money markets are weak and these are not properly integrated to the economy, their capital markets are weak and the economies struggle to maintain the minimum required international reserve to back their currencies. Thus 'protection' becomes the catchword for the developing countries: their capital market requires protection from the interferences of the strong capital from abroad, their currency needs protection from the onslaught of the speculators. An elaborate system develops to control the flow of capital across the political boundaries and to maintain a fixed and rigid exchange rate for the domestic currency. The fixed exchange rate system had been also fully consistent during the Bretton Woods era when the stability of the exchange rate had been the principal objective of the international exchange rate system.

The fixed exchange rate system became the sheet anchor of the policy of international transactions for the developing countries. Meanwhile, the domestic money market created inflation to maintain equilibrium and very soon the domestic price level of the developing countries deviated too much from the world price level. Because of the fixed exchange rate regime, the exchange rate of the domestic currency hardly reflected the true purchasing power and too much deviations of the fixed official exchange rate of the currency created a parallel market for it, where it is exchanged against a foreign currency at a much lower price. This is the black market exchange rate which reflects the ground reality of the disequilibrium in the domestic money market. For example, the Indian rupee has been having a black market exchange rate since the early fifties and this rate is sharply different from the official rate (Figure 1). While the official rate remained fixed, the black market rate fluctuated depending on the

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market situations. The latter depends on the overall macroeconomic policies of the economy and the position of balance of payments. While the official rate remains insulated from the effects of market forces due to government policy of fixed exchange rate regime, the black market rate absorbs the thrusts of the market forces through its fluctuations. The theoretical structure given below explains this relation in detail.

India has been following a rigid exchange control regime since Independence. The whole period can be divided into two parts: The first period covers the period 1950-1971, when the exchange rate was officially fixed. The Bretton-Woods system collapsed in 1971 and India started a basket - currency regime from 1975 onwards. The period 1971-1975 was characterized by experiments with the new exchange rate system when major currencies of the world started floating. In 1973, the rupee was pegged to the U.S. dollar for a brief period and then it was delinked and linked with pound sterling. This system continued till 1975 when the rupee was linked with a basket of currencies. The contents in the basket and their respective weights remained a secret. This system continued till February 1993, when the rupee became a fully floated currency.

The exchange rate regime of the rupee in the post Bretton Woods era since 1973 has been dynamic with the controlled exchange rate showing flexibility. But the flexible official rate could not deter the operation of a black market and the black market exchange rate continued to thrive. Thus the rupee continued to be cheaper in the black market and the difference between the two rates fluctuated over time (Figure 2). In fact, the movement of the two exchange rates from 1980 onwards has been consistently uniform with the black market rate remaining consistently higher than the official rate. The interesting point is that the incipient depreciation of the rupee did not close the gap between the two rates. The relationship between the two rates has its theoretical explanation which comes out as a reduced form of relationship from a structural macro model. While this aspect is important, we are more interested in this study to explore the nature of the movement of the two time series of the two rates of exchange of the rupee. With this broad objective in mind, the present note explores the following: (i) whether the two time series are stochastic in nature, and (ii) whether a casual relationship can be established between the two series.

The paper is divided in several sections. Section 1 analyses in brief the theoretical model linking the official exchange rate with the black market rate of a currency in a broad macroeconomic framework. Section 2 describes the time series econometrics which is used to explain the movement of the two exchange rates. The models explained in section 2 are empirically tested in section 3; and section 4 explores the casual relation between the two series. The last section comes in the form of a conclusion, which also contains the policy implications of the paper.

1. Black Market Exchange Rate: Theoretical Framework

In traditional monetarist framework the exchange rate is defined as the price of domestic currency in terms of foreign currency. Thus exchange rate is a price and it reflects the disequilibrium in the money market in the form of a mis-match between the demand for cash balance and the supply of it. When a currency is under the fixed exchange rate regime, the disequilibrium in the money market in the form of an excess supply of money is partly reflected in the form of a depreciation of the exchange rate and that happens in the unofficial market, which is euphemistically called as black market. The fixed exchange rate regime is also associated with an elaborate exchange control which acts as a rational device in the face of an increasing demand for foreign currency. The black market of the latter emerges when the demand for it exceeds the available supply. The price of foreign currency becomes higher compared to the price quoted in the official rate and the gap is the black market premium, which acts as an incentive to supply foreign currency in the black market. As mentioned in the literature, the premium depends on the economic variables like inflation, trade gap, tax-structure, etc. [Blejer, 1978, Pinto, 1989, Pp. 321-338]. But the extent of this premium, determined as the ratio of the black market rate

(BMR) to the official rate (ER), determines the supply of foreign exchange in the black market. Thus the supply function in logarithmic form can be written as

$$\text{Log } S_B = a_0 + a_1 \log (BMR/ER) \quad \ldots(1)$$

The demand for foreign currency depends positively on the returns from holding the asset (in foreign currency) and negatively on the return from on alternative asset (held in domestic currency). The former depends on the expected rate of depreciation of the domestic currency. Again, the latter depends on the inflation rate differential as higher inflation at home leads to the depreciation of the domestic currency in the black market. From this consideration Blejer [1978] postulated the following expression for the expected depreciation of the black market rate

$$BMR^* = (\log P - \log P_w - \log BMR) + \left(P^{*e} - P_w^{*e}\right) \quad \ldots(2)$$

Where P and P_w are the domestic and world price level respectively, and P^{*e} and P_w^{*e} are their respective change (here asterix (*) means the rate of change of the variable and this is used uniformly).

Further, the opportunity cost of holding foreign currency depends on the difference between the domestic and the foreign interest rate. Assuming that the interest rate differential closely follows the inflation differential between the domestic economy and the world, the demand function for foreign exchange in the black market can be written as

$$\log D_B = b_0 + b_1\left[(BMR^*)_e + P_w^{*e}\right] - b_2 P^{*e} \quad \ldots(3)$$

Where b_1 is the own return elasticity and b_2 is the alternative cost elasticity, which determines relative rate of return when asset is held either in foreign currency or in domestic currency. Assuming that the elasticities are equal (i.e., $b_1 = b_2$), we can write

$$\log D_B = b_0 + b_1 (\log P - \log P_w - \log {}_{BMR}) \quad \ldots(4)$$

Differentiating equations (1) and (4) with respect to time (t) we have

$$S_B^* = a_1(BMR^* - ER^*) \quad \ldots(5)$$

$$D_B^* = b_1\left(P^* - P_w^* - BMR^*\right) \quad \ldots(6)$$

Where the symbol (*) is the rate of change as denoted earlier.

Market clearing in the black market of foreign exchange requires that the flow equilibrium condition is satisfied, or

$$S_B^* = D_B^*$$

and thus from Equations (5) and (6)

$$a_1(BMR^* - ER^*) = b_1\left(P^* - P_w^* - BMR^*\right)$$

which implies

$$BMR^* = [a_1/(a_1 + b_1)]\, ER^* + [b_1/(a_1 + b_1)]\left(P^* - P_w^*\right) \quad \ldots(7)$$

Thus we find that the rate of depreciation of the black market rate is a weighted average of the depreciation of the official exchange rate and the inflation differential.

In an economy where disequilibrium in the money market persists and domestic inflation is a perpetual phenomenon, the two rates move in tandem and the equation (7) gives some sort of an equilibrium relation between the two. The depreciation of the black market rate clears the black market, but we are to remember that this is nothing but the spill over of the disequilibrium in the domestic money market, as the official exchange rate is subject to government intervention.

2. *Time-series Econometrics*

The movement of an economic variable over time creates the time series which is treated as the product of a random economic process of the functioning of the macro-economic structure. The time series thus generated may have a trend component apart from the stochastic part added to the trend. When two economic variables move over time and the theoretician seeks some relationship between the two, then the mere relationship of their absolute level may give a false impression when both the time series are not 'stationary' according to the recent claims of the

econometricians. A stochastic process is defined as stationary if the joint and conditional probability distributions of the process is invariant over time. In a weak sense, stationarity implies constant mean and variance over time. The test of it is the unit root test. Thus the test is based on the estimation of the regression equation for a series Y_t like

$$D\,Y_t = b.\,Y_{t-1} + e_t \qquad \ldots(1)$$

Where D is the first difference operator, and it is followed in this paper.

If the absolute value of the t - of the estimated coefficient is greater than the prescribed value, the null hypothesis that Y_t is non-stationary (i.e. having a unit root) is rejected. The test is proposed by Dickey and Fuller [1979, Pp. 427-431].[1] Failure to reject the null hypothesis leads to the test of higher order integration of the series and for this the following regression is run:

$$D^2Y_t = \beta DY_{t-1} + U_t \qquad \ldots(2)$$

Where D^2 is the second difference operator.

If the null hypothesis is rejected, the series Y_t is stationary and Y_t is integrated of order one or Y_t is I (1). If the null hypothesis cannot be rejected, we can repeat the procedure to ascertain the order of integration. Once the latter is known, the series can be differentiated accordingly to get the stationary series.

Dickey and Fuller [1981, Pp. 1057-1072] advocated an augmented test of the form

$$Yt = AY_{b-1} + \sum_{i=1} aiDY_{t-i} + V_t \qquad \ldots(3)$$

to take care of the possible autocorrelation in (1). This is known as Augmented Dickey-Fuller test (ADF) and is considered as the efficient test of integration. The procedure is the same and the t-statistic for the estimated value of A is examined. The lag structure (the value of K) is kept on the lower side with an eye to the value of autocorrelation.

In economics, most time series are subject to either stochastic or deterministic trend. Regression in such a situation may lead to spurious result. One remedy to this type of situation is differencing the time series. There is another idea related to this situation. If there is a long run relationship between the two non-stationary variables, the idea is that the deviations from this long run path are stationary and when this happens, the variables are said to be cointegrated.

Cointegration and Long-term Equilibrium

The cointegration of two time series variables provides a statistical counterpart of the economic phenomenon when economic theory proposes forces which imply that some combination of time series e.g. prices and wages, money supply and price, etc., will not diverge from each other by too great an extent, at least in the long run [Granger, 1986, p. 213]. This correspondence of the notion of cointegration with the theoretical concept of long run equilibrium gives rise to some tools of analysis by which some propositions of economic theory can be tested. Consider two series X_t and Y_t and both of these are integrated of order one or I(1), that is, first differences of both are stationary. If economic theory suggests a long run equilibrium relationship

$$Y_t = a_1 X_t + a_2 z_t + e_t$$

then a linear combination of the two series is stationery. Again, the cointegration of the two series is at least a necessary condition for them to have a stable long-run relation. Otherwise X_t and Y_t will tend to drift apart without bound [Taylor, 1988, p. 1,373]. This suggests that a stable long-run relationship between the two integrated variables implies that they are also cointegrated. An explanation of this statement can be given in following way [Darnell and Evans, 1990, p. 138]: Consider the following:

$$Y_t = a_1 X_t + a_2 z_t + e_t$$

Where e is the error, and Z_t is a proxy variable which captures the effects of environment, and in the sample $t = 1, 2, \ldots n$, the values of both Z_t and error e_t are stationery, but outside the sample. There is no guarantee that Z_t will remain stationery. Thus within the sample period stability of the long-run relationship may be seen to imply cointegration. But outside the sample, stability of long-run is not guaranteed. Thus the proposition that the cointegration is at least necessary for the existence of a stable long-run relationship is true when the nature of the 'long-run' is restricted.

The error term in the cointegrating equation captures the effects of all influences not otherwise modelled explicitly, and, by its very nature, it picks up the consequences of the failure of the 'real world' to conform to the world of *ceteris paribus*. The procedure of cointegration consigns some systematic influences to the error term, and therefore, the inductively based 'Knowledge' drawn from the cointegrating equation is inadequate. This, along with the implication of change of environment (variable Z_t) beyond the sample may lead to an observation like the following: the existence of a stable long-run relationship between two integrated variables implies that they are also cointegrated, but the converse is not true. A failure to prove cointegration between two integrated variables does not automatically lead to a negation of their stable long-run relationship.[2]

Against the theoretical perspective explained above we can describe the mechanics of testing the cointegration between two time series, say X_t and Y_t. It is a two-step procedure. First, we are to test whether the two series are integrated of order one or not and this is nothing but unit root test. If it is found that both X_t and Y_t are I(1) process, a useful method of testing whether they are cointegrated is to estimate the equation

$$Y_t = a + b X_t + U_t \qquad \text{..... (4)}$$

and test if the residuals are I(0) or not. Some simple tests of the implied null hypothesis that X_t and Y_t are not cointegrated are discussed in Engle and Granger [1987, Pp. 251-276]. The first test is based on the Durbin-Watson statistic (DW) for equation (4), and tests, on the null hypothesis that U_t is I(1), whether DW is significantly greater than zero using the critical values provided in Sargan and Bhargava [1983, Pp. 153-174]. This is cointegration Durbin-Watson test (CIDW), and Banerjee *et al* [1986, Pp. 253-277] proposes a simple 'rule of Thumb' for a quick test of the cointegration hypothesis. If the CIDW computed for equation (4) is smaller than coefficient of determination (R^2) the cointegration hypothesis is likely to be false.

The second test of cointegration examines the estimated residuals U_t of equation (4) and this boils down to the test of the unit root of the residuals, which is discussed earlier.

Thus when two time series X_t and Y_t are integrated of order one and they are cointegrated, then the linear combination $Z_t = Y_t - Bx_t$ will be stationary. This shows the relation between cointegration and long-run equilibrium, because if economic theory suggests a long-run equilibrium between X_t and Y_t like $Y_t = Bx_t$, then Z_t measures the extent to which the system deviated from equilibrium and this is called 'equilibrium error' [Granger, 1986, Pp. 213-228]. When the long-run equilibrium relation is stable, B becomes unique and the values of Z_t (error) gives information about the dynamic nature of the relation. The impact of this on model specification can be had through a dynamic model, called the error correction model by the econometricians. The model is set up as follows:

$$DX_t = Ae_{t-1} + \sum_{1}^{k1} \alpha_i DX_{t-1} + \sum_{1}^{m1} \beta_j DY_{t-j} + U_{1t} \qquad \text{....(5.1)}$$

$$DY_t = Be_{t-1} + \sum_{1}^{k2} \alpha_i DX_{t-1} + \sum_{1}^{m2} \beta_j DY_{t-j} + U_{2t} \qquad \text{....(5.2)}$$

Where e_{t-1} is the lagged error estimated from the cointegration regression (4) and at least one of A, B #0, and K_1, K_2, m_1 and m_2 are optimal lag structure in these equations, while D is the first difference operator.

Granger [1981, Pp. 121-130] pointed out the relationship between error correction model and cointegration. The so-called Granger Representation Theorem [Granger, 1983] shows that a cointegrated series can be represented by error correction model [Engle and Granger, 1987, Pp. 251-276]. The error-correction models are supposed to give better short-run forecasts as well as long-run ones [Granger, 1986, Pp. 213-228]. The implication is that once the cointegration test is done, the resulting information can be used for subsequent specification of the model.

The test of cointegration is also done by another type of test, called the restricted vector autoregression (RVAR) test, which required the estimation of the following equations:

$$DY_t = b_1 \hat{e}_{t-1} + U_{1t} \qquad \text{....(6.1)}$$

$$DX_t = b_2 e_{t-1} + aDY_t + u_{2t} \qquad \text{....(6.2)}$$

(Here also D is the first difference operator)

To test the null hypothesis of no co-integration the required 'test-statistics' is calculated as the sum of the squares of the t-statistics of b_1 and b_2 or

$$T^* = \left(\frac{T^2}{\delta_1} + \frac{t^2}{\delta_2}\right)$$

If T* is statistically significant, we reject the null hypothesis of no cointegration.

The knowledge of cointegration enables us to do another type of test in econometrics and this is the causal relation between the two time series. When the two time series X_t and Y_t are proved to be stationary or I (o), the model can be estimated for the test of causality [Sims, 1972 Pp. 540-552; Granger, 1969, Pp. 24-36]:

$$Y_t = a_0 + \sum_{1}^{m1} a_i X_t - (i-1) + \sum_{1}^{m1} b_j X_{t+j} + V_1$$

$$Y_t = C_0 + \sum_{1}^{m1} C_i X_t - (i-1) + V_2$$

$$X_t = d_0 + \sum_{1}^{n1} d_j Y_t - (i-1) + \sum_{1}^{n2} h_j Y_{t+i} + u_1$$

$$X_t = q_0 + \sum_{1}^{n1} a_j Y_t - (i-1)$$

Here both X and Y represent the economic variables we deal with in this study. The forward and backward lag structure are taken following the standard literature [Chow, 1987, Pp. 55-61]. The stochastic terms V and U have their usual normative properties, that is, both are normally distributed with zero mean and constant variance. The implications of the lag structure are as follows: The prediction of Y from current and past X's would not be improved if future values of X's are included. In other words, one can regress the variable X, and if causality runs from X to Y only, future values of X in the regression estimate should have coefficients, insignificantly different from zero as a group. In order to test the hypothesis that coefficients for future values of the independent variables are jointly equal to zero, F-statistics are calculated as per standard literature [Chow, 1987, Pp. 55-61] and the calculated values of the F-statistic are then compared with the critical values in the table.

3. Data, Methodology and Empirical Result:

The analysis of cointegration in time series econometrics points to the limitations of the use of stochastic time series of economic variables in the analysis of economic theories.[3] In our pursuit of using the available tools in this new area we have taken the period 1973-1991 as the reference period in our study.

The quarterly data for the macro variables (except income and black market exchange rate) are collected from various issues of *International Financial Statistics* [IMF]. The quarterly data of nominal income is derived from annual figures with the help of standard statistical procedure [Boot *et al*, 1967, Pp. 65-75].[4] The data on black market exchange rate are collected from *Pick's Currency Year Book*, which provides information about the market rate of the value of the currencies quoted in New York money market. The authencity of this source is well accepted in the literature. All the data are in Tables 8 and 9.

The quarterly data are subjected to seasonal effects. The latter effects are removed with the help of filters available in standard econometric packages.[5] For most of the results in this study, ordinary least square technique has been used. The Cochrane - Orcutt method has been applied whenever necessary to take care of the possible effects of autocorrelation in the residuals of the estimated equations.

a) Unit Root Test: From Table 2 we see that while the critical value of the t-statistic is 2.98 at 1 per cent level of significance (minus sign being omitted), the ADF test given t-statistics for both official exchange rate and black market exchange rate are much smaller. Thus the null hypothesis of non-stationarity cannot be rejected. The DF test gives sharply different result in this case, but we reject this result in favour of the ADF test as per standard literature [Engle and Granger, 1987, p. 269]. When the existence of the unit root is established, the order of the integration is to be found out. Thus the same ADF test is applied on the first differences of both the variables, that is, the official rate and the black market exchange rate. We find from the results in table 3 that the coefficients of the first differences of the variables are significant and negative. Thus the t-statistics are negative and compared to the critical value of -2.98 at 1 per cent level of significance (for a sample size 75), its value is much higher. So the

null hypothesis of non-stationarity is rejected. Thus the first differences are stationary which indicates that the series of official rate (ER_t) and black market rate (BMR_t) are I(1), but their first differences are I(0). A look at the figure 3 showing the first difference of both the series confirms the result. Both the curves show no specific trend in showing the movement of the two series.

b) Cointegration test: One interesting aspect of the co- movement of both the rates is to see whether cointegration exists between the two variables. Four separate tests are applied and these are - CRDW, DF, ADF and RVAR. The relevant test statistics are 0.26, -2.177, -1.396 and 55.09, respectively. Except in the case of RVAR, the estimation of which is given in Table 5, all other test statistics are too small to reject the null hypothesis of no cointegration. Only the test statistic of RVAR is significantly higher than the critical value of 37.2 at 1 per cent level of significance. Though the result is mixed, we can accept the conclusion of the first three test and conclude that the two variables, ER_t and BMR_t are not cointegrated.

The lack of sufficient evidence in favour of cointegration implies that the construction of error correction model (ECM) is not meaningful. As if to test the result of RVAR (confirming cointegration) we have built up the ECM and the estimation is presented in Table 6. Looking at the poor values of adjusted R^2 and the relevant t-statistics of the estimated coefficients we see that both the equations are poorly fitted. This poor result confirms the lack of cointegration between ER_t and BMR_t. This econometric evidence further shows that the possible theoretical connection between the two exchange rates, which can be established through the monetarist framework, is atleast weak in Indian context. Even then another interest remains and it is the possible causal relations between the two variables. This aspect is worth exploring, and it is done in the next section.

4. Causality:

The model on causality, as explained earlier, has been estimated taking the first differences of logarithm of both the variables and the relevant F-statistics are calculated corresponding to the different lag structure. The first differences are taken because both the series are proved to be stationary only in the first differences. The details of the result (both F-statistic and final prediction error i.e., FPE) are reported in Table 7. Only one lag structure is reported as the variation in the lag structure does not improve the final prediction error, these are not reported in the table. We find uni-dimensional causality, that is, from official rate to black market rate with a lag structure 5. Thus we find that in the period of our study, that is during the period 1973-1991, the changes in the official exchange rate has caused the changes in the black market rate. The downward adjustment of the rupee *vis-a-vis* U.S. dollar based on the estimation of currency basket has not helped in the reduction of the gap between the official rate and the black market rate. This is clear in the figure 2 also. The movement of the two rates continuously upwards shows the depreciation of the currency over time. The statistical result merely established the fact that the depreciation in the official rate has induced the depreciation of the black market rate which is a strange result so far as macroeconomic stabilisation policies are concerned. An over-valued domestic currency encourages the inflow of foreign exchange through unofficial channel, which help in the flourishing of the black market in the foreign exchange. Though the official rate exhibited considerable flexibility during the period the operation of the black market was not abated inspite of the fact that the flexibility ought to have encouraged the inflow of foreign exchange through the official channel.

The premium of the black market rate depends on (i) the deviations of the official rate from the purchasing power parity and (ii) profitability in illegal trade in items which are not officially allowed. While flexibility in the official rate can remove (i), the second factor remains to maintain the gap between the two rates.

To supplement the result on causality the first differences of logarithm of black market exchange rate is regressed on the first differences of logarithm of the official exchange rate and the estimation obtained is as follows:

$$D\log BMR_t = \underset{(0.537)}{0.0056} + \underset{(2.92)}{0.728}\, D\log ER_t + \underset{(0.182)}{0.047}\, D\log ER_{t-1} + \underset{(0.365)}{0.112}\, D\log ER_{t-2} + e$$

Adjusted $R^2 = 0.09$ SEE = 0.348

D W statistic = 2.24 N = 70

(Figures in parentheses are t - values)

Here D is the first difference operator. The result shows some amount of support in the conclusion based on causality analysis, as the coefficient of D log ER_t is significant even at 1 per cent level. Thus the variations in the official rate influences the variation in the black market rate directly and in a significant way. The coefficients of the lagged values of ER are not significant showing the non-existence of their effects.

In brief, we find that both the time series on official exchange rate and black market rate (after deseasonalising both) have unit roots and the first differences of the series are stationary. The cointegration analysis shows that the series are not cointegrated. This is also reflected in the results of the error correction models, as the coefficients are mostly not significant. Taking the first differences in the logarithm we run the causality test and it reveals that causal relation from official exchange rate to black market rate remains.

Conclusion:

In the context of the model showing the equilibrium relation between the official and black market exchange rate of a currency we have described the cointegration approach to explain empirically the relationship between the two exchange rates of the Indian rupee. As lack of cointegration does not deny equilibrium relation as pointed out earlier, a causality test has been done. The result shows the unidimensional causality from official exchange rate to black market rate of rupee.

In a controlled foreign exchange regime, market mechanism is not allowed to function and this leads to a market situation where distortions (mainly to evade the laws) emerge and the speculations also become important. The results are the fluctuations of the prices. If we see Figure 3, we find that the first differences of the black market rate show higher degree of fluctuations compared to the first differences of official rate. The latter being pegged to a basket of currencies shows smaller fluctuations, while the former absorbs the full thrust of the market forces.

India has been following a deficit-finance induced growth process since the second five-year plan and the same process continued in the post-1970 period. Thus money supply increased steadily along with price level. We find that while money supply (M1) and money income increased steadily in the post 1973 period, real income did not register significant growth. This is evident from figure 5.

An increase in money supply through deficit financing releases two forces: (i) it puts upward pressure on the price level by increasing demand and (ii) it helps capacity creation also by the same force of demand. While the first has happened in India, the realisation of the second is a controversial one. In several countries including India government expenditure has been relied on as a supplementary source of the generation of aggregate demand. This process has also been supported in the literature on the ground that in a poor economy demand constraint creates bottlenecks in industrialisation and an increase in government expenditure can ease these bottlenecks. While the controversy continues, the result is a mixed one.[6] From the figure 5, we find that the real income growth is too small compared to the growth of money income. In other words, the growth of money supply in India has failed in its objectives of inducing growth in the real income,[7] but the resultant inflation has cast its shadow on the price structure at the international level, that is, the exchange rate of the rupee. While growth of money supply (M1) and real income are not related to each other (Figure 7), the steady increase in the price level has been associated with an incipient depreciation of the currency. The latter aspect is shown in figure 6. Even the incipient depreciation of the Indian rupee did not corroborate to the movement of the relative price, the latter being defined as the ratio of domestic price level (CPI) to foreign price level. Here the U.S. price level is used as a proxy of the foreign price level. From figure 4 we find that the depreciation of the rupee more than compensated the domestic inflation compared to world inflation during the period 1978-1986 and 1989-1991.[8] Though the period experienced greater flexibility in the official exchange rate, the black market rate showed consistent premium which cannot be explained simply by economic factors. Perhaps government policies having bearing on other factors (like smuggling of gold, etc.) will help in the stabilisation of the exchange rate of the rupee in the future period when the rupee is allowed to have an exchange rate determined by the market mechanism.[9]

The growth process of the last two decades in

the Indian economy has experienced a moderate dose of inflation and a slow rate of growth of real income. In this perspective the analysis of the movement of the exchange rates of the rupee is carried out in this paper. One policy implication of this note is that, in the new free market situation, where the rupee does not have any official rate, a prudent control of money supply *vis-a-vis* the growth of real income will make the exchange rate of rupee stable in its movement in the free market. While the control on money supply requires a reduction in the budget deficit, an improvement in the balance of trade becomes the imperative so that the country's international reserve can be kept at a satisfactory level. The latter gives the strength to the exchange rate of the currency. A consistently strong currency will eliminate the premium in the black market exchange rate.

TABLE 1. CORRELATION AMONG THE MACRO VARIABLES: CORRELATION MATRIX: 1973-1982

	BMR	ER	RY	CPI	FPL	M1	TR
BMR	1						
ER	0.756	1					
RY	0.69	0.5	1				
CPI	0.741	0.54	0.854	1			
FPL	0.695	0.473	0.941	0.965	1		
M1	0.724	0.546	0.955	0.917	0.951	1	
TR	0.711	0.41	0.95	0.932	0.98	0.938	1

Period 1983-1991

	BMR	ER	RY	CPI	FPL	M1	TR
BMR	1						
ER	0.865	1					
RY	0.756	0.934	1				
CPI	0.76	0.937	0.853	1			
FPL	0.815	0.973	0.94	0.97	1		
M1	0.818	0.982	0.95	0.964	0.99	1	
TR	0.758	0.954	0.936	0.953	0.976	0.981	1

Note: The definitions ae as follows:
ER: Official exchange rate; BMR: Black market rate; RY: Real income; CPI: Domestic price level; FPL: Foreign price level; MI: Money stock; TR: Total reserve

TABLE 2. UNIT ROOT TEST: T - STATISTICS

Test	Official Exchange Rate	Black Market Rate
DF	4.714	3.315
ADF	1.864	1.947

Source: Charemza and Deadman (1992) critical value at 1 per cent level of significance is 2.98

TABLE 3. INTEGRATION OF THE SERIES:

1. Official exchange rate:

$$D^2 ER_t = 0.17 - 0.688\ D\ ER_{t-1} + e$$

t - statistics (2.23) (-6.11)

2. Black market rate:

$$D^2 BMR_t = 0.308 - 0.8097\ BMR_{t-1} + e$$

t - stat (2.30) (- 6.95)

=> Both ER and BMR are I(o), but the series at their levels are I (1).

Here D^2 is the second difference operator, while D is the first.

TABLE 4. CO-INTEGRATION TEST BETWEEN OFFICIAL EXCHANGE RATE AND BLACK MARKET RATE HO: NO COINTEGRATION

Tests	Test-statistic	Result
CIDW	0.26*	Fail to reject
DF	- 2.177	Fail to reject
ADF	- 1.396	Fail to reject
RVAR	55.09**	Reject

* Here R = 0.92 and CIDW < $\bar{R}^2$ (adjusted R^2)
** 1 per cent critical value for T is 37.2
The critical value of t- statistics is -2.98 (1 per cent level of significance)

TABLE 5. RESTRICTED VAR MODEL ESTIMATION: OFFICIAL AND BLACK MARKET EXCHANGE RATE

1) $D\,BMR_t = 0.1875\ u_{t-1}$
t - statistics (1.585)

2) $D\,ER_t = 0.078\ u_{t-1} + 0.39\,D\,BMR_t + e$
t - statistics (-1.45) (7.251)

Test statistic: $= [\,(1.585)^2 + (7.251)^2\,] = 55.089$

TABLE 6. ERROR CORRECTION MODEL: OFFICIAL EXCHANGE RATE (ER) AND BLACK MARKET RATE (BMR)

Independent Variables	Dependent variable (ER)	Dependent variable (BMR)
U_{t-1}	-0.024	0.049
	(-0.644)	(0.663)
$D\,ER_{t-1}$	0.286	0.248
	(1.91)	(0.544)
$D\,ER_{t-2}$	0.121	0.776
	(0.823)	(1.734)
$D\,ER_{t-3}$	0.294	-0.364
	(2.03)	(-0.830)
$D\,ER_{t-4}$	0.048	-0.438
	(0.333)	(0.996)
$D\,BMR_{t-1}$	0.028	-0.020
	(0.567)	(-0.131)
$D\,BMR_{t-2}$	-0.008	-0.074
	(-0.166)	(-0.487)
$D\,BMR_{t-3}$	-0.272	-0.036
	(-1.434)	(-0.236)
$D\,BMR_{t-4}$	-0.015	-0.107
	(-0.302)	(-0.710)
Adjusted R^2	0.003	-0.053
D.W.	2.01	1.87
SEE	5.09	47.00
n	63.00	63.00

Figures in parentheses are t - statistics of the coefficients. Here D is the first difference operator.

TABLE 7. SIM'S TEST OF CAUSALITY BETWEEN OFFICIAL EXCHANGE RATE (ER) AND BLACK MARKET EXCHANGE RATE (BMR) (PERIOD: 1973 - 1991)

	HO: BMR does not cause changes in ER			HO: ER does not cause changes in BMR			
Lag Structure	F-Ratio	Result	FPE	F-Ratio	Result	FPE	Causal Inference
5	0.2651 (4,47)	fail to reject	.00099	10.379 (5,46)	Reject HO	.00737	ER-->BMR

The figures in the parentheses under F - value shows the degrees of freedom (v_1 v_2)
FPE is the final prediction error
Some relevant F - values:

$F_{.05;4,47} = 2.57$ $F_{.05;5,46} = 2.38$

TABLE 8. DATA ON MACRO VARIABLES - 1973 - 1991

Year	Lending Rate	Exchange Rate	Price Level	M1 Rs (Billi.)	Quasi Money Rs (Billi.)	Foreign Price Level	National Income Rs (Billi.)	Black Market Rate
1973	4.53	7.589	116.00	92.49	49.71	110.70	124.25	9.73
	5.61	7.272	125.00	98.26	53.91	113.10	132.33	9.07
	5.25	7.773	132.00	97.37	57.78	115.60	140.47	8.85
	11.15	8.130	139.00	101.85	61.58	118.30	148.31	9.33
1974	15.00	7.767	145.00	107.88	61.18	121.60	161.46	9.50
	15.00	7.798	158.00	115.01	64.27	125.00	163.59	8.82
	12.79	8.058	173.00	109.39	68.16	128.90	168.17	9.97
	12.02	8.078	178.00	112.27	70.46	132.60	166.97	8.95
1975	12.07	7.794	174.00	115.36	71.85	135.00	169.88	8.67
	11.79	8.354	175.00	121.77	75.55	137.10	173.05	10.28
	6.83	8.961	173.00	118.76	80.24	140.10	176.21	9.82
	6.40	8.937	168.00	122.33	83.54	142.30	179.37	9.63
1976	6.32	8.973	157.82	127.11	87.89	140.00	182.77	10.15
	6.40	8.987	157.12	136.61	96.35	141.75	187.06	10.35
	6.50	8.787	161.99	142.37	96.66	143.91	192.11	10.63
	12.50	8.881	165.30	152.77	104.58	145.53	196.06	10.40
1977	12.50	8.804	168.08	156.52	106.63	148.10	205.21	10.28
	10.70	8.807	171.91	163.78	116.67	151.34	209.37	9.90
	9.30	8.682	177.83	164.62	122.01	153.50	213.14	9.78
	9.30	8.209	178.87	178.50	128.17	155.25	216.47	9.65
1978	9.33	8.433	174.52	186.27	130.30	157.82	221.49	9.40
	7.55	8.249	174.57	188.72	144.66	162.00	226.72	9.60
	6.99	7.959	179.92	182.81	159.05	165.78	231.77	10.13
	8.32	8.188	183.27	200.95	169.14	169.02	236.61	9.60
1979	8.50	8.150	179.39	165.19	219.39	173.34	241.64	9.70
	8.39	7.973	184.27	176.89	233.28	179.28	247.46	9.95
	8.49	8.032	194.53	170.66	244.88	185.22	254.80	10.17
	8.48	7.907	200.10	176.86	260.49	190.62	260.40	9.28
1980	8.50	8.193	201.14	190.42	260.26	198.05	280.22	8.92
	8.31	7.799	206.54	193.03	277.49	205.20	292.94	8.82
	6.25	7.749	215.76	187.07	289.17	208.98	306.07	8.58
	5.91	7.930	221.15	204.58	302.29	214.52	318.84	8.20
1981	7.90	8.190	225.68	220.24	312.24	216.95	326.35	13.65
	7.97	8.681	234.73	227.81	333.96	221.40	338.75	14.02
	8.60	9.107	245.17	218.05	346.14	225.32	351.48	14.44
	9.98	9.099	249.69	232.85	359.67	229.23	362.85	14.43
1982	10.00	9.346	236.09	234.90	364.99	227.16	376.10	14.69
	9.01	9.542	239.11	251.87	380.30	230.52	390.47	14.88
	4.98	9.671	250.17	242.68	399.12	234.88	405.63	15.01
	5.07	9.634	255.00	273.71	424.04	235.48	422.05	15.64
1983	8.80	9.970	257.21	273.06	426.26	235.28	439.10	16.65
	9.17	10.070	268.47	288.73	451.67	238.25	458.52	16.08
	7.18	10.204	282.55	279.47	474.35	241.02	475.60	16.21
	8.05	10.493	288.38	308.55	507.03	243.20	495.50	16.63
1984	9.99	10.707	289.18	317.92	507.46	245.77	488.13	18.05
	9.94	11.186	219.39	345.23	540.20	248.55	505.63	16.99
	9.89	11.891	302.45	332.41	555.30	251.32	523.41	17.63
	10.00	12.451	305.07	363.32	591.22	253.10	538.82	18.19
1985	10.00	12.430	302.25	382.12	598.38	245.69	556.22	18.44
	10.00	12.432	309.29	405.62	638.92	257.85	573.79	18.44
	9.99	11.991	318.34	378.20	664.84	259.64	590.96	18.00
	10.00	12.166	323.97	412.41	712.30	262.01	608.27	18.04
1986	10.00	12.287	326.59	418.92	715.82	262.61	625.21	18.29
	10.00	12.533	335.44	450.12	769.52	262.01	644.69	18.54
	9.98	12.690	346.50	436.81	786.94	263.99	661.81	18.70
	9.89	13.122	354.94	478.67	847.68	265.38	678.63	19.53

(Contd.)

TABLE 8: *(Concld.)*

Year	Lending Rate	Exchange Rate	Price Level	M1 Rs (Billi.)	Quasi Money Rs (Billi.)	Foreign Price Level	National Income Rs (Billi.)	Black Market Rate
1987	9.98	12.928	354.1371	490.85	858.58	268.35097	684.1311	19.60
	9.89	12.934	362.5833	481.25	911.20	271.91578	721.7013	18.94
	9.77	13.101	379.0735	501.19	937.70	274.88646	759.6538	17.77
	9.69	12.877	387.9219	543.17	999.61	277.26300	793.6050	16.21
1988	16.50	12.954	373.6428	553.10	1004.90	274.82130	829.5823	16.29
	16.50	14.110	383.9210	593.50	1072.10	278.13240	864.4427	17.45
	16.50	14.565	397.8268	576.60	1114.20	281.95290	896.8594	17.90
	16.50	14.949	409.3142	632.80	1192.20	284.75460	927.8781	18.95
1989	16.50	15.632	401.7567	682.10	1225.00	288.06570	956.7342	19.37
	16.50	16.531	409.9188	680.40	1262.70	292.65030	988.6621	20.54
	16.50	16.675	422.6154	702.10	1327.80	295.19730	1016.5887	20.68
	16.50	17.035	426.8476	746.90	1365.10	297.99900	1043.8519	21.57
1990	16.50	17.227	425.9407	785.40	1443.60	303.09300	1103.7078	21.90
	16.50	17.453	442.8695	817.10	1469.80	306.14940	1157.5526	21.85
	16.50	18.068	461.6121	825.30	1546.60	311.49810	1208.3100	25.05
	16.50	18.073	479.4478	853.60	1576.70	316.59210	1259.4777	25.01
1991	16.00	19.620	490.0283	905.80	1633.10	319.13910		29.23
	17.00	21.190	498.1904	926.40	1646.80	320.92200		30.94
	18.50	25.763	528.1181	949.80	1787.40	323.46900		35.11
	20.00	25.834	545.0469	1040.00	1815.40	326.01600		35.84

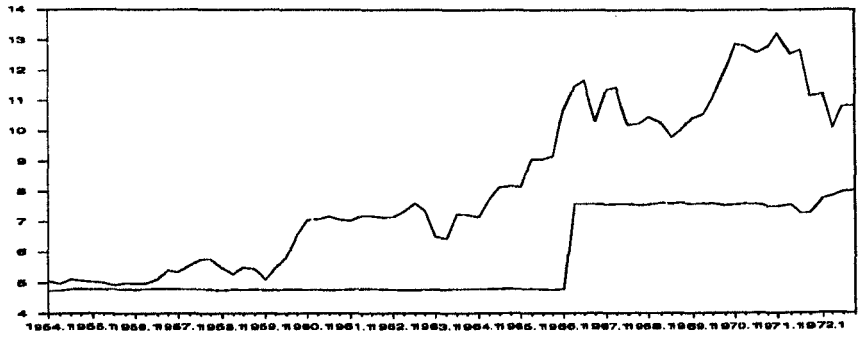
TABLE 9: OFFICIAL AND BLACK MARKET EXCHANGE RATE OF INDIAN RUPEE: 1954-1972

(Rupee value of US Dollar)

Year	Official Rate	Black Market Rate	Year	Official Rate	Black Market Rate
1954.1	4.75	5.07	1963.1	4.78	6.50
2	4.75	4.97	2	4.78	6.45
3	4.79	5.11	3	4.79	7.25
4	4.81	5.07	4	4.79	7.23
1955.1	4.78	5.03	1964.1	4.79	7.15
2	4.78	5.00	2	4.80	7.72
3	4.79	4.92	3	4.81	8.13
4	4.78	4.99	4	4.80	8.18
1956.1	4.78	4.97	1965.1	4.79	8.14
2	4.79	4.97	2	4.80	9.07
3	4.81	5.11	3	4.78	9.07
4	4.80	5.41	4	4.77	9.17
1957.1	4.80	5.35	1966.1	4.79	10.67
2	4.79	5.56	2	7.58	11.47
3	4.79	5.76	3	7.58	11.67
4	4.78	5.77	4	7.58	10.32
1958.1	4.75	5.48	1967.1	7.56	11.37
2	4.78	5.28	2	7.58	11.43
3	4.77	5.50	3	7.58	10.20
4	4.78	5.45	4	7.55	10.25
1959.1	4.76	5.09	1968.1	7.56	10.47
2	4.76	5.46	2	7.62	10.30
3	4.78	5.81	3	7.59	9.80
4	4.78	6.57	4	7.63	10.03
1960.1	4.77	7.05	1969.1	7.58	10.43
2	4.77	7.08	2	7.59	10.55
3	4.76	7.17	3	7.60	11.08
4	4.77	7.07	4	7.54	12.00
1961.1	4.78	7.02	1970.1	7.56	12.87
2	4.80	7.19	2	7.59	12.82
3	4.80	7.19	3	7.58	12.60
4	4.78	7.14	4	7.50	12.78
1962.1	4.77	7.15	1971.1	7.50	13.22
2	4.76	7.32	2	7.56	12.55
3	4.76	7.60	3	7.28	12.67
4	4.77	7.35	4	7.28	11.15
			1972.1	7.77	11.23
			2	7.84	10.10
			3	7.98	10.80
			4	8.05	10.85

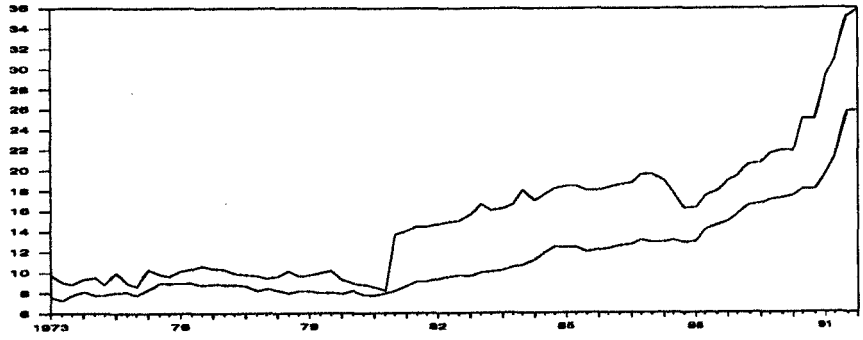
Source: IMF and Pick's Currency Year Book.

FIGURE. 1. OFFICIAL EXCHANGE RATE AND BLACK MARKET RATE: 1954-72



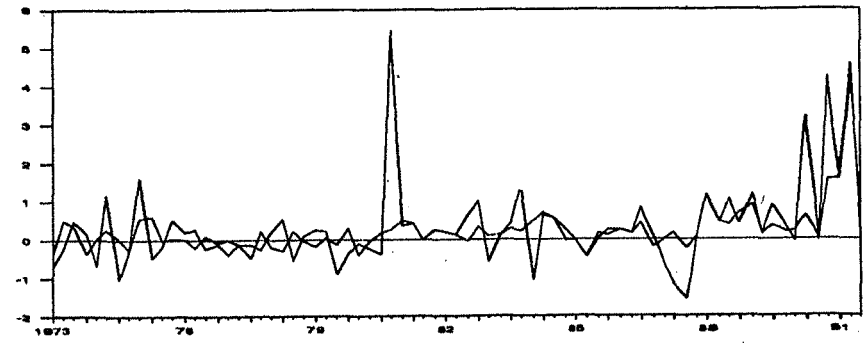
Upper curve Black Market Rate; Lower curve Official Rate

FIGURE 2. OFFICIAL EXCHANGE RATE AN BLACK MARKET RATE: 1973-91



Upper curve Black Market Rate; Lower curve Official Rate

FIG. 3. FIRST DIFFERENCE OF OFFICIAL EXCHANGE RATE AND BLACK MARKET RATE: 1973-91



Upper curve black market rate; Lower curve Official Rate

FIGURE 4. EXCHANGE RATE AND RELATIVE PRICE (CPI/FPI)

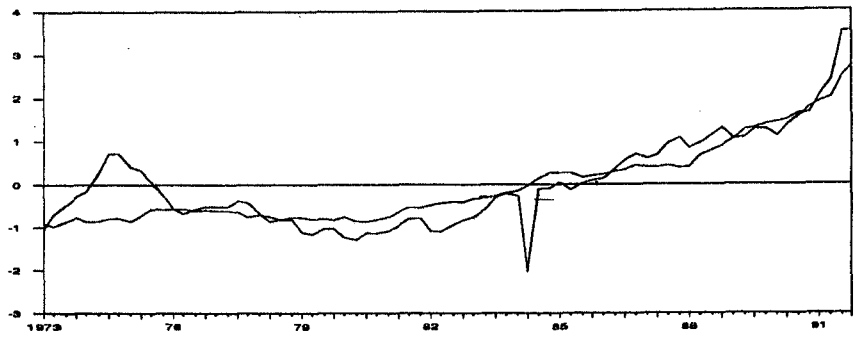
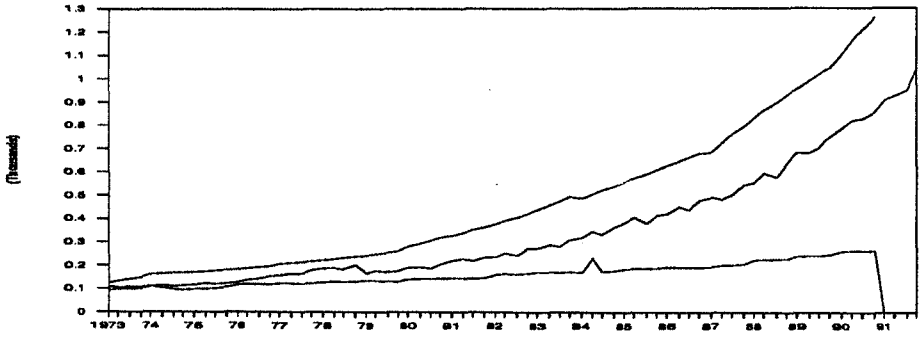


FIGURE 5. NOMINAL INCOME MONEY (M1) AND REAL INCOME: 1973-90



Upper curve Nominal Income; Middle curve Money; Lower curve Real Income

FIGURE 6. EXCHANGE RATE AND PRICE LEVEL IN INDIA 1973-91

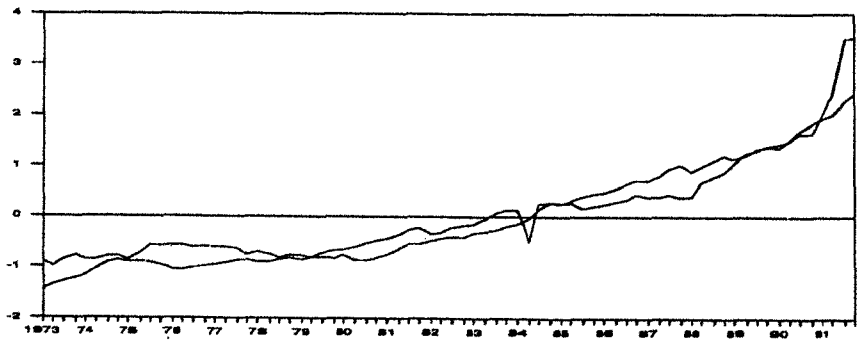
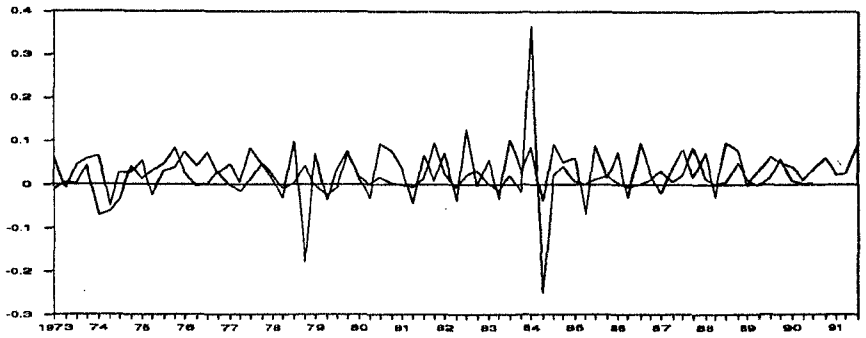


FIGURE 7. GROWTH RATES OF MONEY AND REAL INCOME: 1973-91



NOTES

1. Dickey and Fuller [1979, Pp. 427-431] show that the so-called t- statistic, which is derived by deviding the value of the estimated coefficient of Y_{t-1} by its standard error does not have a *Student-t* distribution, even in the limit as sample size becomes infinite. The distribution of this statistic is published in Dickey *et al* [1986, Pp. 12-26]. As for example, the selected percentiles show that for a large sample, using a 0.05 significance level would require a critical t* value of -2.86, rather than - 1.96 for the normal approximation to Student - t.

When the null hypotheses (Ho: X_t is having a unit root) cannot be rejected, we take the first difference of the X_t series and if the first difference of the series X_t is not having unit root, by the same test, then DX_t or first difference is stationary or we say it is integrated of order one, or X_t I(1). Thus the order of integration shows the number of times the series is to be differenced to get the stationary series.

2. As an example Taylor on the basis of his cointegration analysis, failed to find cointegration between the nominal exchange rate and the relative prices for any of the countries examined in his study, and the results thus became extremely unfavourable to the purchasing power parity doctrine Taylor, 1988, Pp. 1376-77]. But this results cannot negate the theoretical hypothesis about long-run relation between exchange rate and relative prices.

3. Economic time series are often characterised by stochastic trend, which may be the result of exogeneous variables not captured within the model. This aspect along with the fact that analysis is based on the sample size points to the possibility that inference drawn from the reported regression is not because of the relation of the two series as examined but because of other variables which remain in the backgrotnd. Thus the result becomes misleading. Herein lies the importance of ensuring the stationarity of the series before using these for any regression. The analysis of cointegration brings this issue in sharp focus [Charemza and Deadman 1992, ch. 2]

4. Boot *et al.* [1967, Pp. 65-66] suggested that a reasonable procedure for generating a monthly or quarterly series, given only a set of annual totals, is to choose values for the estimated series such that the sum of squares of either the first or second differences of successive quarterly values is minimised.

When the sum of the squares of the differences between the successive quarterly values is minimised, a continuously rising trend does not give a continuously rising straight line, but a line whose slope tapers off in the first and last year, so as to form a long stretched 'S' sign. To remedy this, they introduce a criterion of minimising the sum of squares of second differences.

$$\sum_{i=2}^{4n}(X_i - X_{i-1})^2, \text{ where } X_2 = X^1 + 1 - X_1$$

subject to the constraint

$$\sum_{i=4k-3}^{4k} X_i = t_k (K = 1, 2, \ldots..n)$$

5. In a multiplicative time series model, quarterly values are supposed to contain seasonal effects. A suitable ratio to moving average method in a multiplicative model can determine the individual seasonal effect of each quarter. Once these are determined, the data can be adjusted to remove these effects. The econometric software proceeds the problem in the same way.

6. Assuming that economic growth is constrained by inadequate demand, economists argue for larger government expenditure even financed by deficit financing as that would help the expansion of demand [See Rakshit, 1987, and Chakraborty, 1993, p. 378].

7. To have a precise idea about the relationship the following regression was estimated, when RRY is the rate of growth of real income and RRM is the rate of growth of money supply (M3):

RRY = -0.005 + 0.482 RRM + e
(-0.358) (1.685)*

Adjusted R^2 = 0.0275 SEE = 0.237
F - statistic = 2.84 N = 66
* significant at 10 per cent level.

The result fails to establish any relation between the two (.)

8. In brief, this means the official exchange rate (ER) does not corroborate to the purchasing power parity doctrine. The following estimation shows this:

ER_t = 0.759 (CPI/FPL) + e
(1.085)

Adjusted R^2 = 0.99 SEE = 7.32
D.W. Statistic - 1.52 n = 69

The coefficient is not significant as the t-statistics shows. (FPI. is the price level of the U.S.A.).

9. A look at Table 1 reveals that higher values of the correlation coefficients in the second period, 1983-1991, are more pronounced in the first two columns which are connected with two exchange rates. The same period is also characterised by greater flexibility of both official and black market exchange rates. While the full explanation of this phenomenon itself requires a separate study, we mention the economic scenario briefly. Since early eighties, some relaxations were allowed in the industrial sector and there were some minor reforms in the money market too. Industrial sector enjoyed a steady rate of growth and relaxation of control on the imports of certain items encouraged higher consumption. While official exchange rate depreciated, to what extent this economic situation induced higher fluctuation of black market rate is difficult to answer. In this study of exchange rate movement we just report this phenomenon which has been revealed.

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POLITICAL ECONOMY OF EDUCATION IN INDIA
(An Analysis of Macro Economic Changes and their Impact on Education)

C. Upendranadh

This paper examines the priorities of the government for reform of the education sector in the context of structural adjustment programme. Growth of education in post-Independence India in terms of quantity and the expenditure pattern reveals that there is still an unfinished job in achieving minimum levels of education for all. The problematic issues identified are inadequate financing, uneven allocation of resources, high wastage, etc. An analysis of the data on education participation of population reveals that the poorer sections and females are deprived of education in the country. Current enrolment status also reveals that poorer sections of students are not in higher education levels in appreciable numbers. Corrective measures are necessary to protect the interests of the poor.

Human resource development in the form of education and health is a necessary condition for any economy to grow. Public investment on education and health by many countries, capitalist, ex-socialist and mixed economies testify the premium they had put on human resource development. Consequently, investing in human beings, education for all has become *sine qua non* for any developing society. In India, the government assumed the responsibility of providing education and health for all its population. This involves financial support from the government to the education sector, as it is perceived as a social good.

In recent years, especially in the eighties, many developing countries suffered from adverse balance of payments situation, increased foreign debt and large scale budget deficits. The corrective measures, sought along with IMF/World Bank financial assistance, involved drastic restructuring of expenditure pattern of governments. The basic presumption behind this reform programme is that markets make more efficient allocation of scarce resources, and that government intervention has risen a great deal, resulting in inefficiency in the resource allocation. The reform policies included devaluation of currency and reforms in trade, industrial and fiscal sectors. The fiscal sector reforms included cutting down and targeting of government subsidies to various sections, and pruning down wasteful expenditure of the government.

Evidence points out that in many countries, social service sectors have suffered most in this kind of restructuring process. India, had to undergo the stabilization and structural adjustment programme (SSAP) starting July 1991, due to the same problems mentioned above. The policy reforms enunciated, generated a lot of controversy in the country. Concerns were expressed on the sequencing of the reforms, impact on different sections of the population and various sectors of the economy.

With the new economic policy reforms, financing of education has come under scrutiny. The role of the government in education is questioned and it is feared that it will be severely curtailed. The objectives of equity and equality of educational opportunity have come under severe strain with the changing economic scenario. Thus an assessment is attempted of the education policy and inequality of education in India, across the regions and across socio economic groups. [See Upendranadh, 1993(a)]. The paper is divided into six sections. Section one presents the context of changes taking place in the education sector world wide. In section two, an overview of the education policy in India, and growth of education in the states of India during the post-Independence period is assessed. Section three touches briefly upon some issues relating to educational inequality and its measurement and a discussion on the data analysed in understanding educational inequality across economic sections. Section four presents the levels of education among different groups of population and the inequality of access to education. Section five discusses further inequality in levels of education by measuring mean level

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of education for each economic group of population. In section six the subsidies given for education are discussed.

I

THE CONTEXT OF CHANGE

The development literature in the eighties, especially from the World Bank, emphasized the role of education in development [World Development Report, 1992]. This is a marked shift from the decade of the seventies, when economic growth and development were measured in terms of per capita GDP. Education of girls is highlighted in recent times, '...as better educated women, who are more informed about the value of health care and personal hygiene, tend to be less affected by the absence of community health programmes and tend to use them more frequently...'. Evidence is presented on the role of a mother's education in determining child mortality, contraceptive use, etc. [World Development Report, 1992]. It also highlights the linkages between education and economic growth through improved labour productivity, entrepreneurship and innovation.

Paradoxically, education policy reforms assumed centre stage in the political and social spheres not only in India, but in many other countries during the same period. In the West, educational reform remained a priority in many countries, even at a time when a near world-wide economic recession had set in. The doubts expressed on the efficacy of the public school systems in the West, especially in the USA and UK, signal a change in the attitude towards education by the state. The basic reform strategies aimed at improving the efficiency and effectiveness of American schools, included drastic restructuring in terms of organization, decision making and information flows.

A Brookings Institute publication, while tracing some of the problems associated with the public schools and the school reform movements in the USA, advocated an 'educational choice' for equality and efficiency of the system [Chubb and Moe, 1990]. This approach of school reform attempted to provide an opportunity to parents and students to choose among different schools or school districts within the public sector [Levin, 1992, Pp. 279-285].

Democratic leadership of schools is seen as a hindrance to the efficiency of the system. A total restructuring of governance system of American education-from democratic to market control- is advocated [Bryk and Lee, 1992, Pp. 439-451]. While Chubb and Moe presented, some theoretical justification for 'educational choice' and supported opening of schools to the market, some experiments in the USA lent support for both federal and state to such a thinking. But these ideas stand on a weak theoretical as well as empirical base as demonstrated by some authors and, most importantly, reflect the sweeping conservatism in the USA.[1]

At the same time, economic reforms were initiated under the aegis of the IMF/World Bank in many third world countries, for stabilization and structural adjustment of their economies. These, it is feared, may turn out to be anti-poor especially with respect to the social sectors of education and health. Widening income disparities, withdrawal of state intervention in education and health and privatization of these services, would severely undermine the equality of opportunity in education in many third world countries which have mass illiteracy and poverty.

It is in this context, that an assessment of education in India is attempted. The National Policy of Education (NPE) of 1986 and its subsequent appraisals in 1991 and 1992, showed a commitment in India towards Universalization of Elementary Education (UEE). But many of the policy initiatives question the sincerity of the government toward UEE. The policy changes in education (starting with NPE of 1986) and in the economic spheres (initiated from July 1991) appear to synchronize with the sweeping trends of conservatism being witnessed worldwide.

The equity issues in the context of structural adjustment and its impact on educational sector are of importance for a country like India. The World Bank's recommendations on restructuring the education sector include, i) recovering the public cost of higher education and re-allocating government spending on education towards the level with the highest social returns (Primary); and ii) developing credit market for education, together with selective scholarships, especially in higher education [Shatrugna, 1993]. Opinions are divided on this issue. Differences are essentially

over the equity aspects of these policy measures [See Desai, 1992, Shatrugna, 1993, Sinha, 1993 and Vaidyanathan Ayyar, 1993]. This aspect will be discussed further in the paper.

At the same time, adjustment and its impact on the vulnerable sections - poor and unorganized- is feared to be adverse in the short run [Nayyar, 1993]. Thus, in both economic and educational sectors, poorer sections of the society are going to be adversely effected by the new economic initiatives.

To sum up, education reform in India is taking place at a juncture when conservative ideas are sweeping in many parts of the world. The ideas of market supremacy over government intervention is gaining momentum alike, both in developed and developing worlds, for similar reasons. Social sectors are seen as the culprits in the economic ills of these countries. Thus, the new conservative ideas on education and the economic front, have implications to the society, especially with respect to equity, distribution and social justice.

II

UNIVERSALIZATION OF ELEMENTARY EDUCATION- A MIRAGE? AN APPRAISAL OF PROGRESS OF EDUCATION SINCE INDEPENDENCE

How does one explain the inherent contradictions in the stated objectives of the government towards universal education, and its implementation? A document from Citizens for Democracy in 1978 titled *Education for our People: A Policy Frame work for the Development of Education (1978-87)* succinctly captures the contradictions in the educational policy and progress since Independence, as follows:

> 'The formal education system in India is now a gigantic enterprise with about 700,000 institutions, 3.5 million teachers, 100 million students and an annual expenditure of Rs 25,000 millions. And yet it hardly benefits the common people who are poor, or very poor. Most of them are still illiterate; a large portion of their children do not go to school, and most of those that do, drop out sooner rather than later. A very small minority does climb up, through the limited vertical mobility that the system provides, and is coopted into the system which is thus legitimized. But the main beneficiaries of the system (which overemphasizes secondary and higher education that receive about 60 per cent of the total educational expenditure) are the really rich and well to do classes who form the top 30 per cent of the income groups and who occupy about 70 per cent of the places at the secondary stage and about 80 per cent of the seats at the university stage. Besides, the system is not adequately related to the national needs and aspirations, is highly inefficient and wasteful, and has become greatly dysfunctional, especially in higher education. Nothing short of a major educational revolution can meet the challenges of the desperate educational situation which is becoming worse every year' [Desai, 1992, p. 12].

This observation, made in the seventies is valid even today as we shall see from the data presented in the ensuing pages.

Literacy Levels of Population

One finds a quantitative expansion of education in India since Independence (Table 1). The rate of literacy has increased to almost over 50 per cent. Increased school enrolment rates have contributed much to the growth in literacy as against removal of adult illiteracy. Also, there are considerable regional disparities in literacy levels, the central Indian states of Bihar, Madhya Pradesh, Rajasthan and Uttar Pradesh (referred popularly as BIMARU states) are far behind in literacy as compared to the rest of the country (Table 1). Of the twenty-four districts with literacy levels of less than 30 per cent in 1991, nine belonged to Bihar, six to Uttar Pradesh, four to Madhya Pradesh, and three to Rajasthan. Wide disparity across male-female literacy levels was also found even in the nineties. The female literacy levels were very low in the northern states as compared to the southern states. Of the seventy districts which had female literacy level of less than 20 per cent in 1991, nineteen belonged to

Rajasthan (two of them had below 10 per cent), seventeen each belonged to Bihar and Uttar Pradesh, and eleven to Madhya Pradesh.

Availability and Quality of Schools

The Fifth All India Educational Survey 1986-87 revealed that almost all the villages with over 1,000 population and rural population were covered with primary school/sections within walkable distance. [See NCERT, 1990; and Nambissan and Batra, 1989]. But 73 per cent of habitations with population of less than 300 did not have primary school facilities even at one kilometre distance. These were generally habitations populated by Scheduled Castes and Tribes. At the same time, about 29 per cent of primary schools were single teacher schools. These schools were obviously not conducive for good quality teaching as one teacher had to give attention to a large number of students. The pupil-teacher ratio at the primary stage in India was relatively high at 1:45. This also hindered the quality of education. Many schools in rural areas had poor infrastructure facilities for imparting quality education. For example, 13 per cent of all schools were without *pucca* buildings and less than 50 per cent of schools had drinking water and toilet facilities, etc. As regards middle schools, about 74 per cent of the villages had upper primary schools within the village or within three km distance.

Thus, educational provision upto the elementary level was incomplete even in terms of the physical availability of schools and infrastructure. Compared to the urban areas, rural schools were in a more deplorable condition.

School Enrolments

There was a substantial increase in enrolment in quantity terms at school education level. Primary enrolment increased from 20 million in 1951 to 97 million 1989-90. As a ratio of relevant age group population, the increase was from 38 per cent to 84 per cent. Gross enrolment ratio at primary level stood at 97 per cent in 1988.[2] But the growth rates of enrolment at school levels (primary and middle), were always less than that of higher education since Independence. Thus it can be inferred that in India higher education grew faster than primary education.

DECADAL GROWTH RATES OF ENROLMENTS AT DIFFERENT LEVELS

Decade	Primary	Middle	Secondary	Higher
1950/51 to 1960/61	6.2	8.0	9.2	9.8
1960/61 to 1970/71	5.0	7.1	8.6	12.6
1970/71 to 1980/81	2.6	4.5	5.0	5.6
1980/81 to 1988/89	3.3	5.1	6.9	5.5
1950/51 to 1988/89	4.3	6.2	7.4	8.5

Note: All growth rates are annual averages (per cent).
Source: Varghese and Tilak, 1991, Table 1, p. 5.

The educational participation among the Scheduled Castes (SC) and Scheduled Tribes (ST) who generally constituted the major portion of the poor, was much lower as compared to other groups. In 1986, SC students constituted 17.35 per cent of the total enrolled in primary classes (I-V), and ST, 8.07 per cent. At the middle school level, of the total enrolment, 14.94 per cent belonged to SC and 5.07 per cent to ST. Thus, these sections of the population were the most deprived from formal education. The statewise school enrolment for the latest period are presented in Table 2. There was a wide disparity across the states in enrolments. As a per cent of the relevant age group of population, the northern states had yet to achieve enrolment levels comparable with the southern states. It may be noted that in the Indian context, enrolment itself did not represent the real progress in education on account of irregular attendance, drop outs and stagnation. Substantial educational efforts have been wasted due to the problem of drop outs.

Drop Out Rates

Indian education is plagued with a high inci-

dence of drop outs at the primary stage. Even in 1986-87, nearly half of the enrolled students left school without completing their primary schooling. Table 3 presents drop out rates at the primary and middle stages in different states of the country for the year 1986-87. Drop out rates among girls were high as compared to boys at both the stages. There was also a wide disparity in the rates of drop out which reflected the quality and degree of educational efforts by different states. Kerala had the lowest drop out rate at the primary stage, while Bihar had the highest among both total and female students (Table 3). Although we do not have drop out rates by rural and urban areas, studies have shown higher drop out rates among the rural children. Also drop out rates among SC/ST students were high as compared to all students. As many as 59.20 per cent of SC and 74 per cent of ST students dropped out from school, before reaching class V [Nambissan and Batra, 1989, p. 63].

Higher Education

There has been an enormous growth in higher education in India. The decade of the eighties had witnessed a high growth in enrolment of both boys and girls (Table 2). Enrolments at higher educational levels in 1989-90 stood at 2.74 million for males and 1.32 million for females. As regards regional disparities, Bihar, Maharashtra, and Uttar Pradesh were the first three in enrolments at this level (Table 2). There had been a narrowing of the gap in disparity between males and females, in the recent period. Girls' enrolment as a per cent of total enrolment in 1989-90 was 32.48 while the same was 22.80 in 1972-73. These figures compared well with the ratio of girls enrolment at the secondary and middle levels, which were 32.28 and 36.72 per cent, respectively. Thus any drop out of girls from education, was essentially after the primary stage (here the ratio of girls enrolment to total was 40.67 per cent).

The educational enrolments at different levels thus became a distorted educational pyramid. Expansion of different levels of education was not even. This led to disproportionate allocation of resources to various levels of education. The colonial legacy had much to do with this kind of anomaly. The Asian model of education, had envisaged a balanced growth at different levels of education; the distribution of different levels of education was to be eighty:eighteen:two by 1980 [Tilak, 1988, p. 49]. But the reality by the end of the eighties was far from this. Table 4 presents the ratios at different levels of enrolment to the total enrolment in 1989-90. Almost all the states showed discrepancy in the ratios. In Bihar, higher education took a share of 11.5 per cent in the total enrolment. This reflects that higher education grew comparatively faster than primary education, especially so in educationally backward states. As seen earlier, the rates of growth of enrolment at higher education levels had always been higher than those at lower levels which reflected the distorted educational pyramid in the country.

Educational Finances

Educational growth essentially depends on the quantum of funds spent by the central and state governments. Since Independence, the expenditure on education in India has been increasing. But the increase is not commensurate with population growth and the large mass of illiteracy. Even as early as in the mid sixties, the Education Commission of 1964-66 (the Kothari Commission) had highlighted the inadequacy of funding in education and appealed for an increase in expenditure to at least six per cent of the national income. Expenditure on education as a percentage of GNP grew from 2.5 per cent in 1960 to 4.2 per cent in 1989-90 [Shatrugna, 1993].

There has been a decline in the central plan outlays on education during the five year plans. As a percentage of the total plan outlay in the First Five Year Plan, the educational outlay constituted 7.86 per cent; it came down to almost 3.6 per cent in the Seventh Plan. It is interesting to observe the actual amounts. At constant (1970-71) prices the expenditure increased from Rs 30.40 crore in the First Plan to Rs 254.00 crore in the Seventh Plan. An interesting point to observe is that, though there has been a sharp increase in the allocation for education from the Fifth Plan period to the Sixth and Seventh Plan

periods, the increase as a per cent of total plan outlays remained low. This is because of the general rise in the investment levels during these plan periods [Varghese and Tilak, 1991, p. 26].

OUTLAY ON EDUCATION OVER PLAN PERIODS

Plan Period	Outlay on Education (Rs Crore)		
	Current Prices	Constant Prices (1970/71)	As % of Total Plan
First FYP (1951-56)	153	304	7.86
Second FYP (1956-61)	273	526	5.83
Third FYP (1961-66)	589	966	6.87
Fourth FYP (1966-74)	786	764	5.17
Fifth FYP (1974-79)	912	585	3.27
Sixth FYP (1980-85)	2,945	1,088	2.70
Seventh FYP (1985-90)	8,560	2,540	3.70

Source: Varghese and Tilak, 1991, Op.cit., p. 26.

Along with the government expenditure, there is substantial amount of household expenditure going into education. NSS data on household expenditure on education over the years reveal that there is a decline in household expenditure on education as a percentage of GNP from 2.5 per cent in 1970-71 to 1.9 per cent in 1984-85 [Varghese and Tilak, 1991, p. 13]. This shows that the private expenditure in education is also slowly coming down with increasing expectations from the government to fulfil the needs of the people. Budget expenditure on education by the states in the recent year is presented in Table 5. It can be seen that Kerala spends about 33.6 per cent of its budget on education, followed by Tamil Nadu at 22.6 per cent. In terms of per capita expenditure on education, Himachal Pradesh stands first followed by Kerala, Jammu and Kashmir and Gujarat. Another feature observable from Table 5 is that of the total expenditure on education, plan expenditure constitutes a very small percentage as compared to non-plan expenditure. This means, much of the educational expenditure is recurring expenditure, and little is being spent on plan activities.

HOUSEHOLD EXPENDITURE ON EDUCATION IN INDIA

	Household Expenditure (Rs Crore)		As % of GNP
	Current Prices	Constant Prices(1970/71)	
1970/71	896	896	2.5
1975/76	1,253	844	1.9
1980/81	2,174	1,058	1.9
1984/85	3,667	1,308	1.9

Source: Varghese and Tilak, 1991, Op.cit., p. 13.

At an intra sectoral level also there is disproportionate allocation across primary, secondary and higher education levels. Intra sectoral allocation of education, shows a clear bias toward higher education (Table 6). Primary education expenditure remained, at around 35 per cent of the total with fluctuations until the Seventh Plan. This was, after an initial allocation of over 55 per cent in the First Plan. At the same time, the composition of unit cost indicates that in primary schools 95 per cent of expenditure per pupil goes as salary component. Less than 2 per cent at primary stage and 3 per cent at middle stage is spent on building, equipment, etc., [Nambissan and Batra, 1989, p. 61]. Thus it can be inferred that expenditure at primary level barely covers the recurring expenditure.

It is essential at this juncture to understand the

relations between central (federal) government and state (regional) governments in educational finances. Varghese and Tilak [1991] observe that '....The whole mechanism of federal-fiscal transfers has tended to work to the detriment of the weaker states'. Education is a concurrent subject in the Constitution, wherein central and state governments share the responsibilities. If we see the plan outlays on education in recent years, we find that much of the burden is on the state governments, wherein about 95 per cent of the expenditure at the elementary level is met by the states while the centre bears the rest. Even in higher education, there is a declining trend of central outlay.

CENTRE STATE SHARES IN EDUCATIONAL FINANCES, BY LEVELS OF EDUCATION IN FIVE YEAR PLANS (FYP)

(per cent)

	IV FYP 1969-74		VI FYP+ 1980-85		VII FYP 1985-90	
	Centre	States*	Centre	States*	Centre	States*
Elementary	2.4	97.6	6.4	93.6	5.5	94.5
Secondary	0.3	99.7	4.2	95.8	-	-
Univ/Higher	56.7	43.3	41.3	58.7	-	-
Total General**	29.3	70.7	18.3	81.6	31.8	68.2
Technical	53.4	46.6	44.3	55.7	32.3	67.7
Grand Total	32.9	67.1	22.3	77.7	37.4	62.6

Notes: - Not Available. * States and UTs. ** Includes all other levels of general education. + Actual Expenditure.
Source: Varghese and Tilak, 1991, p. 22.

The allocations by Finance Commissions to the states for education seem to be dependent on factors not related to the needs and aspirations of the states. The arbitrary criterion followed by various Commissions, it is argued, has resulted in educationally backward states losing out to the more vocal states [Varghese and Tilak, 1991, Pp. 23-24]. On final analysis, with more stringent fiscal measures applied to states, which have to bear a large portion of education expenditure, there is little or no space for the states to increase or re-organize the expenditure pattern on education.

Thus as a first step towards improving education, there is need to increase the overall allocation to education. Counterpoising expenditure on higher education with that of primary education, seems to be a ploy, to divert the attention of inadequate allocation to the education sector as a whole. This kind of policy approach would undermine the spirit of equality of educational opportunity, and democratization of education. Also it would reflect the group pressures exerted on the policy makers, especially from the vocal sections of the society. These issues will be further discussed in the paper at a later stage.

III

MEASUREMENT OF EDUCATIONAL INEQUALITY IN INDIA - A BRIEF REVIEW

The quantification of human capital would be an exercise to understand educational development of any nation. This would lead to the question of disparities in human capital formation and the policy measures in that direction. Harbison and Mayers [1964] study on inter-country comparison of human resource development is one of the pioneering studies that quantifies the human capital at the macro level. In an exercise of assessing levels of education of work force Psacharoplous and Arriagada [1986] observed that the mean level of education of work force in South Asia is very low, compared to the other regions of the world. It was observed that, in India the composition of the work force constituted 66 per cent without education and 14.5 per cent with incomplete primary education in the year 1981. The figures for 1961 were 89.9 and 5.2, respectively, [Psachraplous and Arrigada, 1986, Pp. 561-74].

Manocha and Sarma [1979] developed a composite index of human resource development in studying regional variations in human resource development in different states. The study took 'effective current stock' as measurement of

human capital. The study also used cost of education at different levels as weights to arrive at a composite index of human capital. The study identified levels of human capital formation in different states and their position with respect to rural and urban education.

Studies dealing with educational inequality across different economic groups of population were hard to come by, except at the micro level which threw some light on inequality in educational attainment. [See Bhagwati, 1979, Pp. 21-36]. The present analysis presents evidence at both all India and state levels.

The Data

The forty second round survey of NSS was devoted to social consumption of population (education and health). Educational levels of population, current enrolment status, and utilization of free schooling and other financial assistance were captured in the survey. Unfortunately, comparable data sets of similar nature are not available as this was the first time that data was available in published form on these crucial items. (Data was collected, for the 37th Round but not published) Also, data at the district level was not available, which would have given a sharper insight into the nature of educational progress in the country.

NSS data classifies population into fractile groups (FGs) based on monthly per capita consumption expenditure.[3] The FG 0-10 refers to the lowest ten per cent of population in terms of consumer expenditure. Educational levels and other details are presented across each FG. Thus, all our analysis is done at these FG levels. Also, based on per capita monthly expenditure, from the lowest upto 40-60 FG in rural areas, and up to 20-40 FG in urban areas are calculated as population below poverty level for all India sample. One can of course work out the cut off points at each state level also.

It is to be noted that NSS definition of literacy is different from that of Census of India definition. NSS defines, 'A person is considered literate if he/she can read and write a simple message in any language'. But the interviewee is not tested in any manner to establish his/her claim. On the other hand, the Census definition of literacy involves a) ability to read and write should be with understanding, and b) in a doubtful case, the claimant will have to give some test to establish his/her statement of being able to read and write. Thus we can see that the estimates of NSS on illiteracy will be on the lower side as compared to the Census. This is possibly true across all the FGs.

IV

EDUCATIONAL INEQUALITY IN INDIA - EVIDENCE FROM NSS DATA

Table 7 presents educational levels of population of states by rural and urban, and male and female separately. These figures are based on the NSS 42nd Round, 1986-87. In rural India, 47.61 per cent of males and 68.39 per cent of females were illiterate. The same for urban areas were 25.56 and 40.88 per cent, respectively. Thus illiteracy was higher in rural areas and among females as compared to urban areas. The share of higher levels of education was also more in the urban areas as compared to the rural areas. If rural and urban areas were taken together, illiteracy among males was 36.58 per cent, females 54.63 per cent, and the two together worked out to 45.60 per cent. These figures broadly coincide with the illiteracy levels of males (36.14 per cent) and total persons (47.89 per cent) from the 1991 Census. For females, the illiteracy figure worked out to 60.58 per cent in 1991, which was six percentage points above the NSS estimates of 1986-87. There was wide discrepancy in illiteracy rates in case of all the categories in many states, the percentage of illiteracy in the 1991 Census was higher than that of the 42nd Round (1986-87) NSS Survey.

As discussed in the introductory paragraphs, the BIMARU states had high illiteracy especially among the rural and female population. The illiteracy in these states was far above the all India average. In these states the rural-urban disparity in educational attainment was high. Much of the educational effort appears to have resulted in growth in the urban areas. There were sharp disparities across rural and urban areas in all the states in this respect. Also the disparity across males and females was high in all the states,

excepting in Kerala. Thus, in terms of educational levels of population, rural sections and females were the most deprived. Across the states, the inequality in educational attainment was high. This clearly pointed to urban and male bias in Indian education.

The NSS tables present percentages of population of each educational level, spread across different FGs. From these tables it can be inferred that, illiterates were concentrated at the lower FGs; as one moved up the educational ladder, the higher FGs take a predominant share. In rural India, 22.30 per cent of illiterate males belonged to the lowest two fractile groups (0-20 FGs) while 26.54 per cent of female illiterates belonged to this class. At the other end, 13.44 and 10.61 per cent of male and female illiterates belonged to the top two FGs. In the case of urban areas, 37.15 per cent of male and 36.4 per cent of female illiterates belonged to the 0-20 FG. At the same time only 4.7 per cent of male illiterates and 4.05 per cent of female illiterates belong to the top two FGs. Thus, illiterates were concentrated more in the lower fractile groups. The percentage with higher levels of education however, got less as one moved up the educational ladder [*Sarvekshana*, 1991, Vol. 14(3), Table 2.1 and NSSO Report No. 365, Table 2.1].

We have recomputed from NSS tables, educational levels of population belonging to each fractile group. Tables presented in the appendix give the statewise details.[4] These tables reinforce the standard perceptions on unequal access to education across economic sections. Negligible number of population of lower FGs were in matriculation or above education. Over 65 per cent of the 0-10 FG persons in rural India were illiterates. On the other hand, a large percentage of higher FG population had higher education. The BIMARU states have higher illiterates in both rural and urban areas compared to other states at the lower fractile groups. One important point that emerged from the data was that in rural areas there was considerable proportion of illiteracy among the higher FGs (richer sections).

V

MEAN LEVEL OF EDUCATION - INEQUALITY

In order to facilitate more comprehensive understanding, we have computed mean level of education for each FG, for each state, and for both rural and urban areas separately. The mean level of education is calculated by using the formula $\text{Mean}(S) = \sum L_i S_i$ where L_i is the proportion of population having its level of education, and S_i is the number of years of schooling for the completion of ith level of education [Psachraplous and Arrigada, 1986]. In other words,

$$\text{Mean}(S) = [(L_0 * YRSP_0) + (L_1 * YRSP_1) + \ldots\ldots + (L_n * YRSP_n)]/100$$

Where $S_i = YRSP_i$ = Years spent in completion of ith level of education. In the case of educational level 'Literate but not educated' we have assigned the value of $S_i(YRSP_1)$ as 1. This is done to avoid any possible upward bias in using any other value. It was observed by AERC, University of Delhi [1971] study that the minimum years of schooling to become functionally literate was 3 to 4 years. But as the Census classification of literate differs from that of the notion of 'Functional literacy', to avoid any kind of upward bias in the mean level we have used one year as S_i in this case. For illiterates, the years of schooling assigned is zero. The results are presented in tables 8 and 9. The mean levels of education varied from 0.18 years in case of rural females of 0-20 FG of Rajasthan to about 12 years in case of urban male of 90-100 of Haryana. Each state showed disparity across rural-urban and male-female groups. Kerala was again an exception to this. The BIMARU states showed very low mean level of education compared to all India, across all the FGs both in rural and urban areas. As one moved up the FG, the mean level of education increased in all the states, for both rural and urban areas, and for male and female. The mean education of 90-100 was almost five times that of 0-10 in almost all the states, be it rural, or urban areas. At the same time, inequality across FGs among females in rural areas was comparatively lower than that of males in both rural and urban areas in many states.

This is possibly due to the low level of education among rural females across the economic classes. This essentially means that, whatever be the criterion, poorer sections of the population are the most deprived of formal education. At the broader level, it is the rural and female population who are deprived of education.

In order to quantify the inequality across FGs, we have calculated Gini Coefficient for rural and urban population separately (Table 10). The results indicate that, inequality across the FGs was high in urban areas as compared to rural areas and among males than females. This can be easily explained. We found high levels of illiteracy in rural areas in almost all FGs and thereby low mean levels of education. The variation in mean education across FGs was low in rural areas for both males and females. In urban areas, the disparity in educational levels across FGs was high. In general, the mean level of education among rural females across all FGs was low in all the states and even in urban areas. These would lead to two inferences. One, poorer sections in urban areas were most deprived of higher levels of education. And two, in rural areas, educational levels were so low, that even among the upper classes there was a large amount of illiteracy. Thus rural education in general was being neglected at the cost of education of the urban richer sections.

Current Enrolment Status

Tables 11A, 11B present current enrolment status of students across different fractile groups (FGs). The tables themselves speak of the unequal participation in education by different sections of students. At the higher levels of education, participation from lower FGs was low. Also participation from females and rural people was low as compared to their male and urban counterparts. Among the rural male students, at the post PUC level, about 10 per cent of students belong to 0-20 FG while the share of 80-100 FGs was 27.32 per cent. The participation in post PUC education from rural females of lower FGs was still lower as compared to their urban counterparts. The inequality across FGs in urban areas was higher compared to the rural areas. While 6.96 per cent of 0-20 FG students belonged to post PUC classes, the corresponding figure for 80-100 FG was 45.90 per cent. The higher disparity was due to the lack of opportunities for poor urban population to go for higher education. Economic compulsions forced them to discontinue their studies. On the other hand, in rural areas the general level of education itself was very low. Hence the disparity was not so pronounced across the FGs.

This evidence, on current enrolment status of students, brings out the shallowness of the rhetoric about equity, social justice and universalization of education of the state.

VI

SUBSIDIES IN EDUCATION

According to Mundle and Rao [1991], 40 per cent of total government subsidies go into social services like education, health, etc. The education sector accounted for 23 per cent of total subsidies by both central and state governments. They also showed the disproportionate access to subsidies across different levels of education and across urban and rural sections. The distribution of subsidies by different levels of education in 1987-88 was as follows:

SUBSIDIES BY LEVELS OF EDUCATION, 1987-88

Level of Education	Amount (Rs Crore)	Per cent of Total
Elementary education	4,116	42.98
Secondary education	3,006	31.39
Higher/University education	1,833	19.14
Other education	258	2.69
Sports, Arts and Culture	363	3.79
Total Education sector	9,577	100.00

Source: Mundle and Rao, 1991, p. 1,162.

It can be seen that, higher education gets subsidy more than its proportion of enrolment rate. Also, based on the participation rates in education, the distribution of subsidies was skewed in favour of higher economic groups in India [Upendranadh,

1993*b*]. Hence, the need for targeting subsidies should be imperative in the process of restructuring the sector. Adequate funds for primary education would improve the participation from weaker sections in education, which would in turn improve efficiency and the distributive effects of subsidies. Another interesting issue to be analysed is the distribution of scholarships and financial assistance for different sections of the population. This is part of the subsidies that would accrue to the individual directly. Based on the evidence from the all India data it can be inferred that richer sections are getting more benefits from scholarships at the higher education levels. At the primary and middle level more poorer sections are availing of scholarships [Upendranadh, 1993*a*].

Does the debate on subsidies and financing necessarily mean privatization of education would improve efficiency in education? Government seems to advocate it as an alternative at least in the case of higher education. Privatization could lead to accentuation of inequality in higher education as poorer sections would not be able to defray the costs. These sections, belong mostly to the lower castes who have been deprived of education for centuries. This is against the spirit of treating education as the human right of a citizen. Privatization would lead to outright commercialization of education, which would amount to discrimination. It would be against the principles of a welfare state, for the government to abdicate its role in higher education.

On the other side, it can be argued that, privatization coupled with effective targeting of scholarships and subsidies, would lead to efficiency in the sector. It is again a political question whether government would take care of the vulnerable sections, in the process of restructuring. This leads us to the question of pricing and recovering the costs of education. Various methods have been suggested on cost recovery in higher education like discriminatory pricing, user charges, etc., [Upendranadh, 1993*c*]. Efficacy and adoption of these depend on the kind of economic and political will that any government would be able to display.

CONCLUSION

The evidence presented in this paper on educational levels and participation across different economic sections, shows that inequality persists in the society across all the states. The primary task of the government should be to raise the minimum educational levels of all the population and provide access to higher education for those who aspire, from lower economic groups, as a democratic right. Complementary measures, like developing credit markets for education and targeted scholarships to the needy, should be taken up by the government as it would lead to better utilization of educational subsidies by the poorer sections. Coming to public expenditure on education in recent years, as we have seen earlier, the situation is far from satisfactory. State governments are not in a position to spend on education adequately, due to financial austerity measures imposed on them.

With high levels of educational inequality across different sections of the population, across the states, it would be a miracle to achieve Universalization of Elementary Education in this country by the turn of the century. The interests of the poorer sections are at stake in the coming years, both in education and economic spheres.

NOTES

1. See *Economics of Education Review*, Vol. 11, No. 4, 1992, which is entirely devoted to these issues; also Fowler, [1991] and Lowe, [1992].

2. Note that gross enrolment ratio includes students of I-V stage with overage and under age, and the grossness is recorded at about 25 per cent.

3. Population is divided into 7 Fractile groups based on per capita monthly expenditure. See *Sarvekshana*, Vol. 14, No. 3, 1991, Table 1.1, Pp. 5-18 and NSSO Report No. 365 for the classification of population. The cut off points vary with the states.

4. For want of space we aggregated percentages above metric and higher levels and presented as 6 and Above in the tables in the annexure.

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TABLE 1. LITERACY LEVELS OF POPULATION: STATES, 1981 AND 1991

(per cent)

State/U.T.	1981			1991		
	Persons	Males	Females	Persons	Males	Females
Andhra Pradesh	35.66	46.83	24.16	45.11	56.24	33.71
Assam	NA	NA	NA	53.42	62.34	43.70
Bihar	32.03	46.58	16.51	38.54	52.63	23.10
Goa	65.71	76.01	55.17	76.96	85.48	68.20
Gujarat	52.21	65.14	38.46	60.91	72.54	48.50
Haryana	13.85	58.49	26.89	55.33	67.85	40.94
Himachal Pradesh	51.17	64.27	37.72	63.54	74.57	52.46
Jammu & Kashmir	32.68	44.18	19.55	NA	NA	NA
Karnataka	46.20	58.72	33.16	55.98	67.25	44.34
Kerala	81.56	87.74	75.65	90.59	94.45	86.93
Madhya Pradesh	34.22	48.41	18.99	43.45	57.43	28.39
Maharashtra	55.83	69.66	41.01	63.05	74.84	50.51
Orissa	40.96	56.45	25.14	48.55	62.37	34.40
Punjab	48.12	55.52	39.64	57.14	63.68	49.72
Rajasthan	30.09	44.76	13.99	38.81	55.07	20.84
Tamil Nadu						
Uttar Pradesh	33.33	47.43	17.18	41.71	55.35	26.02
West Bengal	48.64	59.93	36.07	57.72	67.24	47.15
Delhi	71.93	79.28	62.57	76.09	82.63	68.01
INDIA	43.56	56.37	29.75	52.11	63.86	39.42
	(43.66)	(56.49)	(29.84)	(52.07)	(63.90)	(39.31)

Note: Figures in the brackets are excluding Assam and Jammu & Kashmir.
Source: Census of India 1981 and 1991, Cited in *Annual Reports* of Ministry of Human Resource Development.

TABLE 2. ENROLMENT BY STAGES 1989-90: MAJOR STATES

(million)

State/U.T.	Primary (I-V)			Middle(VI-VII)			Secondary/Hr.Sec (VIII-X/XII)			Hr. Education*			Total All Stages		
	Boys	Girls	Total	Boys	Girls	Total	Boys	Girls	Total	Boys	Girls	Total	Boys	Girls	Total
Andhra Pradesh	4.21	3.12	7.32	1.30	0.73	2.03	0.88	0.42	1.30	0.19	0.08	0.27	6.58	4.34	10.92
Assam	2.30	1.17	3.47	0.79	0.45	1.24	0.37	0.24	0.61	0.07	0.03	0.11	3.54	1.89	5.42
Bihar	5.58	2.72	8.30	1.44	0.50	1.94	0.99	0.22	1.21	1.40	0.09	1.50	9.41	3.54	12.95
Goa	0.07	0.07	0.14	0.04	0.04	0.08	0.03	0.03	0.06	0.01	0.01	0.01	0.15	0.13	0.29
Gujarat	3.15	2.36	5.51	1.02	0.64	1.67	0.68	0.40	1.03	0.14	0.09	0.23	5.00	3.50	8.44
Haryana	0.95	0.73	1.69	0.44	0.25	0.69	0.28	0.13	0.41	0.04	0.03	0.07	1.72	1.14	2.86
Himachal Pradesh	0.37	0.32	0.69	0.19	0.15	0.33	0.17	0.11	0.28	0.01	0.00	0.01	0.74	0.57	1.31
Jammu & Kashmir	0.45	0.29	0.74	0.19	0.10	0.29	0.12	0.06	0.18	0.02	0.01	0.03	0.78	0.46	1.24
Karnataka	2.97	2.52	5.49	1.04	0.72	1.76	0.73	0.37	1.10	0.18	0.08	0.26	4.92	3.69	8.61
Kerala	1.65	1.56	3.21	0.94	0.89	1.82	0.56	0.57	1.13	0.08	0.09	0.16	3.22	3.11	6.33
Madhya Pradesh	4.79	2.96	7.74	1.76	0.76	2.52	0.76	0.25	1.01	0.16	0.07	0.23	7.47	4.04	11.51
Maharashtra	5.34	4.55	9.89	2.27	1.53	3.80	1.89	0.96	2.85	0.38	0.23	0.62	9.88	7.28	17.16
Orissa	2.15	1.44	3.59	0.55	0.43	0.98	0.48	0.22	0.69	0.05	0.02	0.07	3.23	2.10	5.32
Punjab#	1.13	0.96	2.09	0.46	0.35	0.81	0.32	0.22	0.54	0.08	0.04	0.11	1.99	1.56	3.55
Rajasthan	3.15	1.37	4.52	1.02	0.29	1.31	0.64	0.15	0.79	0.13	0.04	0.17	4.94	1.84	6.79
Tamil Nadu															
Uttar Pradesh	8.69	4.81	13.50	3.03	1.12	4.15	2.22	0.67	2.88	0.35	0.11	0.46	14.28	6.71	20.99
West Bengal#	5.31	3.96	9.27	1.58	1.16	2.74	1.06	0.54	1.60	0.20	0.13	0.33	8.15	5.80	13.95
Delhi	0.49	0.43	0.92	0.28	0.22	0.50	0.21	0.16	0.37	0.07	0.05	0.12	1.04	0.86	1.90
INDIA	57.73	39.59	97.32	20.37	11.82	32.19	13.52	6.45	19.97	2.74	1.32	4.06	94.36	59.17	153.53

* Excludes enrolment in Ph.d/M.Phil and all professional courses except Engineering, Medicine and Teacher training; # Figures relate to the year 1988-89.
Source: Ministry of Human Resource Development, *Annual Report for the Year 1990-91*, Government of India, New Delhi.

TABLE 3. DROPOUT RATES AT PRIMARY AND MIDDLE LEVELS

(per cent)

State/U.T.	Primary(I-V) in 1988-89			Middle (I-VIII) in 1986-87		
	Boys	Girls	Total	Boys	Girls	Total
Andhra Pradesh	51.45	57.54	54.08	78.03	85.14	81.08
Assam	52.20	59.64	55.42	70.13	73.20	71.56
Bihar	64.39	70.26	66.34	77.25	84.68	79.53
Gujarat	40.27	48.30	43.84	58.65	67.90	62.53
Haryana	26.11	30.99	28.13	29.79	48.30	36.38
Himachal Pradesh	26.38	27.99	27.12	15.23	31.04	22.04
Jammu & Kashmir	50.03	38.16	45.30	46.91	57.37	50.89
Karnataka	44.40	55.61	49.70	67.27	77.60	72.06
Kerala	3.00	1.00	2.00	19.09	18.32	18.71
Madhya Pradesh	39.32	42.64	40.62	51.77	69.79	58.07
Maharashtra	34.24	44.25	38.92	37.41	72.15	64.15
Orissa	40.05	37.32	38.97	61.38	74.05	66.66
Punjab	29.20	29.62	29.39	60.26	67.73	63.73
Rajasthan	53.12	60.75	56.25	58.96	69.83	61.63
Tamil Nadu	19.16	24.01	21.41	44.89	55.23	49.67
Uttar Pradesh	50.30	48.96	49.89	50.49	64.20	54.94
West Bengal	62.57	66.89	64.45	78.20	79.57	78.75
Delhi	14.13	22.73	18.30	15.15	30.06	22.30
INDIA	46.76	49.69	47.93	61.44	70.16	64.90

Source: As in Table 2.

TABLE 4. LEVELS OF ENROLMENT AS PERCENTAGE OF TOTAL ENROLMENT 1989-90

(per cent)

State	Primary	Secondary	High	Total
Andhra Pradesh	67.06	30.51	2.43	100.00
Assam	63.93	34.12	1.94	100.00
Bihar	64.12	24.33	11.55	100.00
Goa	48.26	47.83	3.92	100.00
Gujarat	65.26	31.98	2.76	100.00
Haryana	58.98	38.43	2.59	100.00
Himachal Pradesh	52.61	46.58	0.81	100.00
Jammu & Kashmir	59.62	38.18	2.21	100.00
Karnataka	63.79	33.24	2.96	100.00
Kerala	50.75	46.68	2.56	100.00
Madhya Pradesh	67.31	30.67	2.02	100.00
Maharashtra	57.65	38.75	3.60	100.00
Orissa	67.40	31.33	1.27	100.00
Punjab#	58.88	37.94	3.18	100.00
Rajasthan	66.59	30.88	2.52	100.00
Tamil Nadu				
Uttar Pradesh	64.29	33.51	2.20	100.00
West Bengal#	66.50	31.13	2.37	100.00
Delhi	48.34	45.52	6.15	100.00
INDIA	63.39	33.97	2.64	100.00

Source: As in Table 2.

TABLE 5. BUDGET EXPENDITURE (REVENUE) ON EDUCATION IN 1986-87: MAJOR STATES

(at current prices)

State	Budget Expenditure (Rs Crore)			Per Capita Budget Expenditure		Expenditure on Education as percentage of Total Expenditure	Rank
	Plan	Non-Plan	Total	(Rs)	Rank		
Andhra Pradesh	16.9	678.07	794.76	132.63	7	24.5	9
Assam	67.42	217.84	285.26	125.00	9	25.9	5
Bihar	62.33	437.59	499.92	63.03	17	25.4	6
Gujarat	112.47	476.15	588.62	153.17	4	25.4	6
Haryana	33.34	162.37	195.71	128.78	8	21.6	12
Himachal Pradesh	13.05	89.18	102.23	213.54	1	20.6	15
Jammu & Kashmir	24.30	95.60	119.90	170.15	3	19.1	17
Karnataka	32.48	490.61	523.09	124.04	10	23.0	10
Kerala	36.71	474.34	511.05	180.39	2	33.6	1
Madhya Pradesh	50.07	468.69	518.76	87.35	15	20.3	16
Maharashtra	17.18	895.57	965.75	135.79	6	21.2	13
Orissa	41.56	217.76	259.32	88.33	14	21.1	14
Punjab	19.66	264.49	284.15	150.57	5	24.7	8
Rajasthan	38.61	375.93	414.54	103.16	13	26.4	4
Tamil Nadu	119.52	531.41	650.93	121.81	11	26.6	2
Uttar Pradesh	117.86	794.98	912.84	72.75	16	22.1	11
West Bengal	107.68	585.67	693.35	112.97	12	26.5	3
INDIA	1,154.55	7,599.61	8,754.16	112.77		23.8	

Source: *Facts For You*, Annual Number, 1991.

TABLE 6. INTRA SECTORAL ALLOCATION OF EXPENDITURE ON EDUCATION: CENTRE AND STATES

(per cent)

Sector	I FYP 1951-56	II FYP 1957-62	III FYP 1963-68	Plan Holiday 1968-69	IV FYP 1970-75	V FYP 1976-81	VI FYP 1982-87	VII FYP	1990-92	VIII FYP 1991-1995
Elementary	56	35	34	24	30	35	36	37	37	47
Secondary	13	19	18	16	18	17	21	24	22	18
Higher	9	18	15	24	25	22	22	16	12	8
Others	9	10	12	11	14	14	4	3	2	4
Technical	13	18	21	25	13	12	11	14	17	14

Source: Vaidhynathan Ayyar, R V 1992; 'New Economic Policy and Equity in Education', Paper presented at a Seminar on NEP-Equity at IPE Hyderabad.

TABLE 7. DISTRIBUTION OF PERSONS OVER SEX AND LEVEL OF EDUCATION ATTAINED 1986-87

(per cent)

	Illiterate	Literate without Formal Education	Primary	Middle	Technical Education	Matric/ SSC	Matric & above	Not Reported	All
Andhra Pradesh									
Rural									
Male	44.51	18.78	12.41	7.17	0.06	2.65	2.09	12.32	100.00
Female	60.94	11.48	6.97	2.99	0.01	0.71	0.48	16.42	100.00
Person	52.70	15.13	9.70	5.08	0.04	1.68	1.30	14.38	100.00
Urban									
Male	23.88	17.88	15.70	14.20	0.38	9.70	12.11	6.17	100.00
Female	38.82	16.52	12.83	10.15	0.01	5.12	4.80	11.74	100.00
Person	31.10	17.22	14.31	12.24	0.20	7.49	8.59	8.86	100.00
All									
Male	34.20	18.33	14.05	10.69	0.22	6.17	7.10	9.25	100.00
Female	49.88	14.00	9.90	6.57	0.01	2.92	2.64	14.08	100.00
Person	41.90	16.18	12.01	8.66	0.12	4.59	4.95	11.62	100.00

(Contd.)

TABLE 7. *(Contd.)*

	Illiterate	Literate without Formal Education	Primary	Middle	Technical Education	Matric/ SSC	Matric & above	Not Reported	All
Assam									
Rural									
Male	46.27	9.44	20.90	15.00	0.02	5.14	3.03	1.42	100.00
Female	58.90	9.43	16.84	9.84	0.00	2.37	0.82	1.79	100.00
Person	51.31	9.44	19.07	12.67	0.01	3.88	2.03	1.59	100.00
Urban									
Male	20.67	8.39	18.54	19.24	0.31	13.57	17.29	1.99	100.00
Female	28.19	12.95	17.79	18.33	0.12	10.48	9.34	2.78	100.00
Person	24.08	10.46	18.20	18.84	0.23	12.17	13.69	2.35	100.00
All									
Male	33.47	8.92	19.72	17.12	0.17	9.35	10.16	1.70	100.00
Female	43.55	11.19	17.32	14.09	0.06	6.42	5.08	2.29	100.00
Person	37.69	9.95	18.63	15.75	0.12	8.03	7.86	1.97	100.00
Bihar									
Rural									
Male	57.84	11.90	9.03	9.48	0.03	4.30	2.44	4.97	100.00
Female	80.69	6.33	3.24	2.55	0.02	0.62	0.24	6.32	100.00
Person	68.80	9.23	6.25	6.15	0.03	2.53	1.38	5.62	100.00
Urban									
Male	36.79	14.36	10.87	14.96	0.03	8.83	12.64	1.51	100.00
Female	59.87	13.08	8.01	8.66	0.08	4.33	3.98	1.99	100.00
Person	47.38	13.77	9.55	12.09	0.06	6.76	8.66	1.73	100.00
All									
Male	47.32	13.13	9.95	12.22	0.03	6.56	7.54	3.24	100.00
Female	70.28	9.71	5.62	5.60	0.05	2.47	2.11	4.15	100.00
Person	58.09	11.50	7.90	9.12	0.04	4.65	5.02	3.67	100.00
Gujarat									
Rural									
Male	40.05	14.11	19.24	13.29	0.13	4.75	2.56	5.86	100.00
Female	58.78	9.94	12.23	7.43	0.05	2.19	0.80	8.57	100.00
Person	49.09	12.09	15.84	10.45	0.09	3.51	1.71	7.21	100.00
Urban									
Male	21.74	12.26	22.87	16.55	0.20	11.08	11.32	3.98	100.00
Female	35.54	10.40	21.81	12.07	0.02	7.94	6.42	5.78	100.00
Person	28.26	11.38	22.37	14.43	0.12	9.60	9.00	4.83	100.00
All									
Male	30.89	13.18	21.06	14.92	0.17	7.92	6.94	4.92	100.00
Female	47.16	10.17	17.02	9.75	0.04	5.07	3.61	7.18	100.00
Person	38.68	11.73	19.11	12.44	0.10	6.56	5.36	6.02	100.00
Haryana									
Rural									
Male	34.74	18.07	16.36	9.07	0.00	6.44	2.66	12.66	100.00
Female	54.30	11.24	9.50	3.00	0.05	1.19	0.64	20.09	100.00
Person	43.74	14.92	13.20	6.27	0.02	4.02	1.73	16.09	100.00
Urban									
Male	23.70	17.77	16.81	10.79	0.05	14.23	15.56	1.08	100.00
Female	45.12	16.85	12.49	7.70	0.00	9.33	7.95	0.55	100.00
Person	34.04	17.32	14.72	9.30	0.03	11.87	11.89	0.83	100.00
All									
Male	29.22	17.92	16.59	9.93	0.03	10.33	9.11	6.87	100.00
Female	49.71	14.04	11.00	5.35	0.02	5.26	4.30	10.32	100.00
Person	38.89	16.12	13.96	7.79	0.03	7.94	6.81	8.46	100.00

(Contd.)

TABLE 7. *(Contd.)*

	Illiterate	Literate without Formal Education	Primary	Middle	Technical Education	Matric/ SSC	Matric & above	Not Reported	All
Kerala									
Rural									
Male	15.87	19.18	29.18	19.70	0.00	7.37	4.31	4.18	100.00
Female	20.39	17.88	27.27	18.21	0.00	7.10	3.87	5.20	100.00
Person	18.16	18.52	28.21	18.94	0.14	7.23	4.09	4.71	100.00
Urban									
Male	11.32	15.65	25.76	23.16	0.24	10.30	9.87	3.69	100.00
Female	15.22	16.58	24.81	20.64	0.22	10.27	7.72	4.54	100.00
Person	13.31	16.12	25.27	21.87	0.23	10.28	8.77	4.14	100.00
All									
Male	13.60	17.41	27.47	21.43	0.12	8.84	7.09	3.93	100.00
Female	17.81	17.23	26.04	19.42	0.11	8.69	5.80	4.87	100.00
Person	15.74	17.32	26.74	20.40	0.18	8.76	6.43	4.43	100.00
Karnataka									
Rural									
Male	49.16	19.21	22.29	14.82	0.00	5.46	3.36	20.14	100.00
Female	51.55	9.46	9.57	5.71	0.00	1.52	0.66	21.54	100.00
Person	43.90	11.92	13.14	8.42	0.00	2.82	1.60	18.21	100.00
Urban									
Male	25.65	14.18	16.04	17.41	0.09	9.55	11.56	5.53	100.00
Female	37.37	13.64	15.77	13.57	0.03	6.30	5.16	7.97	100.00
Person	31.40	13.91	15.91	15.53	0.06	7.96	8.42	6.81	100.00
All									
Male	37.41	16.69	19.17	16.11	0.05	7.50	7.46	12.84	100.00
Female	44.46	11.55	12.67	9.64	0.02	3.91	2.91	14.76	100.00
Person	37.65	12.92	14.53	11.98	0.03	5.39	5.01	12.51	100.00
Maharashtra									
Rural									
Male	33.34	14.41	20.82	14.73	0.05	5.24	3.09	8.31	100.00
Female	51.33	11.00	14.06	7.22	0.00	1.82	0.65	13.91	100.00
Person	42.18	12.73	17.50	11.03	0.03	3.56	1.89	11.07	100.00
Urban									
Male	19.76	11.79	20.75	16.62	0.12	15.03	12.80	3.12	100.00
Female	32.06	10.02	20.38	15.27	0.07	10.02	7.57	4.61	100.00
Person	25.50	10.96	20.57	15.99	0.10	12.69	10.36	3.82	100.00
All									
Male	26.55	13.10	20.79	15.68	0.09	10.14	7.95	5.72	100.00
Female	41.69	10.51	17.22	11.24	0.03	5.92	4.11	9.26	100.00
Person	33.84	11.85	19.03	13.51	0.07	8.13	6.13	7.45	100.00
Madhya Pradesh									
Rural									
Male	57.28	20.26	12.67	4.48	0.01	1.13	2.54	1.63	100.00
Female	82.51	8.53	4.17	1.40	0.00	0.27	0.38	2.73	100.00
Person	69.49	14.58	8.56	2.99	0.01	0.71	1.50	2.17	100.00
Urban									
Male	23.22	20.28	18.91	12.93	0.12	3.88	18.85	1.80	100.00
Female	45.89	16.46	14.29	8.12	0.00	2.12	10.31	2.80	100.00
Person	34.00	18.45	16.71	10.64	0.07	3.04	14.79	2.29	100.00
All									
Male	40.25	20.27	15.79	8.70	0.06	2.50	10.70	1.72	100.00
Female	64.20	12.49	9.23	4.76	0.00	1.19	5.35	2.76	100.00
Person	51.75	16.52	12.63	6.82	0.04	1.88	8.14	2.23	100.00
Orissa									
Rural									
Male	54.54	18.59	12.26	9.97	0.11	2.31	1.37	0.84	100.00
Female	75.70	10.92	6.74	4.52	0.02	0.85	0.32	0.92	100.00
Person	65.10	14.76	9.50	7.25	0.07	1.59	0.85	0.88	100.00
Urban									
Male	27.52	17.17	11.78	18.70	0.21	9.89	13.32	1.41	100.00
Female	46.21	15.30	11.35	13.89	0.00	5.78	5.40	2.07	100.00
Person	36.15	16.30	11.58	16.48	0.11	7.99	9.66	1.71	100.00
All									
Male	41.03	17.88	12.02	14.34	0.16	6.10	7.35	1.12	100.00
Female	60.96	13.11	9.05	9.21	0.01	3.32	2.86	1.50	100.00
Person	50.62	15.53	10.54	11.87	0.09	4.79	5.26	1.30	100.00

(Contd.)

TABLE 7. *(Concld.)*

	Illiterate	Literate without Formal Education	Primary	Middle	Technical Education	Matric/ SSC	Matric & above	Not Reported	All
Punjab									
Rural									
Male	43.03	15.63	15.68	8.37	0.10	6.41	2.83	7.95	100.00
Female	53.70	12.94	13.78	4.10	0.04	3.56	1.34	10.54	100.00
Person	48.05	14.34	14.76	6.33	0.07	5.06	2.12	9.26	100.00
Urban									
Male	28.09	18.94	16.99	13.03	0.08	11.35	10.28	1.25	100.00
Female	40.78	15.15	17.27	10.61	0.00	7.34	4.72	1.23	100.00
Person	34.00	17.20	17.17	11.87	0.04	9.46	9.01	1.23	100.00
All									
Male	35.56	17.28	16.33	10.70	0.09	8.88	6.55	4.60	100.00
Female	47.24	14.05	15.52	7.36	0.02	5.45	3.03	5.88	100.00
Person	41.03	15.77	15.97	9.10	0.05	7.26	5.56	5.25	100.00
Rajasthan									
Rural									
Male	58.42	17.27	11.03	7.17	0.05	2.27	2.13	1.66	100.00
Female	87.24	5.62	3.68	1.28	0.00	0.21	0.20	1.77	100.00
Person	72.33	11.65	7.48	4.32	0.02	1.28	1.20	1.71	100.00
Urban									
Male	33.46	16.80	13.56	12.12	0.17	5.76	16.20	1.93	100.00
Female	57.00	12.94	10.29	6.80	0.04	4.54	4.77	1.33	100.00
Person	44.53	14.98	12.02	9.62	0.11	5.19	11.90	1.65	100.00
All									
Male	45.94	17.03	12.29	9.64	0.11	4.02	9.17	1.80	100.00
Female	72.12	9.28	6.98	4.04	0.02	2.38	2.49	1.55	100.00
Person	58.43	13.32	9.75	6.97	0.07	3.23	6.55	1.68	100.00
Tamil Nadu									
Rural									
Male	36.40	23.71	20.76	10.59	0.03	3.51	2.67	2.34	100.00
Female	60.08	16.63	13.01	4.85	0.01	1.53	0.94	2.95	100.00
Person	48.36	20.13	16.85	7.69	0.02	2.51	1.80	2.65	100.00
Urban									
Male	19.39	18.97	20.97	16.27	0.00	10.52	11.45	2.12	100.00
Female	31.46	18.21	20.80	12.54	0.00	6.55	6.04	4.40	100.00
Person	25.41	18.61	20.88	14.40	0.15	8.54	8.74	3.26	100.00
All									
Male	27.90	21.34	20.86	13.43	0.01	7.02	7.06	2.23	100.00
Female	45.77	17.42	16.90	8.70	0.00	4.04	3.49	3.68	100.00
Person	36.89	19.37	18.86	11.05	0.08	5.53	5.27	2.96	100.00
Uttar Pradesh									
Rural									
Male	56.01	15.02	11.48	8.67	0.04	3.72	3.45	1.60	100.00
Female	83.20	6.59	4.72	2.00	0.00	0.84	0.44	2.02	100.00
Person	68.92	11.02	8.27	5.51	0.02	2.35	2.11	1.80	100.00
Urban									
Male	37.08	16.02	13.89	10.82	0.11	6.72	13.98	1.37	100.00
Female	57.09	12.81	9.74	6.40	0.00	4.42	4.84	1.61	100.00
Person	46.27	14.54	11.98	8.79	0.06	5.68	11.20	1.48	100.00
Male	46.55	15.52	12.69	9.75	0.08	5.22	8.71	1.49	100.00
Female	70.15	9.70	7.23	4.20	0.00	2.63	2.64	1.82	100.00
Person	57.59	12.78	10.13	7.15	0.04	4.01	6.65	1.64	100.00
West Bengal									
Rural									
Male	49.01	16.73	19.11	7.84	0.04	2.96	2.57	1.73	100.00
Female	68.72	11.48	12.71	3.45	0.00	0.84	0.39	2.29	100.00
Person	58.50	14.20	16.03	5.72	0.02	1.94	1.59	2.00	100.00
Urban									
Male	23.61	15.24	20.22	15.09	0.10	8.59	15.58	1.57	100.00
Female	35.69	14.62	20.13	12.69	0.04	5.49	4.41	1.96	100.00
Person	29.14	14.95	20.17	13.99	0.07	7.17	12.74	1.77	100.00
All									
Male	36.31	15.99	19.67	11.46	0.07	5.78	9.08	1.65	100.00
Female	52.20	13.05	16.42	8.07	0.02	3.16	2.40	2.13	100.00
Person	43.82	14.58	18.10	9.86	0.05	4.55	7.17	1.88	100.00
INDIA									
Rural									
Male	47.61	16.28	15.02	9.73	0.05	3.78	2.73	4.80	100.00
Female	68.39	9.78	8.80	4.24	0.00	1.30	0.51	6.79	100.00
Person	57.68	13.13	12.00	7.07	0.04	2.58	1.74	5.76	100.00
Urban									
Male	25.26	15.53	17.36	14.51	1.59	9.56	13.42	2.54	100.00
Female	40.88	14.13	15.93	11.23	0.03	6.36	4.53	4.07	100.00
Person	33.01	14.98	16.80	13.06	0.87	8.11	10.65	3.28	100.00
All									
Male	36.44	15.91	16.19	12.12	0.82	6.67	8.07	3.67	100.00
Female	54.63	11.96	12.37	7.74	0.02	3.83	2.52	5.43	100.00
Person	45.35	14.06	14.40	10.06	0.45	5.35	6.19	4.52	100.00

Source: Calculated from NSS-42nd Round data.

TABLE 8.1. MEAN LEVELS OF EDUCATION-STATES URBAN MALES IN 1986-87

FG	Karnataka	Kerala	Haryana	Assam	Bihar	Gujarat	West Bengal	Uttar Pradesh	Tamil Nadu	Punjab	Rajasthan	Maharashtra	Madhya Pradesh	Orissa	Andhra Pradesh	India
0-10	2.80	4.17	2.90	4.74	2.33	2.85	2.60	2.22	2.88	2.35	2.27	3.58	2.88	1.79	2.57	2.95
10-20	2.97	4.20	3.95	4.30	1.94	3.19	3.33	2.23	3.47	2.97	2.67	3.66	3.24	3.01	2.55	2.9
0-20	2.87	4.19	3.37	4.50	2.13	3.02	2.99	2.23	3.19	2.63	2.46	3.62	3.06	2.42	2.56	2.92
20-40	3.68	4.80	4.58	5.78	3.03	4.46	4.10	2.85	3.99	3.60	2.92	4.80	4.01	3.48	3.54	3.84
40-60	4.96	5.42	5.05	6.44	4.61	5.49	5.21	4.10	4.70	4.78	4.72	5.89	4.98	5.67	4.75	5.19
60-80	6.48	7.02	6.46	7.19	6.30	6.37	6.70	6.10	6.18	5.70	6.42	7.20	6.53	6.73	6.2	6.71
80-90	8.93	8.75	8.48	8.41	8.50	8.19	8.89	8.48	7.76	6.67	9.78	8.57	7.63	7.57	8.09	8.35
90-100	10.24	9.81	12.10	10.39	9.03	9.63	10.14	10.90	9.82	9.21	11.24	10.04	9.58	10.27	9.74	10.01
80-100	9.51	9.31	9.87	9.38	8.77	8.88	9.45	9.50	8.75	7.82	10.41	9.21	8.58	8.74	8.32	9.11
ALL	5.00	5.71	5.36	6.22	4.45	5.37	5.34	4.33	5.14	4.57	4.61	5.81	5.09	5.02	4.9	5.15

TABLE 8.2. MEAN LEVELS OF EDUCATION-STATES URBAN FEMALES IN 1986-87

FG	Karnataka	Kerala	Haryana	Assam	Bihar	Gujarat	West Bengal	Uttar Pradesh	Tamil Nadu	Punjab	Rajasthan	Maharashtra	Madhya Pradesh	Orissa	Andhra Pradesh	India
0-10	1.69	3.29	1.14	2.93	1.18	1.84	1.40	0.96	2.12	2.19	0.93	2.11	1.45	0.96	1.36	1.69
10-20	1.73	4.06	2.06	3.48	0.76	2.00	2.04	1.05	2.23	2.01	0.66	2.30	1.47	1.46	1.23	1.62
0-20	1.78	3.70	1.62	3.28	0.96	1.92	1.73	1.01	2.18	2.10	0.80	2.21	1.43	1.22	1.29	1.65
20-40	2.51	4.51	3.06	3.93	1.32	3.15	2.81	1.34	2.71	2.99	1.28	3.41	2.04	1.71	1.81	2.37
40-60	3.47	5.31	3.85	4.96	2.14	3.91	4.27	2.44	3.40	3.22	2.62	4.44	3.06	4.11	2.89	3.51
60-80	4.38	6.26	4.94	6.33	3.37	5.41	5.53	4.80	4.63	5.02	4.42	5.98	4.28	4.37	4.06	5.06
80-90	7.03	7.48	7.43	7.26	5.98	6.86	7.55	7.03	5.84	6.64	6.56	7.65	5.66	7.14	6.03	6.99
90-100	9.76	9.34	11.40	7.41	6.87	8.14	8.64	8.83	8.17	6.86	8.24	9.47	7.82	8.67	7.08	8.52
80-100	8.16	8.34	7.86	7.34	6.46	7.37	8.05	7.59	6.90	6.75	7.31	8.43	6.67	7.91	6.5	7.65
ALL	3.51	5.20	3.39	4.71	2.17	3.96	3.23	2.21	3.74	3.17	2.26	4.44	3.11	3.08	3.02	3.08

TABLE 8.3. MEAN LEVELS OF EDUCATION-STATES URBAN PERSONS IN 1986-87

FG	Karnataka	Kerala	Haryana	Assam	Bihar	Gujarat	West Bengal	Uttar Pradesh	Tamil Nadu	Punjab	Rajasthan	Maharashtra	Madhya Pradesh	Orissa	Andhra Pradesh	India
0-10	2.36	3.73	1.97	3.83	1.75	2.35	2.02	1.63	2.49	2.29	1.62	2.87	2.15	1.38	2.02	2.35
10-20	2.31	4.08	2.83	4.05	1.34	2.61	2.72	1.67	2.84	2.46	1.64	3.02	2.41	2.24	1.9	2.31
0-20	2.32	3.90	2.41	3.93	1.54	2.48	2.62	1.66	2.67	2.37	1.63	2.95	2.28	1.82	1.96	2.33
20-40	3.10	4.48	3.82	4.95	2.23	3.83	3.40	2.12	3.35	3.31	2.16	4.15	3.08	2.58	2.71	3.16
40-60	4.27	5.50	4.48	5.75	3.49	4.74	4.73	3.33	4.06	4.07	3.58	5.22	4.05	4.98	3.87	4.43
60-80	5.47	6.74	5.77	6.83	5.06	6.08	6.04	5.53	5.43	5.40	5.67	6.64	5.47	5.75	5.21	6.01
80-90	8.02	8.23	8.04	7.96	7.41	7.55	8.23	7.83	6.81	6.66	8.37	8.15	6.72	7.43	7.16	7.83
90-100	10.02	9.51	12.00	8.97	8.17	9.00	9.51	10.20	9.06	8.11	10.15	9.79	8.83	9.61	8.52	9.45
80-100	8.88	8.87	9.22	8.43	7.88	8.17	8.81	8.71	7.86	7.41	9.16	8.87	7.72	8.43	7.79	9.23
ALL	4.28	5.45	4.40	5.54	3.41	4.71	4.72	3.57	4.46	4.12	3.66	5.18	4.16	4.13	4.02	4.43

Source: Same as Table 8.

TABLE 9.1. MEAN LEVELS OF EDUCATION-STATES: RURAL MALES IN 1986-87

FG	Karna-taka	Kerala	Harya-na	Assam	Bihar	Gujarat	West Bengal	Uttar Pradesh	Tamil Nadu	Punjab	Rajas-than	Mahara-shtra	Madhya Pradesh	Orissa	Andhra Pradesh	India
0-10	3.07	3.35	2.75	2.31	1.56	1.95	1.19	1.31	2.16	2.01	1.23	2.08	0.85	0.71	1.40	1.73
10-20	2.79	3.42	1.75	3.09	1.35	2.14	1.00	1.64	1.84	1.73	1.27	2.70	0.98	1.05	1.14	1.79
0-20	2.93	3.38	2.17	2.74	1.46	2.05	1.10	1.46	2.00	1.87	1.25	2.38	0.91	0.88	1.26	1.76
20-40	3.38	4.00	2.41	2.81	1.74	2.49	1.57	1.84	2.27	2.50	1.28	2.87	1.23	1.58	1.46	2.01
40-60	3.91	4.58	3.57	3.16	1.85	2.75	2.28	2.16	2.67	2.49	1.88	3.27	1.59	1.90	1.96	2.28
60-80	4.61	5.17	3.52	3.22	2.34	3.49	2.88	2.74	3.12	3.14	1.80	3.98	1.95	2.33	2.48	2.75
80-90	5.34	6.09	3.62	3.54	2.91	4.61	3.79	3.21	4.17	3.77	2.86	4.80	2.42	2.79	3.30	3.28
90-100	8.77	7.34	4.11	4.71	4.22	5.19	5.12	4.35	5.60	4.99	3.26	6.05	3.60	3.85	5.41	4.41
80-100	6.87	6.57	3.85	4.04	3.53	4.85	4.38	3.69	4.89	4.36	3.04	5.38	2.96	3.27	4.38	3.77
ALL	4.19	4.54	3.02	3.13	2.09	3.05	2.35	2.21	2.80	2.79	1.77	3.45	1.62	1.93	2.12	2.46

TABLE 9.2. MEAN LEVELS OF EDUCATION-STATES: RURAL FEMALES IN 1986-87

FG	Karna-taka	Kerala	Harya-na	Assam	Bihar	Gujarat	West Bengal	Uttar Pradesh	Tamil Nadu	Punjab	Rajas-than	Mahara-shtra	Madhya Pradesh	Orissa	Andhra Pradesh	India
0-10	1.01	3.34	1.21	1.39	0.35	1.00	0.48	0.23	1.08	1.20	0.18	1.05	0.20	0.22	0.44	0.67
10-20	0.76	3.50	0.72	1.95	0.31	0.98	0.40	0.26	1.04	0.86	0.18	1.19	0.20	0.39	0.31	0.58
0-20	0.89	3.42	0.95	1.69	0.33	0.99	0.44	0.24	1.06	1.05	0.18	1.12	0.20	0.31	0.36	0.59
20-40	1.12	3.74	0.75	1.74	0.37	1.20	0.74	0.43	0.96	1.42	0.17	1.40	0.31	0.59	0.64	0.75
40-60	1.45	4.17	1.43	2.07	0.42	1.43	1.10	0.58	1.21	1.86	0.43	1.76	0.47	0.88	0.90	1.02
60-80	1.76	4.85	1.46	2.12	0.59	2.25	1.53	0.91	1.95	2.35	0.46	2.21	0.61	1.16	1.20	1.46
80-90	2.60	5.69	1.95	2.45	1.02	2.94	1.99	1.36	2.36	2.82	0.89	2.83	0.74	1.62	1.31	1.98
90-100	3.61	6.84	1.86	3.09	1.36	3.23	3.14	2.25	3.61	3.03	0.84	3.87	1.53	2.26	3.25	2.97
80-100	3.03	6.17	1.91	2.70	1.18	3.06	2.49	1.66	2.99	2.92	0.87	3.31	1.10	1.89	2.33	2.40
ALL	1.54	4.27	1.26	2.00	0.53	1.70	1.15	0.59	1.48	1.84	0.38	1.84	0.48	0.90	0.97	1.10

TABLE 9.3. MEAN LEVELS OF EDUCATION-STATES: RURAL PERSONS IN 1986-87

FG	Karnataka	Kerala	Haryana	Assam	Bihar	Gujarat	West Bengal	Uttar Pradesh	Tamil Nadu	Punjab	Rajasthan	Maharashtra	Madhya Pradesh	Orissa	Andhra Pradesh	India
0-10	1.56	3.34	1.97	1.88	0.99	1.50	0.84	0.77	1.61	1.62	0.72	1.57	0.53	0.46	0.92	1.06
10-20	1.37	3.46	2.83	2.57	0.84	1.59	0.70	0.96	1.44	1.34	0.73	1.99	0.60	0.71	0.74	1.10
0-20	1.47	3.40	2.41	2.25	0.92	1.54	0.77	0.86	1.52	1.49	0.73	1.77	0.56	0.58	0.86	1.08
20-40	1.78	3.87	3.82	2.32	1.08	1.87	1.16	1.16	1.58	2.00	0.74	2.16	0.78	1.09	1.06	1.35
40-60	2.13	4.37	4.48	2.68	1.17	2.12	1.73	1.42	1.94	2.18	1.18	2.54	1.04	1.39	1.45	1.65
60-80	2.58	5.01	5.77	2.73	1.51	2.86	2.25	1.88	2.55	2.76	1.16	3.16	1.32	1.73	1.89	2.23
80-90	3.22	5.89	8.04	3.05	2.02	3.83	2.96	2.37	3.28	3.35	1.91	3.88	1.63	2.23	2.37	2.84
90-100	4.99	7.10	12.00	4.06	2.91	4.30	4.21	3.57	4.62	4.13	2.17	5.05	2.60	3.13	4.37	4.06
80-100	4.00	6.42	9.22	3.47	2.44	4.03	3.51	2.83	3.95	3.72	2.02	4.42	2.09	2.31	3.40	3.35
ALL	2.28	4.42	4.40	2.62	1.35	2.41	1.79	1.46	2.13	2.34	1.10	2.69	1.07	1.42	1.56	1.82

Source: Same as Table 8.

TABLE 10. EDUCATION INEQUALITY ACROSS ECONOMIC GROUPS- GINI CO-EFFICIENT IN 1986-87

Region	Karnataka	Kerala	Haryana	Assam	Bihar	Gujarat	W.Bengal	U.P	T.N	Punjab	Rajasthan	Maharashtra	M.P	Orissa	A.P	India
Urban																
Male	0.23	0.16	0.20	0.13	0.13	0.19	0.22	0.29	0.20	0.20	0.29	0.18	0.20	0.24	0.22	0.22
Female	0.29	0.16	0.27	0.16	0.16	0.24	0.27	0.39	0.23	0.23	0.39	0.25	0.29	0.33	0.31	0.29
Persons	0.26	0.17	0.24	0.15	0.15	0.22	0.23	0.33	0.21	0.22	0.33	0.21	0.23	0.28	0.26	0.26
Rural																
Male	0.17	0.13	0.12	0.08	0.17	0.17	0.26	0.18	0.18	0.16	0.18	0.16	0.22	0.22	0.25	0.19
Female	0.24	0.12	0.16	0.09	0.27	0.23	0.31	0.35	0.24	0.19	0.32	0.21	0.31	0.31	0.33	0.28
Persons	0.20	0.12	0.24	0.09	0.19	0.19	0.28	0.23	0.20	0.17	0.21	0.18	0.23	0.23	0.27	0.23

Source: Calculated from NSS data presented in tables 8 and 9.

TABLE 11A. CURRENT ENROLLMENT STATUS BY ECONOMIC GROUP-1986-87 RURAL INDIA

(per cent)

	0-10	10-20	0-20	20-40	40-60	60-80	80-90	90-100	80-100	ALL
Rural Male										
I-V	12.15	11.30	23.49	23.09	21.56	19.23	8.06	4.57	12.63	100.00
VI-VII	8.16	8.23	16.40	20.50	21.67	23.45	11.11	6.87	17.98	100.00
I-VII	11.24	10.60	21.88	22.50	21.59	20.19	8.76	5.09	13.85	100.00
VIII-X	6.91	8.02	14.93	17.50	20.45	23.92	13.17	10.04	23.21	100.00
PUC	6.04	5.53	11.57	14.35	18.85	25.11	15.82	14.30	30.11	100.00
>PUC	5.75	3.61	9.36	11.21	15.78	21.72	18.46	23.46	41.92	100.00
NR	3.34	6.06	9.60	18.47	18.35	26.27	9.61	17.71	27.32	100.00
ALL	10.06	9.73	19.79	20.94	21.12	21.18	10.10	6.86	16.97	100.00
Rural Female										
I-V	9.95	9.93	20.13	22.41	23.33	20.20	8.65	5.28	12.50	100.00
VI-VII	7.23	7.29	14.52	17.23	22.17	24.91	12.68	8.48	21.15	100.00
I-VII	9.46	9.46	19.13	21.49	23.12	21.04	9.37	5.85	14.04	100.00
VIII-X	5.94	5.66	11.60	13.80	17.62	26.40	17.41	13.17	30.58	100.00
PUC	4.39	3.50	7.93	10.68	15.61	24.85	16.79	24.17	40.96	100.00
>PUC	5.41	2.66	8.07	6.64	10.05	22.09	22.05	31.04	53.08	100.00
NR	3.70	6.25	9.95	20.34	17.72	16.18	19.63	16.18	35.81	100.00
ALL	8.82	8.73	17.55	20.04	21.86	21.71	11.19	7.65	18.84	100.00
Rural Persons										
I-V	11.34	10.77	22.11	22.82	22.13	17.59	8.52	4.88	13.40	100.00
VI-VII	7.88	7.94	15.82	19.48	21.83	23.91	11.60	7.37	18.97	100.00
I-VII	10.61	10.18	20.79	22.12	22.07	18.91	9.16	5.40	14.57	100.00
VIII-X	6.66	7.42	14.07	16.54	19.72	24.55	14.26	10.85	25.10	100.00
PUC	5.68	5.09	10.78	13.56	18.15	25.06	16.03	16.43	32.46	100.00
>PUC	5.70	3.34	9.11	10.06	14.47	22.08	19.04	25.21	44.28	100.00
NR	3.58	6.12	9.70	19.00	18.17	23.12	12.44	17.28	29.72	100.00
ALL	9.64	9.36	19.09	20.63	21.36	21.36	10.47	7.13	17.60	100.00

Source: Calculated from NSS 42nd round data on *Participation in Education Report No. 365.*

TABLE 11B. CURRENT ENROLLMENT STATUS BY ECONOMIC GROUP-1986-87 URBAN INDIA

(per cent)

	0-10	10-20	0-20	20-40	40-60	60-80	80-90	90-100	80-100	ALL
Urban Male										
I-V	13.65	12.08	25.73	29.24	20.63	15.18	5.20	4.04	9.24	100.00
VI-VII	9.96	9.47	19.43	25.75	24.62	18.95	5.90	5.34	11.24	100.00
I-VII	12.74	11.44	24.18	28.38	21.61	16.11	5.38	4.36	9.74	100.00
VIII-X	9.13	7.32	16.45	22.19	22.88	23.46	8.50	6.51	15.01	100.00
PUC	5.68	5.13	10.81	15.21	19.82	27.53	14.55	12.09	26.63	100.00
>PUC	3.83	3.66	7.50	9.48	15.36	21.16	18.06	28.44	46.50	100.00
NR	2.92	5.36	8.28	13.13	20.29	26.35	18.63	13.33	31.96	100.00
ALL	10.64	9.41	20.05	24.39	21.19	18.96	7.89	7.52	15.41	100.00
Urban Female										
I-V	14.09	11.54	25.64	27.03	20.67	17.30	5.39	3.87	9.26	100.00
VI-VII	9.92	9.16	19.08	24.11	22.72	21.53	8.10	4.46	12.56	100.00
I-VII	13.04	10.95	23.99	26.29	21.19	18.36	6.07	4.02	10.09	100.00
VIII-X	6.69	6.13	12.82	21.33	24.81	24.75	9.35	6.95	16.30	100.00
PUC	3.72	4.00	7.73	12.75	20.57	29.89	16.23	12.82	29.06	100.00
>PUC	3.65	2.31	6.00	7.30	15.60	26.15	22.91	22.19	44.81	100.00
NR	0.95	2.00	2.94	14.14	18.49	34.87	9.69	19.86	29.55	100.00
ALL	10.61	9.01	19.62	23.27	21.46	20.94	8.35	6.35	14.71	100.00
Urban Person										
I-V	13.84	11.86	25.70	21.78	20.64	16.15	5.29	3.96	9.25	100.00
VI-VII	9.93	9.39	19.31	24.99	23.75	20.09	6.88	4.98	11.86	100.00
I-VII	12.87	11.24	24.11	22.58	21.42	17.13	5.68	4.21	9.90	100.00
VIII-X	8.15	6.84	14.98	21.84	23.67	23.98	8.84	6.69	15.53	100.00
PUC	4.98	4.71	9.68	14.29	20.10	28.40	15.18	12.35	27.53	100.00
>PUC	3.77	3.18	6.96	8.74	15.46	22.95	19.65	26.26	45.90	100.00
NR	2.02	3.82	5.83	13.59	19.46	30.26	14.53	16.33	30.85	100.00
ALL	10.62	9.26	19.88	23.91	21.30	19.80	8.08	7.03	15.11	100.00

Source: Same as Table 11A.

APPENDIX

Levels of Education Code:

Not Literate	0
Literate but below primary/not undergone any formal education	1
Primary/Junior Basic	2
Middle /Senior Basic	3
Technical / Vocational Education	4
Matric /school leaving certificate	5
6 & Above include	
Higher secondary / Pre University /Intermediate	6
Under graduate diploma /certificate not equivalent to degree	7
Degree / diploma equivalent to degree (at graduation level)	8
Post graduate degree /diploma certificate	9
Not reported	n.r.

APPENDIX: TABLE (A.1): DISTRIBUTION OF POPULATION OF FRACTILE GROUPS OVER LEVEL OF EDUCATION ATTAINED ALL INDIA- RURAL

(per cent)

Fractile group	level of education code*								
	0	1	2	3	4	5	6 & Above	n.r	all
Male									
0-10	52.80	18.49	12.30	6.47	0.01	2.07	1.16	6.69	100.00
10-20	52.59	18.15	13.06	7.32	0.04	1.90	1.12	5.84	100.00
0-20	52.70	18.32	12.68	6.89	0.02	1.98	1.14	6.27	100.00
20-40	50.44	17.47	14.17	8.23	0.05	2.39	1.45	5.79	100.00
40-60	48.96	16.60	15.08	9.58	0.02	3.33	1.95	4.48	100.00
60-80	45.09	15.20	17.05	11.44	0.05	4.32	3.01	3.84	100.00
80-90	41.70	13.91	17.13	13.16	0.09	6.35	4.56	3.11	100.00
90-100	35.28	12.02	15.63	13.56	0.16	9.61	10.31	3.44	100.00
80-100	38.91	13.09	16.48	13.34	0.12	7.76	7.06	3.25	100.00
Female									
0-10	76.02	7.39	5.46	2.89	0.02	0.40	0.15	8.73	100.00
10-20	76.32	8.56	4.97	2.17	0.01	0.44	0.08	7.13	100.00
0-20	76.16	7.96	5.36	2.00	0.01	0.42	0.12	7.95	100.00
20-40	73.20	9.52	6.66	2.54	0.03	0.58	0.25	7.24	100.00
40-60	69.24	10.52	8.87	3.71	0.01	0.98	0.41	6.25	100.00
60-80	63.12	10.52	11.47	6.03	0.01	1.84	0.64	6.39	100.00
80-90	56.73	11.16	14.21	8.03	0.04	2.76	1.55	5.57	100.00
90-100	46.37	11.41	14.50	11.44	0.06	5.38	4.73	5.13	100.00
80-100	52.58	11.26	14.71	9.40	0.04	3.81	2.82	5.39	100.00

TABLE (A.2): DISTRIBUTION OF PERSONS OF FRACTILE GROUPS OVER LEVEL OF EDUCATION ATTAINED ALL INDIA- URBAN

(per cent)

Fractile group	level of education code*								
	0	1	2	3	4	5	6 & Above	n.r	all
Male									
0-10	40.78	19.35	16.29	11.62	1.89	3.68	3.57	3.15	100.00
10-20	39.20	18.77	17.38	11.64	0.56	4.50	3.15	3.93	100.00
0-20	39.99	19.05	16.81	11.63	1.24	4.08	3.36	3.53	100.00
20-40	30.36	18.67	19.31	15.15	1.06	6.31	5.82	2.91	100.00
40-60	22.67	15.16	19.42	17.13	1.72	11.07	10.78	2.21	100.00
60-80	16.12	12.10	17.12	16.49	2.13	14.59	20.11	1.91	100.00
80-90	10.69	9.45	13.64	13.68	2.16	17.07	32.15	1.75	100.00
90-100	6.45	8.34	10.22	9.54	2.33	14.56	48.19	1.14	100.00
80-100	8.76	8.94	12.07	11.79	2.24	15.92	39.47	1.47	100.00
Female									
0-10	57.32	15.20	12.52	6.20	0.03	1.83	1.51	5.43	100.00
10-20	58.73	14.03	12.64	6.26	0.05	1.93	0.91	5.46	100.00
0-20	57.99	14.63	12.57	6.22	0.04	1.88	1.21	5.44	100.00
20-40	49.16	15.44	15.88	9.64	0.01	3.49	2.24	4.13	100.00
40-60	37.56	15.13	18.20	13.66	0.02	6.35	5.42	3.68	100.00
60-80	25.94	12.90	19.30	15.60	0.05	10.71	11.88	3.33	100.00
80-90	16.32	10.16	16.05	16.21	0.13	15.45	22.76	2.96	100.00
90-100	10.66	9.98	12.62	13.27	0.01	16.09	35.03	2.31	100.00
80-100	13.88	10.07	14.57	14.94	0.08	15.73	28.05	2.68	100.00
ALL	40.88	14.13	15.93	11.23	0.03	6.36	4.53	4.07	100.00

TABLE (A.3): DISTRIBUTION OF PERSONS OF FRACTILE GROUPS OVER LEVEL OF EDUCATION ATTAINED ANDHRA PRADESH -RURAL

(per cent)

Fractile group	level of education code*								
	0	1	2	3	4	5	6 & Above	n.r	all
Male									
0-10	53.87	17.22	10.16	5.29	0.00	1.19	0.50	11.75	100.00
10-20	58.61	16.68	8.18	4.33	0.00	0.97	0.29	10.95	100.00
0-20	56.31	16.94	9.14	4.80	0.00	1.08	0.39	11.34	100.00
20-40	50.15	18.16	10.00	4.87	0.00	1.35	0.65	14.81	100.00
40-60	43.34	20.70	13.41	7.11	0.13	1.94	1.07	12.29	100.00
60-80	36.52	20.40	15.80	7.68	0.00	3.22	2.12	14.28	100.00
80-90	33.51	18.67	15.94	13.32	0.47	5.79	3.59	8.66	100.00
90-100	18.89	17.76	16.98	16.07	0.07	9.96	14.26	5.97	100.00
80-100	26.17	18.22	16.48	14.71	0.27	7.89	8.95	7.31	100.00
Female									
0-10	69.61	7.03	4.54	0.80	0.02	0.04	0.00	17.96	100.00
10-20	75.09	7.86	2.54	0.79	0.00	0.06	0.00	13.66	100.00
0-20	70.50	7.23	3.49	0.77	0.01	0.05	0.00	15.51	100.00
20-40	62.81	12.03	3.99	1.39	0.00	0.42	0.47	18.92	100.00
40-60	60.84	12.18	7.46	3.01	0.04	0.44	0.04	16.01	100.00
60-80	54.47	12.52	9.11	3.96	0.00	0.87	0.23	18.83	100.00
80-90	57.19	12.80	9.66	5.09	0.00	1.28	0.33	13.66	100.00
90-100	33.86	18.49	20.30	12.01	0.00	3.99	4.36	6.99	100.00
80-100	45.38	15.69	15.04	8.59	0.00	2.65	2.37	10.29	100.00

TABLE (A.4): DISTRIBUTION OF PERSONS OF FRACTILE GROUPS OVER LEVEL OF EDUCATION ATTAINED ANDHRA PRADESH- URBAN

(per cent)

Fractile group	level of education code*								
	0	1	2	3	4	5	6 & Above	n.r	all
Male									
0-10	42.76	20.24	14.85	9.19	0.20	2.12	4.45	6.19	100.00
10-20	36.15	23.26	16.19	11.39	0.33	3.41	0.87	8.38	100.00
0-20	39.56	21.69	15.52	10.25	0.26	2.74	2.73	7.24	100.00
20-40	31.64	18.95	16.83	15.36	0.09	5.37	5.12	6.71	100.00
40-60	21.06	19.84	18.78	13.26	0.14	11.51	9.33	6.07	100.00
60-80	12.90	15.00	15.97	18.82	1.44	15.53	13.66	6.68	100.00
80-90	6.62	13.16	12.09	15.64	0.00	16.18	32.64	3.65	100.00
90-100	4.04	9.59	8.15	12.76	0.00	18.66	43.90	2.85	100.00
80-100	5.48	11.58	10.35	14.37	0.00	12.40	37.63	3.30	100.00
Female									
0-10	57.87	12.70	7.93	4.45	0.00	2.05	1.00	14.01	100.00
10-20	51.15	20.46	8.28	3.37	0.00	1.54	0.29	14.88	100.00
0-20	54.41	16.70	8.11	3.90	0.00	1.79	0.63	14.46	100.00
20-40	48.83	16.52	10.68	7.62	0.00	2.04	0.99	13.64	100.00
40-60	36.92	19.10	15.59	11.10	0.00	4.70	3.06	9.51	100.00
60-80	25.30	17.82	15.52	16.18	0.05	5.50	7.17	12.46	100.00
80-90	17.96	9.89	19.14	15.64	0.03	16.12	13.47	7.82	100.00
90-100	12.04	13.06	15.76	17.02	0.00	15.72	22.64	3.77	100.00
80-100	15.32	11.30	17.56	16.25	0.01	15.94	17.55	6.01	100.00

TABLE (A.5): DISTRIBUTION OF PERSONS OF FRACTILE GROUPS OVER LEVEL OF EDUCATION ATTAINED ASSAM- RURAL

(per cent)

Fractile group	level of education code*								
	0	1	2	3	4	5	6 & Above	n.r	all
Male									
0-10	56.11	10.42	16.57	9.00	0.00	5.08	1.48	2.82	100.00
10-20	44.78	10.32	23.76	14.15	0.00	4.98	2.26	0.91	100.00
0-20	49.99	10.37	20.46	11.77	0.00	5.03	1.90	1.79	100.00
20-40	48.28	10.61	20.85	15.25	0.00	3.47	1.71	1.09	100.00
40-60	46.52	7.85	20.83	15.99	0.00	4.86	2.85	2.33	100.00
60-80	46.57	9.23	20.46	14.76	0.00	5.38	4.00	0.85	100.00
80-90	44.74	7.84	19.44	17.22	0.00	6.69	4.54	0.72	100.00
90-100	26.89	10.17	26.07	20.28	0.00	9.08	7.19	0.82	100.00
80-100	37.03	8.84	22.28	18.52	0.00	7.71	5.67	0.77	100.00
Female									
0-10	68.93	7.47	13.59	5.94	0.00	1.22	0.52	2.33	100.00
10-20	57.84	10.49	16.78	10.26	0.00	1.76	0.58	2.29	100.00
0-20	63.08	9.30	15.28	8.23	0.00	1.51	0.55	2.31	100.00
20-40	59.73	11.40	18.60	7.05	0.00	1.56	0.15	1.51	100.00
40-60	59.02	8.14	16.97	9.83	0.00	2.82	1.00	2.25	100.00
60-80	59.22	8.03	16.26	10.67	0.00	2.97	1.21	1.62	100.00
80-90	54.94	9.02	15.17	15.43	0.00	3.47	1.27	0.76	100.00
90-100	41.51	13.10	20.93	17.12	0.00	4.09	2.26	1.07	100.00
80-100	49.63	10.63	17.46	16.10	0.00	3.72	1.62	0.88	100.00

TABLE (A.6): DISTRIBUTION OF PERSONS OF FRACTILE GROUPS OVER LEVEL OF EDUCATION ATTAINED ASSAM- URBAN

(per cent)

Fractile group	level of education code*								
	0	1	2	3	4	5	6 & Above	n.r	all
Male									
0-10	27.38	12.48	28.19	14.33	0.00	12.02	7.46	1.51	100.00
10-20	31.75	12.28	21.89	15.69	0.00	6.45	9.37	2.57	100.00
0-20	29.64	10.77	24.93	15.03	0.00	9.14	8.47	2.06	100.00
20-40	22.31	6.11	23.27	23.16	0.00	11.59	12.97	0.59	100.00
40-60	16.94	11.10	11.97	23.10	0.81	15.14	17.83	3.11	100.00
60-80	16.28	7.00	15.05	20.36	0.24	17.59	21.33	2.18	100.00
80-90	7.41	6.46	13.34	18.86	1.60	22.11	27.46	2.79	100.00
90-100	13.78	3.55	7.14	1.45	0.00	14.44	57.44	2.22	100.00
80-100	10.13	5.29	10.84	11.70	0.94	19.06	40.74	2.57	100.00
Female									
0-10	39.77	13.76	20.72	16.93	0.00	3.65	0.52	4.60	100.00
10-20	30.73	14.76	24.79	11.09	0.00	6.34	4.78	1.27	100.00
0-20	36.71	14.63	23.23	14.70	0.00	5.02	2.54	3.18	100.00
20-40	34.03	13.33	19.79	14.84	0.00	11.52	4.44	1.98	100.00
40-60	25.20	10.91	18.72	21.32	0.00	12.26	7.75	3.81	100.00
60-80	18.34	11.82	9.22	27.50	0.70	13.16	17.23	1.92	100.00
80-90	9.03	14.72	9.84	20.36	0.00	18.24	23.23	4.56	100.00
90-100	16.84	12.46	9.42	10.99	0.15	11.02	38.11	0.99	100.00
80-100	12.90	13.59	9.63	15.68	0.07	14.64	30.66	2.78	100.00

TABLE (A.7): DISTRIBUTION OF PERSONS OF FRACTILE GROUPS OVER LEVEL OF EDUCATION ATTAINED BIHAR- RURAL

(per cent)

Fractile group	level of education code*								
	0	1	2	3	4	5	6 & Above	n.r	all
Male									
0-10	62.79	9.60	6.86	7.95	0.00	2.62	1.25	8.88	100.00
10-20	67.90	10.10	6.93	6.40	0.04	2.15	1.26	5.26	100.00
0-20	65.21	9.84	6.90	7.22	0.02	2.40	1.25	7.17	100.00
20-40	59.60	11.87	9.42	8.33	0.10	2.98	1.15	6.55	100.00
40-60	59.67	13.68	8.42	9.08	0.02	3.72	1.65	3.77	100.00
60-80	57.05	11.88	9.63	10.06	0.02	5.34	3.25	2.74	100.00
80-90	48.01	13.08	10.61	13.09	0.00	6.60	4.01	4.63	100.00
90-100	36.27	12.51	13.04	15.99	0.00	10.71	8.50	3.04	100.00
80-100	42.49	12.82	11.74	14.43	0.00	8.52	6.10	3.88	100.00
Female									
0-10	80.10	3.57	3.03	1.47	0.00	0.10	0.10	11.61	100.00
10-20	85.78	4.60	2.09	1.58	0.00	0.27	0.00	5.65	100.00
0-20	82.84	4.07	2.58	1.52	0.00	0.18	0.05	8.74	100.00
20-40	82.36	5.45	2.42	1.49	0.09	0.32	0.17	7.71	100.00
40-60	83.03	7.02	2.73	1.99	0.00	0.39	0.08	4.77	100.00
60-80	80.97	7.77	3.95	3.10	0.00	0.58	0.18	3.47	100.00
80-90	71.79	8.58	4.90	5.38	0.02	1.40	0.72	7.19	100.00
90-100	69.97	8.43	5.92	6.49	0.00	3.07	1.23	4.99	100.00
80-100	70.91	8.51	5.36	5.88	0.01	2.16	0.95	6.18	100.00

TABLE (A.8): DISTRIBUTION OF PERSONS OF FRACTILE GROUPS OVER LEVEL OF EDUCATION ATTAINED BIHAR- URBAN

(per cent)

Fractile group	level of education code*								
	0	1	2	3	4	5	6 & Above	n.r	all
Male									
0-10	57.05	15.10	7.28	9.60	0.00	4.80	4.68	1.44	100.00
10-20	52.60	21.91	11.78	8.95	0.00	1.89	2.21	0.71	100.00
0-20	54.77	18.59	9.59	9.26	0.00	3.30	3.42	1.07	100.00
20-40	48.18	14.28	10.45	14.28	0.03	6.00	5.20	1.59	100.00
40-60	32.17	13.26	14.59	15.48	0.00	11.38	10.26	2.85	100.00
60-80	21.50	12.87	11.20	20.26	0.13	11.73	21.18	1.15	100.00
80-90	7.30	14.17	6.60	17.17	0.00	18.52	36.20	0.12	100.00
90-100	13.94	6.44	6.26	19.65	0.00	14.47	39.04	0.27	100.00
80-100	10.76	10.12	6.42	18.43	0.00	16.39	37.65	0.20	100.00
Female									
0-10	74.84	9.47	5.22	7.28	0.31	1.47	1.03	0.43	100.00
10-20	76.89	11.20	4.48	4.01	0.00	0.62	0.48	2.31	100.00
0-20	75.91	10.37	4.83	5.57	0.15	1.02	0.74	1.41	100.00
20-40	70.50	11.72	6.35	5.35	0.00	3.70	0.82	1.85	100.00
40-60	53.58	16.09	10.67	9.66	0.00	3.41	2.50	4.12	100.00
60-80	45.21	15.37	10.48	13.28	0.00	7.26	7.27	1.10	100.00
80-90	22.99	18.77	16.37	13.45	0.00	14.28	18.85	0.00	100.00
90-100	22.75	9.59	7.83	19.72	0.92	14.37	23.90	0.90	100.00
80-100	20.68	13.77	11.72	16.87	0.50	14.33	21.61	0.49	100.00

TABLE (A.9): DISTRIBUTION OF PERSONS OF FRACTILE GROUPS OVER LEVEL OF EDUCATION ATTAINED GUJARAT- RURAL

(per cent)

Fractile group	level of education code*								
	0	1	2	3	4	5	6 & Above	n.r	all
Male									
0-10	53.52	15.15	13.49	7.16	0.00	3.35	1.25	6.07	100.00
10-20	50.37	13.88	14.23	10.04	0.00	2.64	1.23	7.65	100.00
0-20	51.92	14.50	13.86	8.62	0.00	2.99	1.24	6.87	100.00
20-40	42.74	17.13	18.31	8.81	0.19	4.53	0.98	7.33	100.00
40-60	41.17	15.50	18.93	14.31	0.00	2.73	1.63	5.73	100.00
60-80	33.82	13.77	23.42	16.59	0.00	4.78	2.74	4.89	100.00
80-90	29.35	8.85	22.28	22.26	0.18	9.20	5.81	2.05	100.00
90-100	24.82	7.27	23.50	16.95	1.04	10.67	9.33	6.43	100.00
80-100	27.39	8.17	22.81	19.96	0.55	9.83	7.33	3.94	100.00
Female									
0-10	66.68	8.94	9.81	2.58	0.00	1.34	0.00	10.65	100.00
10-20	67.04	12.28	7.64	3.47	0.00	0.69	0.73	8.12	100.00
0-20	66.86	10.59	8.73	3.02	0.00	1.02	0.36	9.40	100.00
20-40	65.43	10.28	9.08	5.14	0.23	0.97	0.55	8.31	100.00
40-60	62.32	10.19	12.09	6.11	0.00	1.23	0.53	7.51	100.00
60-80	50.43	8.74	16.89	10.01	0.00	3.02	0.60	10.30	100.00
80-90	42.42	11.11	17.25	14.82	0.00	4.77	1.88	7.74	100.00
90-100	46.25	7.78	13.69	15.75	0.00	7.33	3.09	6.19	100.00
80-100	43.95	9.75	15.80	15.20	0.00	5.81	2.38	7.11	100.00

TABLE (A.10): DISTRIBUTION OF PERSONS OF FRACTILE GROUPS OVER LEVEL OF EDUCATION ATTAINED GUJARAT- URBAN

(per cent)

Fractile group	level of education code*								
	0	1	2	3	4	5	6 & Above	n.r	all
Male									
0-10	37.83	16.94	22.54	12.91	0.00	3.94	0.90	4.91	100.00
10-20	38.74	13.08	24.99	10.72	0.00	6.03	2.36	4.07	100.00
0-20	38.29	14.99	23.77	11.81	0.00	5.00	1.64	4.49	100.00
20-40	23.31	16.90	20.70	20.55	0.81	9.59	4.42	3.73	100.00
40-60	18.71	10.45	27.32	19.01	0.00	12.29	9.34	2.87	100.00
60-80	14.54	8.66	23.47	18.37	0.10	15.60	14.42	3.18	100.00
80-90	6.13	9.39	19.59	11.91	0.00	17.73	28.68	6.07	100.00
90-100	5.57	6.27	15.48	12.86	0.00	12.95	41.03	5.68	100.00
80-100	5.90	7.97	17.73	12.35	0.00	15.61	34.32	6.14	100.00
Female									
0-10	53.96	13.84	17.85	5.01	0.00	1.60	1.25	6.48	100.00
10-20	55.73	10.75	16.71	5.39	0.00	2.92	1.90	6.61	100.00
0-20	54.83	12.30	17.29	5.20	0.00	2.26	1.57	6.54	100.00
20-40	40.97	10.78	19.27	15.06	0.00	6.30	1.37	6.23	100.00
40-60	33.20	9.97	28.15	12.45	0.00	7.47	4.78	3.99	100.00
60-80	20.67	9.26	23.16	17.84	0.13	12.87	9.00	7.04	100.00
80-90	12.68	9.87	24.30	12.87	0.00	15.04	21.08	4.15	100.00
90-100	10.13	5.78	22.44	11.94	0.00	17.71	26.25	5.70	100.00
0-100	11.66	8.24	23.56	12.49	0.00	16.10	23.14	4.76	100.00

TABLE (A.11): DISTRIBUTION OF PERSONS OF FRACTILE GROUPS OVER LEVEL OF EDUCATION ATTAINED HARYANA- RURAL

(per cent)

Fractile group	level of education code*								
	0	1	2	3	4	5	6 & Above	n.r	all
Male									
0-10	27.57	20.16	17.56	6.41	0.00	3.86	1.60	22.81	100.00
10-20	47.67	20.47	12.55	4.44	0.00	1.40	1.78	11.69	100.00
0-20	38.52	20.33	14.83	5.33	0.00	2.52	1.70	16.75	100.00
20-40	41.04	18.44	14.71	7.24	0.00	4.95	1.57	12.05	100.00
40-60	29.10	14.57	19.35	10.67	0.00	8.39	2.30	15.62	100.00
60-80	32.33	18.97	16.45	11.98	0.00	8.55	3.88	7.82	100.00
80-90	31.82	18.21	15.85	9.06	0.00	10.00	4.66	10.43	100.00
90-100	27.25	16.96	18.61	15.58	0.00	9.19	5.07	7.29	100.00
80-100	29.74	17.64	17.11	12.03	0.00	9.63	4.85	9.00	100.00
Female									
0-10	43.12	11.10	9.78	2.65	0.00	0.24	0.00	33.16	100.00
10-20	55.65	13.61	7.46	0.70	0.00	0.00	0.00	22.61	100.00
0-20	49.39	12.36	8.60	1.67	0.00	0.12	0.00	27.82	100.00
20-40	60.29	11.62	7.96	0.94	0.00	0.20	0.09	18.90	100.00
40-60	50.55	12.71	9.51	4.27	0.00	1.91	0.36	20.68	100.00
60-80	57.28	10.17	10.06	4.98	0.25	1.75	0.69	14.84	100.00
80-90	54.75	5.33	13.17	3.22	0.00	2.87	3.10	17.57	100.00
90-100	53.21	12.03	11.61	4.76	0.00	2.34	2.45	13.55	100.00
80-100	54.08	8.27	12.48	3.89	0.00	2.64	2.81	15.82	100.00

TABLE (A.12): DISTRIBUTION OF PERSONS OF FRACTILE GROUPS OVER LEVEL OF EDUCATION ATTAINED HARYANA- URBAN

(per cent)

Fractile group	level of education code*								
	0	1	2	3	4	5	6 & Above	n.r	all
Male									
0-10	38.37	26.68	14.02	11.92	0.00	6.80	3.32	0.29	100.00
10-20	33.34	13.39	20.75	19.27	0.00	10.85	2.40	0.42	100.00
0-20	35.98	19.62	17.22	15.42	0.00	8.73	2.67	0.35	100.00
20-40	24.31	19.24	22.36	9.08	0.00	14.57	7.13	3.32	100.00
40-60	26.01	17.88	16.23	10.48	0.00	15.63	13.14	0.53	100.00
60-80	15.93	19.25	15.44	9.51	0.26	18.51	21.01	0.00	100.00
80-90	9.03	12.33	11.44	11.18	0.00	22.57	33.50	0.00	100.00
90-100	0.00	0.00	2.03	0.53	0.00	3.27	91.66	2.59	100.00
80-100	5.47	7.47	7.72	6.98	0.00	14.96	56.34	1.02	100.00
Female									
0-10	72.77	11.16	5.01	5.24	0.00	1.69	1.60	2.50	100.00
10-20	51.74	20.95	15.71	4.81	0.00	5.51	1.30	0.00	100.00
0-20	61.82	16.26	10.58	5.02	0.00	3.68	1.44	1.20	100.00
20-40	47.67	17.13	12.68	5.60	0.00	9.93	6.77	0.22	100.00
40-60	38.87	17.26	14.66	9.16	0.00	12.19	7.88	0.00	100.00
60-80	30.34	17.41	11.32	14.60	0.00	13.51	12.43	0.38	100.00
80-90	11.77	17.84	19.40	4.68	0.00	15.06	30.48	0.87	100.00
90-100	4.79	0.00	14.20	0.00	0.00	14.14	67.24	0.00	100.00
80-100	10.95	15.77	18.77	4.14	0.00	14.92	34.55	0.77	100.00

TABLE (A.13): DISTRIBUTION OF PERSONS OF FRACTILE GROUPS OVER LEVEL OF EDUCATION ATTAINED KERALA -RURAL

(per cent)

Fractile group	level of education code*								
	0	1	2	3	4	5	6 & Above	n.r	all
Male									
0-10	24.46	24.33	27.47	14.29	0.00	4.88	0.79	3.79	100.00
10-20	22.34	22.30	31.13	17.16	0.00	1.68	0.97	4.44	100.00
0-20	23.41	23.32	29.29	15.71	0.00	3.30	0.88	4.11	100.00
20-40	17.64	19.42	31.64	17.75	0.08	5.54	1.22	6.73	100.00
40-60	14.48	19.46	30.72	21.86	0.36	6.73	3.49	2.91	100.00
60-80	10.75	17.96	28.65	24.03	0.23	9.24	5.65	3.51	100.00
80-90	8.88	12.79	27.60	23.49	0.38	15.97	8.67	2.15	100.00
90-100	7.27	12.50	18.85	18.91	0.68	16.13	22.03	3.69	100.00
80-100	8.14	12.66	23.59	21.38	0.52	16.04	14.24	2.86	100.00
Female									
0-10	26.09	21.89	27.67	14.95	0.00	3.86	1.15	4.36	100.00
10-20	23.05	21.52	29.67	13.06	0.00	5.12	1.17	6.38	100.00
0-20	24.61	21.73	28.66	14.03	0.00	4.48	1.16	5.35	100.00
20-40	22.27	19.02	28.26	15.23	0.00	5.35	1.66	8.21	100.00
40-60	22.29	17.12	28.69	18.91	0.09	6.36	3.48	3.07	100.00
60-80	16.68	15.84	25.47	22.75	0.00	8.75	5.20	5.34	100.00
80-90	12.66	13.09	25.42	24.25	0.00	13.62	8.08	2.82	100.00
90-100	8.94	11.49	20.07	24.47	0.90	14.53	16.38	3.21	100.00
80-100	11.11	12.44	23.18	24.36	0.38	14.00	11.53	2.99	100.00

TABLE (A.14): DISTRIBUTION OF PERSONS OF FRACTILE GROUPS OVER LEVEL OF EDUCATION ATTAINED KERALA -URBAN

(per cent)

Fractile group	level of education code*								
	0	1	2	3	4	5	6 & Above	n.r	all
Male									
0-10	17.12	22.63	28.23	18.77	0.00	6.54	2.84	3.86	100.00
10-20	11.94	22.84	34.89	17.90	0.00	7.73	0.00	4.72	100.00
0-20	14.47	22.74	31.62	18.33	0.00	7.15	1.39	4.30	100.00
20-40	14.75	17.49	28.08	22.63	0.35	8.89	3.80	4.02	100.00
40-60	10.53	14.46	26.95	29.18	0.40	9.59	4.91	3.97	100.00
60-80	6.50	10.12	21.56	27.48	0.25	15.29	14.50	4.32	100.00
80-90	7.91	5.54	13.82	20.78	0.00	15.84	36.13	0.00	100.00
90-100	3.51	6.55	11.53	18.89	0.60	12.18	46.11	0.70	100.00
80-100	5.47	6.08	12.36	19.77	0.32	13.87	41.49	0.38	100.00
Female									
0-10	24.82	23.23	26.90	16.04	0.00	3.78	0.44	4.76	100.00
10-20	15.68	21.17	29.28	19.19	0.00	5.23	1.70	7.72	100.00
0-20	19.99	22.16	28.17	17.72	0.00	4.55	1.11	6.33	100.00
20-40	16.11	18.66	27.09	21.29	0.35	7.97	3.16	5.35	100.00
40-60	13.61	14.04	25.92	24.80	0.40	13.54	4.15	3.54	100.00
60-80	10.05	13.86	22.01	23.23	0.31	14.13	12.47	3.94	100.00
80-90	17.55	2.34	18.36	15.84	0.00	20.92	23.15	1.83	100.00
90-100	6.90	12.25	8.71	13.77	0.00	13.58	44.74	0.00	100.00
80-100	12.71	6.84	14.00	14.90	0.00	17.58	32.98	1.00	100.00

TABLE (A.15): DISTRIBUTION OF PERSONS OF FRACTILE GROUPS OVER LEVEL OF EDUCATION ATTAINED KARNATAKA- RURAL

(per cent)

Fractile group	level of education code*								
	0	1	2	3	4	5	6 & Above	n.r	all
Male									
0-10	59.90	20.45	21.78	9.14	0.00	1.75	0.70	20.71	100.00
10-20	58.92	20.87	17.75	8.98	0.00	2.84	1.76	23.32	100.00
0-20	54.27	20.45	21.04	13.10	0.00	3.50	1.21	20.88	100.00
20-40	51.21	19.50	22.51	15.03	0.00	4.70	2.53	18.96	100.00
40-60	44.59	19.18	25.65	16.20	0.00	7.32	3.05	18.47	100.00
60-80	39.84	15.43	29.50	20.24	0.00	9.32	3.76	16.35	100.00
80-90	20.12	13.64	22.04	27.85	0.00	12.34	18.15	20.20	100.00
90-100	30.84	14.61	26.08	23.73	0.00	10.71	10.35	18.11	100.00
80-100	49.17	19.21	22.30	14.82	0.00	5.46	3.36	20.14	100.00
Female									
0-10	57.77	9.34	5.88	2.28	0.00	0.28	0.00	24.43	100.00
10-20	55.77	8.13	6.37	2.92	0.00	0.24	0.19	26.39	100.00
0-20	58.19	7.85	7.68	4.54	0.00	0.66	0.30	20.82	100.00
20-40	53.37	11.15	10.27	4.89	0.00	1.75	0.38	18.15	100.00
40-60	47.33	12.29	11.21	6.19	0.00	2.28	0.50	20.24	100.00
60-80	42.76	9.03	13.12	12.10	0.00	3.14	1.61	18.21	100.00
80-90	30.45	8.01	16.98	13.22	0.00	4.46	3.67	23.27	100.00
90-100	37.27	8.58	14.85	12.60	0.00	3.73	2.53	20.46	100.00
80-100	51.54	9.46	9.57	5.71	0.00	1.52	0.66	21.54	100.00

TABLE (A.16): DISTRIBUTION OF PERSONS OF FRACTILE GROUPS OVER LEVEL OF EDUCATION ATTAINED KARNATAKA- URBAN

(per cent)

Fractile group	level of education code*								
	0	1	2	3	4	5	6 & Above	n.r	all
Male									
0-10	36.53	17.55	16.24	18.97	0.00	2.34	1.85	6.67	100.00
10-20	41.61	15.99	14.57	16.01	0.00	3.57	2.61	5.64	100.00
0-20	30.21	17.51	17.24	16.02	0.00	6.29	4.50	8.25	100.00
20-40	20.94	14.19	20.56	22.03	0.06	9.89	7.41	4.90	100.00
40-60	17.64	8.95	16.21	20.54	0.06	15.04	16.53	5.03	100.00
60-80	5.77	10.99	11.88	12.40	0.94	20.13	36.56	1.32	100.00
80-90	4.30	11.85	3.99	7.74	0.00	18.42	50.64	3.02	100.00
90-100	5.11	11.39	8.25	10.32	0.52	19.38	42.89	2.08	100.00
80-100	25.65	14.18	16.04	17.41	0.09	9.55	11.55	5.53	100.00
Female									
0-10	54.30	13.91	15.28	5.78	0.00	1.51	0.97	8.20	100.00
10-20	53.79	13.36	15.07	6.61	0.00	1.92	0.72	7.93	100.00
0-20	42.50	15.74	15.88	11.53	0.00	3.98	0.90	9.48	100.00
20-40	32.41	14.94	17.54	18.61	0.00	5.49	2.09	8.92	100.00
40-60	28.14	13.25	15.69	20.62	0.08	8.62	5.93	7.68	100.00
60-80	14.74	11.44	15.68	15.59	0.29	17.17	21.97	3.28	100.00
80-90	5.38	3.50	11.98	13.60	0.00	22.53	38.09	4.18	100.00
90-100	11.09	8.10	14.12	14.75	0.17	19.43	28.66	3.66	100.00
80-100	37.41	13.64	15.77	13.57	0.03	6.30	5.15	8.14	100.00

TABLE (A.17): DISTRIBUTION OF PERSONS OF FRACTILE GROUPS OVER LEVEL OF EDUCATION ATTAINED MAHARASHTRA- RURAL

(per cent)

Fractile group	level of education code*								
	0	1	2	3	4	5	6 & Above	n.r	all
Male									
0-10	48.14	14.42	15.74	7.94	0.00	2.56	0.93	10.25	100.00
10-20	38.28	14.81	20.10	11.05	0.05	2.71	1.35	11.61	100.00
0-20	43.23	14.62	17.92	9.49	0.03	2.63	1.14	10.93	100.00
20-40	35.47	16.42	20.28	13.03	0.05	3.06	1.24	10.47	100.00
40-60	33.50	15.35	22.74	15.67	0.04	4.74	1.51	6.43	100.00
60-80	27.66	13.82	23.33	18.66	0.00	5.66	3.95	6.94	100.00
80-90	24.80	11.25	20.22	19.35	0.11	10.97	6.50	6.79	100.00
90-100	18.39	10.15	20.76	18.87	0.21	14.25	13.57	3.75	100.00
80-100	21.86	10.75	20.47	19.13	0.16	12.48	9.74	5.40	100.00
Female									
0-10	60.68	9.52	9.39	3.15	0.00	0.90	0.00	16.32	100.00
10-20	54.69	11.73	8.94	4.21	0.00	0.90	0.11	19.42	100.00
0-20	57.78	10.59	9.17	3.66	0.00	0.90	0.05	17.83	100.00
20-40	54.09	12.48	12.21	4.81	0.00	0.65	0.37	15.41	100.00
40-60	52.94	11.36	14.93	7.63	0.05	1.35	0.17	11.55	100.00
60-80	46.48	10.70	17.55	9.74	0.00	1.82	0.58	13.17	100.00
80-90	42.61	10.05	18.89	11.75	0.11	4.20	1.85	10.49	100.00
90-100	36.23	8.24	20.59	15.16	0.00	8.02	4.21	7.60	100.00
80-100	39.76	9.24	19.65	13.28	0.06	5.91	2.91	9.21	100.00

TABLE (A.18): DISTRIBUTION OF PERSONS OF FRACTILE GROUPS OVER LEVEL OF EDUCATION ATTAINED MAHARASHTRA- URBAN

(per cent)

Fractile group	level of education code*								
	0	1	2	3	4	5	6 & Above	n.r	all
Male									
0-10	34.44	14.19	21.55	15.40	0.05	5.97	3.88	4.55	100.00
10-20	30.35	18.03	23.52	15.76	0.00	7.33	2.86	2.14	100.00
0-20	32.42	16.09	22.52	15.58	0.03	6.65	3.38	3.35	100.00
20-40	21.48	14.98	21.77	19.69	0.04	11.68	5.84	4.53	100.00
40-60	18.40	10.96	21.53	17.46	0.28	17.09	11.71	2.54	100.00
60-80	12.21	7.22	20.91	17.31	0.09	22.04	17.58	2.64	100.00
80-90	9.17	7.39	13.82	13.97	0.44	22.28	30.64	2.25	100.00
90-100	4.72	4.76	15.93	7.54	0.00	23.32	42.42	1.39	100.00
80-100	7.24	6.26	14.73	11.19	0.25	22.73	35.74	1.88	100.00
Female									
0-10	49.09	14.02	16.23	8.84	0.00	2.40	1.01	8.32	100.00
10-20	50.23	12.65	18.22	11.66	0.09	2.36	0.87	3.87	100.00
0-20	49.66	13.36	17.25	10.21	0.05	2.38	0.94	6.16	100.00
20-40	35.53	12.87	22.82	16.43	0.00	5.54	2.13	4.65	100.00
40-60	31.63	8.87	21.54	17.62	0.08	11.54	5.52	3.22	100.00
60-80	19.40	6.25	23.46	17.84	0.20	16.39	11.42	5.04	100.00
80-90	11.54	5.49	18.85	19.08	0.04	19.75	22.42	2.88	100.00
90-100	6.51	5.06	12.60	11.82	0.00	24.89	35.70	3.26	100.00
80-100	9.38	5.31	16.14	15.94	0.02	21.97	28.14	3.04	100.00

TABLE (A.19): DISTRIBUTION OF PERSONS OF FRACTILE GROUPS OVER LEVEL OF EDUCATION ATTAINED MADHYA PRADESH- RURAL

(per cent)

Fractile group	level of education code*								
	0	1	2	3	4	5	6 & Above	n.r	all
Male									
0-10	67.87	18.93	8.54	1.68	0.05	0.24	0.54	2.19	100.00
10-20	68.29	18.19	8.28	2.54	0.00	0.76	0.97	0.96	100.00
0-20	68.04	18.58	8.41	2.08	0.02	0.48	0.74	1.62	100.00
20-40	61.24	20.20	11.14	3.30	0.00	0.76	1.12	2.26	100.00
40-60	57.14	20.17	12.95	4.92	0.00	1.15	1.98	1.67	100.00
60-80	50.59	23.08	15.06	5.63	0.00	1.07	3.37	1.18	100.00
80-90	46.41	19.86	19.17	6.65	0.03	1.69	4.54	1.61	100.00
90-100	38.79	19.05	17.28	9.54	0.00	3.98	10.53	0.83	100.00
80-100	42.95	19.49	18.34	7.96	0.02	2.73	7.25	1.26	100.00
Female									
0-10	89.00	5.26	2.24	0.38	0.00	0.02	0.00	3.09	100.00
10-20	88.42	7.09	1.94	0.34	0.00	0.00	0.00	2.15	100.00
0-20	88.76	6.12	2.10	0.36	0.00	0.01	0.00	2.65	100.00
20-40	84.14	7.75	3.05	0.53	0.00	0.14	0.09	4.27	100.00
40-60	82.11	9.20	5.04	1.06	0.00	0.27	0.12	2.20	100.00
60-80	80.11	10.22	4.92	1.78	0.00	0.41	0.68	1.89	100.00
80-90	77.46	10.72	5.59	2.75	0.00	0.60	0.68	2.24	100.00
90-100	66.90	10.80	9.46	6.96	0.00	0.87	2.53	2.39	100.00
80-100	72.70	10.76	7.34	4.65	0.00	0.72	1.51	2.31	100.00

TABLE (A.20): DISTRIBUTION OF PERSONS OF FRACTILE GROUPS OVER LEVEL OF EDUCATION ATTAINED MADHYA PRADESH- URBAN

(per cent)

Fractile group	level of education code*								
	0	1	2	3	4	5	6 & Above	n.r	all
Male									
0-10	40.50	22.00	17.15	9.60	0.13	1.29	6.86	2.43	100.00
10-20	28.03	26.52	21.61	12.67	0.11	3.12	4.45	3.53	100.00
0-20	34.12	24.31	19.43	11.17	0.12	2.23	5.62	2.99	100.00
20-40	28.72	22.36	20.56	11.49	0.09	3.23	11.80	1.73	100.00
40-60	20.12	22.15	22.10	13.16	0.00	4.23	16.88	1.36	100.00
60-80	15.57	15.71	18.34	16.52	0.15	5.03	27.37	1.33	100.00
80-90	11.45	15.76	11.65	15.83	0.00	8.04	36.98	0.33	100.00
90-100	7.92	10.46	11.53	10.78	0.58	3.50	53.03	1.90	100.00
80-100	9.73	13.19	11.59	13.38	0.28	5.84	44.87	1.09	100.00
Female									
0-10	62.18	24.57	10.65	3.48	0.00	0.23	2.78	2.65	100.00
10-20	58.03	16.31	14.42	2.99	0.13	0.53	1.72	5.86	100.00
0-20	60.11	17.17	12.54	3.24	0.06	0.38	2.25	4.25	100.00
20-40	53.35	18.03	13.10	7.69	0.00	1.60	3.62	2.60	100.00
40-60	44.09	15.41	18.18	9.77	0.00	2.27	7.60	2.70	100.00
60-80	35.64	16.44	16.01	10.64	0.00	2.26	17.26	1.76	100.00
80-90	26.14	16.74	11.31	12.52	0.00	5.61	25.47	2.25	100.00
90-100	17.63	10.84	11.17	11.77	0.00	6.31	40.66	1.58	100.00
80-100	22.21	14.02	11.25	12.18	0.00	5.93	32.48	1.94	100.00

TABLE (A.21): DISTRIBUTION OF PERSONS OF FRACTILE GROUPS OVER LEVEL OF EDUCATION ATTAINED ORISSA- RURAL

(per cent)

Fractile group	level of education code*								
	0	1	2	3	4	5	6 & Above	n.r	all
Male									
0-10	75.31	12.86	6.33	2.99	0.00	0.16	0.13	2.20	100.00
10-20	70.64	13.60	8.14	5.44	0.00	0.63	0.39	1.21	100.00
0-20	73.00	13.23	7.22	4.20	0.00	0.40	0.26	1.71	100.00
20-40	59.19	18.65	11.55	8.08	0.00	1.17	1.07	0.28	100.00
40-60	51.78	21.82	13.14	9.97	0.03	1.89	0.96	0.42	100.00
60-80	46.46	20.61	15.24	13.06	0.09	3.15	0.88	0.49	100.00
80-90	43.59	17.98	15.97	14.83	0.16	4.45	2.34	0.71	100.00
90-100	32.59	19.97	13.72	17.31	0.92	7.13	6.29	2.06	100.00
80-100	38.55	18.90	14.94	15.97	0.51	5.67	4.15	1.33	100.00
Female									
0-10	90.21	5.16	1.36	0.99	0.00	0.06	0.14	2.04	100.00
10-20	85.03	8.10	3.03	2.01	0.00	0.13	0.00	1.66	100.00
0-20	87.62	6.63	2.20	1.50	0.00	0.09	0.07	1.85	100.00
20-40	82.00	9.38	4.53	3.01	0.00	0.46	0.07	0.54	100.00
40-60	74.99	12.26	7.39	4.08	0.00	0.61	0.26	0.40	100.00
60-80	68.77	13.51	10.28	5.66	0.00	0.84	0.13	0.80	100.00
80-90	61.59	14.81	10.30	8.71	0.00	2.47	0.58	1.55	100.00
90-100	56.98	13.05	11.77	11.98	0.32	3.33	2.46	0.18	100.00
80-100	59.60	14.08	10.92	10.08	0.13	2.83	1.37	0.98	100.00

TABLE (A.22): DISTRIBUTION OF PERSONS OF FRACTILE GROUPS OVER LEVEL OF EDUCATION ATTAINED ORISSA- URBAN

(per cent)

Fractile group	level of education code*								
	0	1	2	3	4	5	6 & Above	n.r	all
Male									
0-10	53.62	21.53	11.36	8.29	0.77	1.64	1.26	1.52	00.00
10-20	34.88	23.72	15.15	21.10	0.00	2.53	2.00	0.64	100.00
0-20	44.04	22.65	13.30	14.84	0.38	2.09	1.64	1.07	100.00
20-40	33.67	21.16	12.23	18.91	0.00	7.65	3.54	2.86	100.00
40-60	15.74	19.25	12.43	29.14	0.54	9.47	12.97	0.46	100.00
60-80	23.11	8.98	12.14	16.04	0.00	17.51	22.25	0.00	100.00
80-90	17.57	9.17	8.72	15.07	0.00	21.53	26.91	1.08	100.00
90-100	6.91	8.00	5.34	10.45	0.00	13.61	50.61	5.05	100.00
80-100	12.82	8.65	7.22	13.03	0.00	18.02	37.43	2.84	100.00
Female									
0-10	71.98	13.55	8.13	2.50	0.00	0.95	0.80	2.08	100.00
10-20	64.07	14.24	10.61	9.40	0.00	0.73	0.39	0.60	100.00
0-20	67.94	13.90	9.40	6.03	0.00	0.84	0.59	1.32	100.00
20-40	59.04	17.04	10.78	8.02	0.00	2.95	0.95	1.20	100.00
40-60	26.81	19.77	12.88	22.33	0.00	8.65	4.79	4.77	100.00
60-80	28.89	15.16	17.61	20.73	0.00	7.70	7.70	2.17	100.00
80-90	21.29	4.12	6.76	27.75	0.00	16.64	22.62	0.82	100.00
90-100	13.09	7.43	5.67	20.05	0.00	19.72	33.42	0.69	100.00
80-100	17.08	5.82	6.19	23.79	0.00	18.19	28.11	0.75	100.00

TABLE (A.23): DISTRIBUTION OF PERSONS OF FRACTILE GROUPS OVER LEVEL OF EDUCATION ATTAINED PUNJAB- RURAL

(per cent)

Fractile group	level of education code*								
	0	1	2	3	4	5	6 & Above	n.r	all
Male									
0-10	56.44	11.53	13.73	6.83	0.84	1.90	2.40	6.37	100.00
10-20	53.60	14.55	13.42	4.72	0.00	2.98	0.90	9.72	100.00
0-20	55.03	13.03	13.57	5.82	0.42	2.44	1.65	8.03	100.00
20-40	40.90	17.43	16.70	7.58	0.00	5.56	0.97	10.86	100.00
40-60	46.95	13.77	14.34	8.08	0.00	5.91	1.95	9.00	100.00
60-80	37.65	17.99	18.43	9.28	0.00	8.21	3.08	5.33	100.00
80-90	31.73	19.68	17.52	9.30	0.00	10.05	5.82	5.81	100.00
90-100	29.33	12.39	13.40	15.79	0.00	13.68	10.33	5.02	100.00
80-100	30.64	16.23	15.57	12.39	0.00	11.78	7.97	5.44	100.00
Female									
0-10	61.36	12.41	10.22	1.67	0.28	1.18	1.25	11.32	100.00
10-20	64.12	9.34	7.72	2.41	0.00	0.82	0.00	15.63	100.00
0-20	62.64	11.00	9.07	2.01	0.15	1.01	0.67	13.46	100.00
20-40	55.33	14.71	13.25	2.47	0.00	2.26	0.39	11.58	100.00
40-60	54.86	10.78	14.43	4.87	0.00	3.93	0.84	10.29	100.00
60-80	45.71	15.83	16.52	7.04	0.00	4.66	1.53	8.71	100.00
80-90	44.82	12.78	16.92	4.52	0.00	7.20	3.81	9.96	100.00
90-100	47.18	12.47	18.24	5.37	0.00	8.26	4.94	3.64	100.00
80-100	45.90	12.64	17.52	4.91	0.00	7.68	4.33	7.07	100.00

TABLE (A.24): DISTRIBUTION OF PERSONS OF FRACTILE GROUPS OVER LEVEL OF EDUCATION ATTAINED PUNJAB- URBAN

(per cent)

Fractile group	level of education code*								
	0	1	2	3	4	5	6 & Above	n.r	all
Male									
0-10	51.48	16.07	12.75	10.29	0.00	5.23	1.63	2.58	100.00
10-20	33.97	25.79	16.69	11.60	0.19	4.90	3.52	3.34	100.00
0-20	43.43	20.53	14.57	10.89	0.09	5.08	2.50	2.93	100.00
20-40	27.17	26.78	18.66	12.22	0.00	10.51	3.47	1.18	100.00
40-60	26.48	14.78	24.41	10.53	0.30	14.75	8.56	0.19	100.00
60-80	20.91	16.21	16.40	17.88	0.00	11.16	17.00	0.45	100.00
80-90	17.33	15.37	10.04	16.40	0.00	19.74	19.85	1.15	100.00
90-100	11.21	7.89	6.12	14.29	0.00	18.29	41.41	0.76	100.00
80-100	14.60	12.04	8.29	15.51	0.00	19.10	29.51	0.98	100.00
Female									
0-10	57.45	12.62	14.20	6.63	0.00	2.03	4.58	2.49	100.00
10-20	52.36	18.76	15.46	4.91	0.00	4.01	2.07	2.42	100.00
0-20	54.81	15.81	14.85	5.73	0.00	3.06	3.28	2.45	100.00
20-40	43.53	16.57	17.91	10.86	0.00	5.70	4.16	1.28	100.00
40-60	46.23	14.83	16.21	7.74	0.00	9.17	5.65	0.16	100.00
60-80	23.84	12.53	24.00	20.83	0.00	8.21	10.02	0.56	100.00
80-90	19.37	12.32	15.67	14.37	0.00	18.21	19.62	0.45	100.00
90-100	18.96	17.28	12.36	8.73	0.00	13.67	27.59	1.40	100.00
80-100	19.16	14.78	14.03	11.57	0.00	15.95	23.57	0.92	100.00

TABLE (A.25): DISTRIBUTION OF PERSONS OF FRACTILE GROUPS OVER LEVEL OF EDUCATION ATTAINED RAJASTHAN- RURAL

(per cent)

Fractile group	level of education code*								
	0	1	2	3	4	5	6 & Above	n.r	all
Male									
0-10	64.77	16.52	7.70	5.02	0.00	1.26	1.34	3.35	100.00
10-20	64.13	17.36	8.30	5.82	0.00	0.84	1.13	2.42	100.00
0-20	64.45	16.94	8.00	5.42	0.00	1.05	1.24	2.89	100.00
20-40	63.78	17.31	8.82	5.65	0.00	1.05	0.98	2.40	100.00
40-60	55.10	19.00	12.39	7.23	0.04	2.59	2.15	1.48	100.00
60-80	61.44	13.54	12.46	7.98	0.15	2.38	1.68	0.39	100.00
80-90	41.58	21.86	17.53	9.73	0.04	4.33	4.78	0.24	100.00
90-100	43.59	17.24	12.07	12.56	0.10	6.55	6.93	0.92	100.00
80-100	42.49	19.78	15.06	11.01	0.07	5.34	5.75	0.55	100.00
Female									
0-10	89.27	4.63	1.84	0.47	0.00	0.00	0.00	3.77	100.00
10-20	92.80	3.48	2.57	0.19	0.00	0.00	0.00	0.95	100.00
0-20	91.03	4.05	2.21	0.33	0.00	0.00	0.00	2.39	100.00
20-40	91.14	4.26	1.51	0.54	0.00	0.10	0.04	2.45	100.00
40-60	85.99	6.26	4.19	1.76	0.00	0.12	0.10	1.58	100.00
60-80	86.91	5.77	4.83	0.93	0.00	0.37	0.47	0.73	100.00
80-90	78.03	7.08	7.84	3.68	0.00	0.80	0.50	2.10	100.00
90-100	76.41	11.92	6.00	3.67	0.00	0.59	0.79	0.52	100.00
80-100	77.35	9.11	7.08	3.67	0.00	0.71	0.62	1.43	100.00

TABLE (A.26): DISTRIBUTION OF PERSONS OF FRACTILE GROUPS OVER LEVEL OF EDUCATION ATTAINED RAJASTHAN- URBAN

(per cent)

Fractile group	level of education code*								
	0	1	2	3	4	5	6 & Above	n.r	all
Male									
0-10	52.95	16.94	12.49	9.85	0.00	3.24	3.07	1.50	100.00
10-20	46.16	20.07	12.35	8.28	0.00	3.91	6.08	3.17	100.00
0-20	49.67	18.43	12.42	9.09	0.00	3.56	4.51	2.30	100.00
20-40	43.53	19.60	13.83	10.49	0.13	3.75	6.35	2.33	100.00
40-60	27.83	18.12	16.61	14.56	0.42	8.09	13.17	1.19	100.00
60-80	17.79	15.52	14.64	15.24	0.30	9.39	25.31	1.85	100.00
80-90	7.58	9.40	8.61	12.79	0.00	6.50	53.75	1.41	100.00
90-100	7.04	1.47	7.60	14.54	0.00	4.65	62.72	1.92	100.00
80-100	7.32	5.96	8.17	13.54	0.00	5.70	57.64	1.63	100.00
Female									
0-10	80.77	8.55	5.29	3.15	0.00	1.41	1.40	1.60	100.00
10-20	84.33	8.51	4.99	1.34	0.12	0.97	0.67	2.59	100.00
0-20	82.46	8.53	5.15	2.28	0.06	1.20	1.05	2.07	100.00
20-40	70.19	11.13	7.79	4.19	0.00	0.88	2.80	1.35	100.00
40-60	51.26	19.69	14.41	8.03	0.00	4.05	5.25	0.93	100.00
60-80	29.82	17.14	15.96	9.39	0.17	11.14	11.85	0.97	100.00
80-90	21.27	10.71	8.70	22.09	0.00	9.47	23.96	0.72	100.00
90-100	11.82	4.95	15.95	11.89	0.00	15.63	33.24	0.85	100.00
80-100	17.16	10.64	11.85	17.66	0.00	12.14	28.00	0.78	100.00

TABLE (A.27): DISTRIBUTION OF PERSONS OF FRACTILE GROUPS OVER LEVEL OF EDUCATION ATTAINED TAMIL NADU - RURAL

(per cent)

Fractile group	level of education code*								
	0	1	2	3	4	5	6 & Above	n.r	all
Male									
0-10	39.84	28.90	17.80	8.95	0.00	2.45	0.62	1.45	100.00
10-20	45.33	26.81	18.24	6.03	0.00	1.13	0.73	1.73	100.00
0-20	42.66	27.83	18.03	7.45	0.00	1.77	0.68	1.59	100.00
20-40	40.17	24.55	17.90	10.28	0.00	1.84	0.90	4.33	100.00
40-60	36.27	23.87	22.42	9.01	0.02	3.52	1.82	3.03	100.00
60-80	34.47	20.67	24.52	12.36	0.00	3.72	3.19	1.07	100.00
80-90	24.95	19.93	23.64	15.16	0.00	8.88	5.63	1.83	100.00
90-100	17.48	16.89	22.58	18.55	0.36	9.53	13.93	0.72	100.00
80-100	21.23	18.43	23.10	16.85	0.18	9.20	9.77	1.28	100.00
Female									
0-10	65.79	15.41	11.42	2.90	0.00	0.55	0.47	3.47	100.00
10-20	63.58	18.36	10.24	3.53	0.00	0.58	0.00	3.67	100.00
0-20	64.71	16.88	10.82	3.21	0.00	0.56	0.24	3.57	100.00
20-40	65.05	18.58	9.97	2.56	0.01	0.47	0.12	3.25	100.00
40-60	62.39	17.70	12.39	3.45	0.00	0.63	0.55	2.90	100.00
60-80	54.79	15.33	16.65	7.62	0.00	2.48	1.10	2.02	100.00
80-90	52.82	10.60	19.75	7.60	0.08	3.13	2.24	3.87	100.00
90-100	38.51	15.14	17.98	13.44	0.00	7.66	6.14	1.06	100.00
80-100	45.72	12.85	18.86	10.50	0.04	5.38	4.18	2.47	100.00

TABLE (A.28): DISTRIBUTION OF PERSONS OF FRACTILE GROUPS OVER LEVEL OF EDUCATION ATTAINED TAMIL NADU - URBAN

(per cent)

Fractile group	level of education code*								
	0	1	2	3	4	5	6 & Above	n.r	all
Male									
0-10	29.08	28.63	20.87	9.43	0.05	3.82	2.56	5.53	100.00
10-20	26.10	23.91	22.02	16.74	1.04	5.70	1.36	3.16	100.00
0-20	27.53	26.18	21.47	13.23	0.57	4.80	1.93	4.30	100.00
20-40	23.78	21.31	25.05	16.24	0.16	7.51	4.10	1.83	100.00
40-60	18.64	20.52	23.39	20.05	0.14	8.62	7.13	1.52	100.00
60-80	16.21	13.17	20.36	18.42	0.42	14.60	15.73	1.08	100.00
80-90	7.43	12.03	16.27	18.30	0.21	20.44	23.72	1.59	100.00
90-100	6.80	10.42	8.40	7.19	0.11	19.00	46.64	1.47	100.00
80-100	7.12	11.26	12.49	12.97	0.16	19.75	34.72	1.53	100.00
Female									
0-10	40.03	24.05	19.42	5.23	0.00	2.12	1.28	7.88	100.00
10-20	44.94	17.88	19.29	9.09	0.00	2.09	0.86	5.86	100.00
0-20	42.56	20.85	19.36	7.23	0.00	2.10	1.06	6.83	100.00
20-40	36.58	21.13	22.71	11.16	0.00	2.91	1.36	4.18	100.00
40-60	33.34	16.84	23.10	14.01	0.00	5.69	3.02	4.01	100.00
60-80	24.48	17.50	20.47	15.58	0.00	10.49	8.80	2.64	100.00
80-90	17.31	13.45	20.29	17.48	0.00	12.27	14.75	4.45	100.00
90-100	7.76	11.17	14.29	16.47	0.00	18.20	29.24	2.90	100.00
80-100	13.02	12.43	17.60	17.02	0.00	14.93	21.26	3.75	100.00

TABLE (A.29): DISTRIBUTION OF PERSONS OF FRACTILE GROUPS OVER LEVEL OF EDUCATION ATTAINED UTTAR PRADESH- RURAL

(per cent)

Fractile group	level of education code*								
	0	1	2	3	4	5	6 & Above	n.r	all
Male									
0-10	66.75	15.54	7.97	5.34	0.00	2.07	1.22	1.09	100.00
10-20	65.01	13.39	8.80	7.87	0.04	1.95	2.43	0.50	100.00
0-20	65.94	14.54	8.36	6.52	0.02	2.02	1.78	0.82	100.00
20-40	60.04	15.24	11.05	7.88	0.03	2.87	2.07	0.80	100.00
40-60	54.52	15.40	11.83	9.10	0.06	3.40	2.76	2.95	100.00
60-80	47.75	16.31	14.62	10.98	0.07	4.17	4.61	1.50	100.00
80-90	47.01	12.58	15.12	11.25	0.09	5.39	6.93	1.59	100.00
90-100	40.26	13.17	9.91	8.45	0.00	12.95	11.44	3.70	100.00
80-100	44.20	12.84	12.92	10.06	0.05	8.59	8.84	2.48	100.00
Female									
0-10	92.09	3.70	2.12	0.47	0.00	0.34	0.11	1.15	100.00
10-20	91.35	4.85	2.14	1.12	0.00	0.21	0.03	0.28	100.00
0-20	91.75	4.23	2.13	0.77	0.00	0.28	0.07	0.75	100.00
20-40	86.70	6.15	3.86	1.40	0.00	0.45	0.20	1.22	100.00
40-60	80.61	7.57	4.64	1.76	0.00	0.66	0.46	4.33	100.00
60-80	77.72	7.80	6.64	3.41	0.00	1.64	0.60	2.19	100.00
80-90	69.93	10.18	10.07	3.34	0.00	2.06	2.14	2.15	100.00
90-100	64.94	7.63	10.23	7.13	0.00	2.39	6.52	1.27	100.00
80-100	68.26	9.33	10.12	4.61	0.00	2.17	3.61	1.86	100.00

TABLE (A.30): DISTRIBUTION OF PERSONS OF FRACTILE GROUPS OVER LEVEL OF EDUCATION ATTAINED UTTAR PRADESH- URBAN

(per cent)

Fractile group	level of education code*								
	0	1	2	3	4	5	6 & Above	n.r	all
Male									
0-10	54.19	16.47	12.08	9.03	0.00	2.39	4.09	1.75	100.00
10-20	52.56	16.18	12.57	9.34	0.02	2.98	3.14	3.25	100.00
0-20	53.36	16.32	12.33	9.19	0.01	2.70	3.61	2.51	100.00
20-40	45.74	18.29	14.90	10.03	0.04	4.30	5.49	1.20	100.00
40-60	34.82	18.41	14.39	13.20	0.10	7.88	10.29	0.91	100.00
60-80	22.49	14.64	16.43	12.47	0.11	11.49	21.45	0.94	100.00
80-90	14.72	9.26	12.79	11.12	0.01	12.39	38.77	0.86	100.00
90-100	3.33	8.61	8.25	7.21	1.10	9.91	61.26	0.27	100.00
80-100	10.01	9.00	10.90	9.50	0.46	11.36	48.13	0.61	100.00
Female									
0-10	72.82	12.02	7.06	3.40	0.00	1.15	0.80	2.79	100.00
10-20	73.81	10.05	6.82	3.84	0.00	1.64	1.10	2.74	100.00
0-20	73.30	11.02	6.94	3.62	0.00	1.40	0.95	2.76	100.00
20-40	71.40	10.34	7.97	4.29	0.00	2.04	2.32	1.62	100.00
40-60	53.97	16.68	11.12	6.70	0.02	4.29	5.72	1.52	100.00
60-80	35.37	13.46	15.74	10.56	0.00	8.42	15.92	0.56	100.00
80-90	20.61	14.46	10.52	13.29	0.00	11.60	29.16	0.36	100.00
90-100	9.90	15.92	7.59	9.48	0.00	15.04	41.68	0.28	100.00
80-100	17.27	14.91	9.61	12.14	0.00	12.67	33.07	0.34	100.00

TABLE (A.31): DISTRIBUTION OF PERSONS OF FRACTILE GROUPS OVER LEVEL OF EDUCATION ATTAINED WEST BENGAL- RURAL

(per cent)

Fractile group	level of education code*								
	0	1	2	3	4	5	6 & Above	n.r	all
Male									
0-10	65.71	15.29	13.17	1.75	0.00	1.04	0.93	2.07	100.00
10-20	69.32	13.75	9.81	3.27	0.00	0.62	0.35	2.89	100.00
0-20	67.45	14.54	11.55	2.49	0.00	0.84	0.65	2.46	100.00
20-40	58.18	16.26	16.93	4.44	0.00	1.11	0.83	2.26	100.00
40-60	46.85	18.86	21.18	7.75	0.00	2.43	1.69	1.22	100.00
60-80	38.92	19.02	23.69	9.77	0.20	4.07	2.64	1.72	100.00
80-90	32.94	16.00	23.02	15.03	0.00	5.99	6.18	0.82	100.00
90-100	24.16	12.58	23.29	18.93	0.00	9.19	11.15	0.75	100.00
80-100	29.06	14.51	23.14	16.74	0.00	7.39	8.36	0.79	100.00
Female									
0-10	83.57	6.24	6.34	0.72	0.00	0.25	0.07	2.87	100.00
10-20	83.86	7.37	4.76	0.91	0.00	0.15	0.00	2.95	100.00
0-20	83.68	6.80	5.57	0.81	0.00	0.20	0.04	2.91	100.00
20-40	75.85	10.89	9.28	1.73	0.00	0.22	0.08	1.93	100.00
40-60	68.11	12.82	13.25	2.59	0.00	0.65	0.34	2.24	100.00
60-80	60.41	12.85	17.71	4.85	0.00	0.78	0.42	2.99	100.00
80-90	54.41	14.96	19.57	6.46	0.00	2.07	1.38	1.14	100.00
90-100	38.76	16.43	23.07	12.85	0.00	4.27	3.50	1.02	100.00
80-100	47.62	15.61	21.11	9.25	0.00	3.03	2.31	1.09	100.00

TABLE (A.32): DISTRIBUTION OF PERSONS OF FRACTILE GROUPS OVER LEVEL OF EDUCATION ATTAINED WEST BENGAL- URBAN

(per cent)

Fractile group	level of education code*								
	0	1	2	3	4	5	6 & Above	n.r	all
Male									
0-10	44.36	20.89	17.59	8.26	0.12	2.94	4.33	1.49	100.00
10-20	32.82	18.55	25.33	15.09	0.00	4.46	2.67	1.09	100.00
0-20	38.20	19.64	21.72	11.90	0.05	3.74	3.44	1.28	100.00
20-40	28.40	16.03	25.32	16.67	0.00	5.64	6.89	1.05	100.00
40-60	20.67	15.93	21.27	18.94	0.19	9.63	12.10	1.26	100.00
60-80	11.82	13.17	20.30	18.59	0.10	14.07	19.28	2.66	100.00
80-90	12.17	8.56	9.18	12.29	0.00	14.41	41.32	2.12	100.00
90-100	8.43	8.85	10.12	5.97	0.39	11.45	53.00	1.79	100.00
80-100	10.49	8.69	9.59	9.45	0.17	13.08	46.57	1.97	100.00
Female									
0-10	66.14	14.05	10.29	4.94	0.00	0.94	2.14	1.50	100.00
10-20	52.18	15.46	20.57	8.01	0.29	1.52	0.73	1.25	100.00
0-20	58.92	14.78	15.60	6.53	0.15	1.24	1.41	1.37	100.00
20-40	42.30	17.37	23.01	10.15	0.00	2.55	3.54	1.08	100.00
40-60	27.58	16.69	25.12	15.53	0.00	4.18	8.99	1.91	100.00
60-80	17.07	13.96	23.05	20.87	0.00	10.65	11.40	3.02	100.00
80-90	14.46	7.50	16.45	18.26	0.00	13.31	26.58	3.42	100.00
90-100	11.09	9.11	12.57	13.01	0.00	14.97	36.05	3.26	100.00
80-100	12.93	8.24	14.69	15.87	0.00	14.06	30.88	3.35	100.00

FOOD MANAGEMENT REVISITED

S.K. Ray

The paper presents a critical review of the government's food management operations and, in the context of the present environment for policy reforms, advocates a new approach for the management of food economy. For this purpose, it outlines a production- oriented farm price policy, and works out the operational details for making the management of food economy more efficient. The paper also estimates the stock requirements for food management over the next five years. It finds that a relatively smaller storage plan (a minimum reserve of about 5 million tonnes and a maximum reserve of about 15 million tonnes) would be adequate to stabilise price, farm income and consumption within reasonable limits.

I

INTRODUCTION

This paper is essentially a revisit of my earlier studies on various aspects related to food management in India, with a view to examine their relevance in the present environment for policy reforms. The paper is organised as follows. First, a review of government management of food economy is presented. Farm price policy and operational strategy for food management are next outlined. Stock requirements for food management are then estimated and their implications on price and farm income stabilisation are analysed. Finally, brief concluding observations are made at the end of the paper.

II

A REVIEW OF GOVERNMENT MANAGEMENT OF FOOD ECONOMY

In India, although agriculture is a State subject, the responsibility to provide food to all sections of people in different states of the country rests mainly on the central government. This responsibility on the Centre has come from the moral dictates of a society which was characterized by recurring food shortages and extreme inequality in the distribution of income. These conditions have had a long history and compulsion is likely to remain so long as the shortages are felt and wide disparities in income continue.

The severity of these conditions, however, has been declining since the introduction of seed-fertiliser technology in the mid-1960s. The consequent attainment of an overall self-sufficiency in foodgrains production in the early 1970s, and the progressive decline in the incidence of poverty have considerably eased the food management problems. Even then sharp year-to-year fluctuations in the level of foodgrains production, and the presence of a sizeable section of the population still below the poverty line, build up pressure for continuance of the Centre's involvement in food management operations. As a result, the central government has not yet been able to reduce its involvement in the management of the food economy. Increasingly, it has been purchasing foodgrains and making distributions, apparently with little change in its operational strategy which was followed during the period when the country was passing through a chronic food shortage situation. Reliance on international trade has remained marginal because of the apprehension that it might make food prices more unstable and expose the country to the risk of political arm-twisting as experienced in the sixties. Emphasis has, therefore, remained to manage the food economy mainly from the domestic sources.

Broadly, the objectives for which the Centre continues to remain involved in food management operations are: (i) to increase the level of food production, (ii) to reduce intra-year and inter-year fluctuations in food prices, (iii) to stabilise relative prices of agricultural commodities, and (iv) to protect the consumption levels of low-income groups. It is for the attainment of these objectives that the Centre purchases foodgrains and makes distribution.

There are two sets of prices through which the government can purchase foodgrains - support prices and procurement prices. Support prices are to provide incentives to the producers and ensure stability in price and farm income around certain minimum levels. These prices are announced in advance of the sowing season to influence cultivators' production decisions and are backed by

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guaranteed government purchase if market prices fall below support levels. Purchases under the price support scheme have remained practically inoperative in India. This is because support prices are generally fixed at levels which are too low to have a possibility of becoming operational.

To cope with the increasing demand for food distribution, procurement operations have been introduced. Here the government purchases foodgrains from the producers, traders and millers, with an element of compulsion at prices called procurement prices. The methods of procurement that have been tried so far with varying degrees of success or failure in different parts of the country are: (i) a levy on producer and/or miller, (ii) voluntary purchase from millers and wholesalers on an agreed basis as to quantity and/or price, (iii) pre-emption on market sales/auctions, and (iv) monopoly purchase.

In the past, when an overall food shortage situation prevailed in the country, procurement prices have had much more operational significance, since the procurement price has been the government's purchasing price, while the support price became 'notional' owing to the very high level of the ruling market prices. It was the practice then to announce the procurement prices at the beginning of each marketing season, which was too late to influence production decisions. However, anticipation of procurement prices might have influenced production decisions, in which case the support price, which was significantly lower than the procurement price, became even more irrelevant for agricultural decision making.

From late 1960s, government started abandoning the practice of announcing support prices for those cereal crops for which it intended to carry out actual procurement operations. Purchases remained confined mainly to rice and wheat, and were made at procurement prices announced at the beginning of each marketing season and maintained for the entire year. For the first time in 1978-79, procurement prices for the rabi season cereal crops were announced before the sowing period. Since then, it has become the practice to announce the procurement prices for cereals (except barley for which only support price is announced) and some other crops before the sowing periods, and keep them fixed for the entire year at the announced levels. Simultaneously, more crops have been brought under price support operations. There are now 21 crops under the purview of procurement/support price operations.

At the implementation stage, several distortions have taken place in the government's actual purchase operations. Firstly, in theory, procurement prices are not minimum government guaranteed purchase prices. These are prices at which the government is supposed to buy, at its discretion and without any compulsion, the quantities needed for buffer stocks and for various intra-year distribution programmes. However, ever since the government stopped the practice of announcing procurement targets from 1978, the procurement prices have been used to purchase virtually whatever quantities have been offered by the farmers for sale. The distinction between the procurement and support price has thus become blurred. For all practical purposes, the procurement prices have become minimum government guaranteed purchase prices.

Secondly, the cost plus approach adopted for fixing the levels of procurement/support prices takes into account not only the variable cost but also the fixed cost of cultivation. The latter now covers a large number of items like rent on owned land, interest on owned capital, minimum wages for labour fixed by the state governments, compensation for management cost, etc., and provide thereby ample scope for manipulation. For example, one of the major cost items in agricultural production is land. However, since the land market in India is highly imperfect, it is very difficult to determine the fair return on land. When prices are supported, the big farmers have a guaranteed built-in profit, so they can afford and are willing to pay prices for land higher than its opportunity cost in the expectation that future adjustments in the cost of production based pricing will compensate them. Thus a built-in mechanism for raising prices is created.

Thirdly, since the procurement prices are fixed and announced before the sowing periods and are maintained at those levels for the entire marketing year, any change in the supply-demand situation in the market between the sowing and harvesting

periods causes stresses and strains on the government's procurement operations. Thus, when a bumper crop is harvested due to favourable weather and market prices threaten to fall, pressure builds up on the government to purchase, irrespective of its requirements, whatever quantities are offered for sale at procurement prices. Similarly, in a year of poor harvest due to drought when the market prices rule higher than the procurement prices, government finds it difficult to procure the required quantities unless some coercive measures are used.

Finally, although a large number of crops are brought under procurement/support price operations, the implementing agencies of the government, viz., the Food Corporation of India, state agencies and the co-operative societies carry out procurement operations only for a few crops in a few selected states. Almost the entire quantity of foodgrains procured by the government is made up by rice and wheat (Table 1), over 90 per cent of which are now procured from the states of Punjab, Haryana, Uttar Pradesh and Andhra Pradesh (Table 2). It is because of this limited coverage of procurement operations, the objective of ensuring incentive prices to the producers is largely defeated in majority of the remaining states, where the traders generally mop up the marketable surpluses from the producers at below procurement prices and sell them at considerably higher levels in the open market. Moreover, procurement operations are generally carried out over a very short period immediately after the harvest. Over 95 per cent of total wheat procurement is usually made in the months of April and May. For rice, around 80 per cent of the total procurement is generally made over a four-month period, October to January. The volume of procurement too is increasing steeply, around 50 per cent of which is made by the Food Corporation of India. Total procurement in 1990 crossed 24 million tonnes and caused serious handling, transportation and storage problems. All these distortions at the implementation stage have considerably defeated the government's stated objectives for procurement/support price operations, increased steeply the costs for procurement, and made functioning of the procuring agencies very difficult and expensive.

TABLE 1. PROCUREMENT AND PUBLIC DISTRIBUTION OF RICE, WHEAT AND FOODGRAINS

(million tonnes)

	Procurement				Public Distribution			
Year	Rice	Wheat	Cols. (2+3)	Total Food-grains	Rice	Wheat	Cols. (6+7)	Total Food-grains
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1971	3.46	5.09	8.55	8.86	3.23	4.46	7.69	7.82
1972	2.55	5.02	7.57	7.67	3.67	7.41	11.08	11.40
1973	3.46	4.53	7.99	8.42	3.21	7.13	10.34	11.41
1974	3.48	1.89	5.37	5.64	3.75	6.67	10.42	10.79
1975	5.40	4.10	9.50	9.56	3.21	7.55	10.76	11.25
1976	6.00	6.62	12.62	12.85	3.64	5.02	8.66	9.17
1977	4.66	5.17	9.83	9.87	4.59	6.40	10.99	11.73
1978	5.55	5.47	11.04	11.10	3.23	6.86	10.09	10.18
1979	5.72	8.00	13.72	13.84	4.05	7.49	11.54	11.66
1980	5.21	5.87	11.08	11.18	6.06	8.82	14.88	14.99
1981	6.20	6.59	12.79	12.98	6.40	6.43	12.83	13.01
1982	7.48	7.72	15.20	15.42	7.50	7.17	14.67	14.77
1983	7.30	8.27	15.57	15.57	7.85	8.12	15.97	16.21
1984	9.31	9.31	18.62	18.72	6.74	6.51	13.25	13.33
1985	9.58	10.36	19.94	20.12	7.23	8.48	15.71	15.80
1986	9.14	10.53	19.67	19.72	8.46	8.50	16.96	17.27
1987	7.73	7.86	15.59	15.67	9.82	8.78	18.60	18.70
1988	7.34	6.56	13.90	14.07	9.70	8.72	18.42	18.58
1989	9.86	8.98	18.84	18.94	8.57	7.25	15.82	15.90
1990	12.82	11.09	23.91	24.04	8.66	6.57	15.23	15.32

Source: *Bulletin on Food Statistics*, 1990 and back issues.

As mentioned earlier, annual purchases are made by the government for meeting its requirements for intra-year distributions and for buffer stocks. Intra-year requirements are generally for distributions to: (i) roller flour mills, (ii) defence services and other organisations/ institutions, (iii) various welfare and employment generation programmes like NREP, RLEGP, NP, JRY, etc., and (iv) fair price shops for direct distribution to consumers. Buffer stocks are the accumulation of annual purchases minus annual sales over time. Purchases and distribution requirements for buffer stocks operation arise only during good and bad years of harvest and such stocks are supposed to be built over time through a clearly stated inter-year price stabilization objective of the government. However, even in normal years with output just matching the aggregate demand, the government has to purchase foodgrains in order to fulfil its commitments for intra-year distributions.

The responsibility to supply to the roller flour mills was taken up by the government during imports under PL 480 agreement when two distribution outlets were used for releasing the imported, wheat, viz. the fair price shops and the roller flour mills. Roller flour mills used to sell their products to bulk consumers or to state governments for distribution through fair price shops at prices prescribed by the government. Supplies to the mills remained regulated till 1986, lest their entry in the market might push up the price and frustrate the government's procurement operation. From 1987, government has stopped supply of wheat to the mills; roller flour mills now purchase wheat from the open market.

TABLE-2. STATE-WISE PRODUCTION, PROCUREMENT AND DISTRIBUTION OF FOODGRAINS IN 1990.

(thousand tonnes)

	Total Foodgrains Production	Total Procurement of Foodgrains	Total Public Distribution (Both from Central and State Governments)	Supplies of Foodgrains from Central Pool to		
				Public Distribution	NREP/ RLEGP/ RELIEF/ NP/JRY	Total
(1)	(2)	(3)	(4)	(5)	(6)	(7)
North						
Haryana	8,652	3,720	31	28	3	31
Himachal Pradesh	1,420	-	98	121	-	121
Jammu & Kashmir	1,310	7	315	276	2	278
Punjab	18,986	12,219	11	8	1	9
Uttar Pradesh	33,672	2,974	489	526	-	526
Total	64,040	18,920	944	959	6	965
South						
Andhra Pradesh	12,630	2,839	1,342	1,319		1,319
Karnataka	7,128	164	870	826	28	854
Kerala	1,072	-	1,764	1,736	24	1,760
Tamil Nadu	8,124	963	1710	900	14	914
Total	28,954	3,966	4,804	4,781	66	4,847
East						
Assam	2,951	5	615	612	1	613
Bihar	11,845	-	445	455	-	455
Orissa	7,869	258	399	429	18	447
West Bengal	11,819	105	1,537	1,491	35	1,526
Total	34,484	368	2,996	2,987	54	3,041
West						
Gujarat	4,788	26	937	830	1	831
Madhya Pradesh	14,805	440	440	443	76	519
Maharashtra	13,249	111	1,716	1,607	9	1,616
Rajasthan	8,531	172	604	584	19	603
Total	41,373	749	3,697	3,464	105	3,569
Others	1,776	37	2,596	1,748	4	1,752
Defence Services	-	-	288	288	-	288
All-India	170,627	24,040	15,325	14,227	235	14,462

Source: *Bulletin on Food Statistics*, 1990

Requirement for defence services and other organisations/institutions is a very tiny component of the government's total requirements for intra-year distributions. Surprisingly, however, distributions made for various welfare and employment generation programmes, on which much emphases have been given by the government, have also remained at a very low level. Total quantity of foodgrains distributed through these programmes was less than 450 thousand tonnes in 1989, and it was reduced further to less than 240 thousand tonnes in 1990.

Almost the entire quantity of foodgrains required for intra-year distributions is now used for maintaining and supporting the public distribution system (PDS). The distribution outlet to the consumers for this purpose is through the fair price shops system. Under this scheme, consumers get given quantities of foodgrains from the fair price shops (usually rice, wheat, and some other food items like sugar, edible oils, etc.) at prices called issue prices. The issue prices are fixed by the government at levels lower than the market prices and slightly higher than the procurement prices. However, due to storage, handling, transportation, etc., charges, the economic costs per unit of foodgrains purchased by the government at procurement prices and distributed through the fair price shops system become higher than their respective issue prices. The differences between the economic costs and the issue prices are borne by the government by providing food subsidy. Clearly, increases in these differences and/or in the total quantity of foodgrains distributed through the fair price shops cause increases in the government's total food subsidy bill.

The burden of food subsidy on the government is increasingly becoming heavier due to increasing volume of public distribution and growing gaps between economic costs and issue prices. It was around Rs 2,800 crore in 1992-93. The heavy burden of food subsidy has become a subject of intense debate and discussion in the context of the present on-going programmes for economic reforms. While the views and recommendations on the subject vary widely [Bhalla, 1993; Desai, 1993], there is a general agreement that poorer people and poorer regions are benefitting little from the costly operation of the present public distribution system [Mooij, 1994; Parikh, 1993].

In the past, the public distribution system was essentially used to provide a steady supply to urban areas. The rationale was that flows to the urban areas generally dry up most easily during the period of shortages. Therefore, the urban areas with their high purchasing power and greater vulnerability to price fluctuations were likely to suck away part of the rural demand. Cordoning of the big cities along with the fair price shops system was thus justified for equalizing the distribution between the high income cities and low income rural areas.

As the situation on the food front started improving, the public distribution system was progressively extended to cover more and more rural areas. Presently, there are now more than 4 lakh fair price shops, over 75 per cent of which are located in rural areas. However, since both in the rural and urban areas, the distributions through the fair price shops are not specifically targeted for the low-income people, virtually all sections of the society are enjoying the advantage of subsidised food distribution. It is due to this reason, the costs for maintaining and supporting the public distribution system are increasing steadily and causing serious concern. Moreover, functioning of the present public distribution system has an urban bias, and it has failed to provide larger supplies to the states having higher incidence of poverty [Bhalla, 1993; Desai, 1993; Jha, 1991; Mahendra Dev and Suryanarayana, 1991; Tyagi, 1990].

Several suggestions have been made by scholars to revamp the public distribution system for catering to the needs of only low-income people. The government has also introduced in 1992, a scheme to revamp the public distribution system in 1,700 blocks having higher concentration of low-income people. However, available studies suggest that, apart from the difficulties in implementation, a target-oriented approach for distribution based on nutritional and poverty norms may require much more than the present level of foodgrains distributed through the fair price shops [Sharma, *et al.*, 1991]. Under a number of alternative scenarios, Geetha and Suryanarayana [1993] found that PDS revamping done in the right perspective would have required for 1988 additional cereal amount ranging from 20 to 52 million tonnes. Extending the analysis

for the year 1993, they estimated that 'the additional food subsidy required for PDS revamping would range from Rs 3,600 to Rs 9,300 crore. This is just the additional subsidy that would be required towards enhanced PDS quantum, not to speak of the additional outlays required for setting up proper infrastructure for the PDS in backward regions. For, PDS revamping is not merely a question of targeting but also involves the creation of the necessary infrastructure, like storage facilities and distribution network, particularly in states like Bihar and Orissa' [Geetha and Suryanarayana, 1993, p. 8].

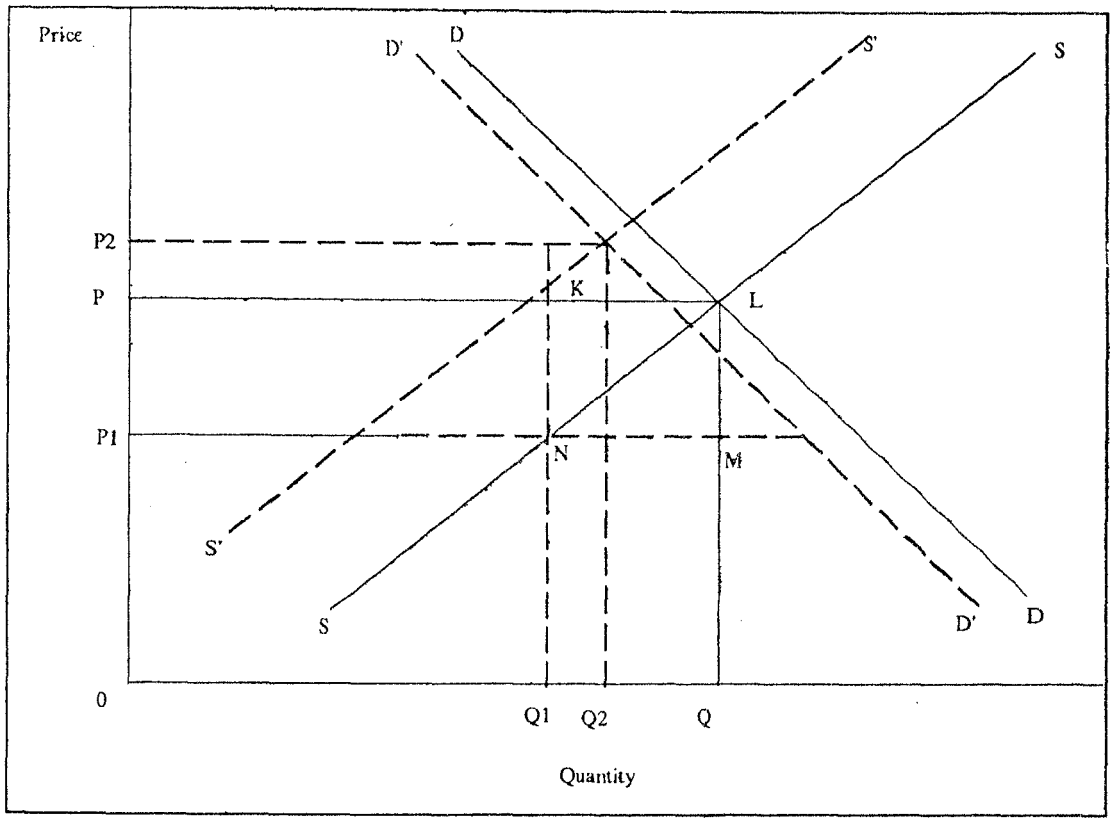
Whatever the dimension of government purchases and distribution, the operational policies for them should be feasible to implement and should produce the desired results. At present, government conducts the food management operations with a set of instruments which are rigid in the sense that they are fixed before each operation and cannot be altered to adjust with changing market situations. Government commits itself to distribute a certain quantity at a certain fixed price and, directly or indirectly coerces the producers and traders to supply the required quantity at a certain prescribed price. The system can work only if economic criteria are used in fixing the levels of each of the above variables. So far, the practice has been somewhat different with obviously frustrating outcomes.

The public distribution system is perceived by the government as an instrument through which it can simultaneously operate to (i) influence the market prices, (ii) maintain a steady supply to urban areas, and (iii) induce a change in the income distribution. These elements are envisaged as resulting from the establishment of a separate market of fair distribution. Here the government-determined supply has to come from the partial procurement of total supply at a price lower than the free market, and then, distributed to consumers as a part of their total requirements, again at a price lower than the free market.

The viability of this system of public distribution, however, rests basically upon the levels at which government-determined prices are fixed, since the forces of demand and supply in the two markets are inter-linked through their relative price structure. Quantity demanded from the public distribution system is functionally related to the difference between the price in the fair price shops and the free market price. The wider this difference is, the greater will be the demand. Also, compared to the free market, the public distribution system is less preferred for reasons that the Study Team on Fair Price Shops had observed as 'consumers preferences for qualities of grains and relative conveniences of the two systems of distribution' [GOI, 1966, p. 4]. Because of this, the Study Team had argued that the public distribution system can influence the free market price only when releases from it act as net additions to the total market supply. This could be obtained by lowering or raising the prices in the fair price shops, but in either case, the impact on the free market would be of a small order compared to the corresponding price adjustment made in the fair price shops.

The system collapses if it is run on the basis of a partial withdrawal of the total supply for distribution at a lower than the market price. It cannot then bring down the price in the residual market. Under such a situation, public distribution system can function alongside a free market only if the price in the fair price shops is made market-oriented as illustrated in the figure.

With the market demand curve DD, for a given level of output, let the supply curve be SS so that a quantity OQ is cleared at a price OP. Suppose, the government considers this price to be too high and, in order to provide relief to the consumers, procures a quantity Q_1Q for distribution at a price lower than OP, say at OP_1. Both the free market demand and supply curves will then shift to the left but the extent of shift in the former is likely to be less than in the latter. This may happen because of the relative convenience of the two systems of distribution mentioned earlier. Also, since part of the total supply is now made available at a lower price, an excess demand situation will develop and consumer demand will get augmented. The residual market will then fix the price at OP_2 and clear a quantity OQ_2. Total supply now (i.e., OQ_2 plus Q_1Q) will be more than



what it would have been in the absence of government operation, but the market price and the difference between it and the distribution price also will now be higher than previous levels. As a result, pressures will build up on the public distribution system and after making distribution of the procured quantity, it will discover that it is in a precarious position to meet this additional demand. The only alternative then will be to ask consumers to satisfy their additional demand from the residual market. This should increase total consumption and also raise the price. Those who can pay more will now be consuming more.

In the figure, both the market demand and supply curves are allowed to make a parallel shift. Also, the shift in the supply curve is shown equal to the quantity procured by the government. Neither of these is likely to hold true in actual situation; they will be governed by the government's operational policies regarding foodgrains procurement and distribution. The magnitude of the shift in demand has a direct relationship with the quantity distributed; it also has an inverse relationship with the difference between the free market price and the distribution price. The wider the price differential or lower the quantity distributed, the lesser will be the shift of the demand curve toward the left. The shape of the demand curve can also be influenced by adopting a discriminating price policy for distribution. For instance, suppose the government makes distribution of the procured quantity Q_1Q at two prices - a low price, say OP_1 for the low-income group, and a high price, say around OP, for the

high-income group. A section of the high-income group will then withdraw from the public distribution system. At the same time, the released pressure of the high-income group will provide an opportunity to the public distribution system to meet more adequately the needs of the low-income group. The consequences of all these is likely to make the demand curve D'D' more elastic and shift it more towards the left.

When the government procures the quantity Q_1Q at a low price, say at OP_1, the suppliers' revenue declines by an amount $(P_1P) \times (Q_1Q)$ i.e., KLMN. There will thus be an anxiety on the part of the suppliers to sell the residual quantity in the free market at a price at which they could at least recover the loss. If this is not forthcoming through the forces of the new market demand curve, suppliers will try to evade procurement, and thereby, create ideal conditions leading to speculative demand for inventories from traders and consumers alike. Once these unhealthy activities develop, the supply curve S'S' becomes more inelastic and food management begins to become increasingly unmanageable. A vicious circle is created in food management with spiralling consequences. High market prices increase the pressure on the public distribution system and compels the government to have a more ambitious procurement plan. An ambitious plan, in turn, stretches the procurement net beyond the manageable limits of the government. Tendency to evade procurement can cause a further rise in speculative demand and market price. This outcome has been commonly experienced in the past, particularly during the years of crises.

To make the procurement operation a success, the government has in the past often adopted measures which are attempts to defy the principle of market mechanism. One of these is the much debated policy of movement restrictions which, though relaxed in 1978, remained a part of the government operations in foodgrains until last year when its complete withdrawal was announced by the Finance Minister in his budget speech for 1993-94. The justification of the government for movement restrictions was that its procurement efforts for equitable distribution of foodgrains would be frustrated if the profit motivated private traders were allowed to operate freely.[1] However, an analysis of the dezoned and zoned periods market prices of 1961-63 and 1966-68 indicated that food zones actually accentuated regional price differences [Ray, 1970]. Prices were depressed in surplus states but there was a sharp increase of prices in deficit states.[2]

An extreme form of market intervention was mooted in 1972-73 when the government nationalised wholesale trade in wheat and rice. The objective behind the move was to ensure a more regular flow of supplies to consumers at reasonable prices through the fair price shops. The experiment, however, was carried out only on wheat in 1972-73. It failed and was subsequently given up.

The move for nationalisation of wholesale trade in foodgrains was conceived wrongly on the assumption that the entire marketable surplus could be procured only if traders were eliminated. It failed because 'the rich farmer who has considerably improved his marketable surplus as well as retaining capacity... has been left free to manipulate his stocks as he likes' [Rao, 1974, p. 24]. Besides the experience of failure, the take-over move raises a number of questions, the most important of which arises from its implications on resource allocation. Nationalisation of foodgrains trade may divert resources from food to non-food crops, and in the long run may adversely affect the level of foodgrains production which, in the final analysis, is at the root of India's food management problems.

The built-in inconsistencies in the present system of food management operations bring in sharp focus the conflicting goals and policies of the government on the food front. Government desires to protect the interests of the low-income group and for this reason, withdraws a part of the total domestic supply for distribution at a low price. If this plan is executed, government loses control over the free market and the objective of influencing the market price is defeated. The market price can be influenced only by following a market- oriented price policy for distribution. But if it is adopted, the objective of protecting the interests of the low-income group gets defeated. Government wants to minimize the cost of distribution through procurement of the required

quantity at a low price, but when this is attempted through various control measures, market imperfections result and adversely affect the objective of increasing the level of production. Actions too, contradict the intentions. The government intends to provide incentives to the producers but adopts measures that directly or indirectly take away the production incentives. To regulate the in-flow of food from the rural poor to the urban rich, government takes the responsibility of distribution in urban areas. Yet, distribution proceeds not in relation with the purchasing capacity of the individual consumers but at a uniform low price for which the society pays a subsidy.

Market interventions like movement restrictions, etc., involve a good deal of policing - an unpalatable situation in a democracy. The fact that the government has been able to get away with it for so long is only because the alternatives proved risky politically. The past situation was one of shortage and husbanding the stocks available to make fair distribution. Radical changes should follow when the reverse is the case and surpluses pile up. That it would be so, is already noticeable. With the initiation of economic reforms and structural adjustment programmes in 1991, pressures are building up to free the agricultural sector from all sorts of governmental controls and regulations [Desai, 1993; Pursell and Gulati, 1993]. The growing load of subsidy has exposed government's food management operations to intense scrutiny and criticism. Efforts are now being made to initiate a process of economic liberalisation in agriculture. Clearly, in this changed policy environment, a new approach is needed to manage the food economy.

III

FARM PRICE POLICY FOR FOOD MANAGEMENT

Concerns which prompt the government to intervene in the management of the food economy should be recognised. Production in the agricultural sector is significantly influenced by extraneous factors, generally stochastic in nature. Again, fluctuations in production are likely to induce fluctuations in income and may make demand unstable. With such inherent stochastic characters, the forces of demand and supply if allowed to operate freely, introduce instability in price, farm income and availability of food for consumption. The economic consequences of such instability, both in the short and long run affect producers' and consumers' interests and impede the overall economic growth.

The present economic environment for liberalisation and globalisation has added a new dimension to the problem of food management. The country has achieved marginal self-sufficiency in foodgrains production, but the potential to become a leading exporter in foodgrains is now visible. To exploit this potential fully, rational economic policies must be pursued to boost up production. However, in following any such policies, limitations arise due to the presence of vulnerable population in the country. The sufferings of the underfed millions haunt the policy makers with the possibility of social unrest and protection to the consumers assumes priority. Any ambitious programme to safeguard both producing and consuming sectors' interests is further constrained by the prevailing inflationary situation and lack of adequate funds in the country.

The solution to India's food management problem rests basically on raising the level of foodgrains production and making the income distribution less skewed. The attainment of a higher level of foodgrains production through rapid acceptance of new technology, added investment in minor irrigation, and increasing utilization of purchased inputs will be encouraged if the uncertainties in farm income levels are reduced. It is this concern of increased economic efficiency and production which makes the role of price incentives to the producers very crucial for management of the food economy. This is not to say that all farmers in all locations and under all circumstances respond to price incentives. It is clear that a market must exist, production inputs must be available, and farmers must have a basic knowledge of the technology, and enough market contact to need cash. If these conditions hold, then the available evidence suggests that Indian farmers do respond to prices. Therefore, a production-oriented price policy is a necessary, although not sufficient, condition for raising the level of foodgrains production.

While over the long run, it is inevitable that market forces of supply and demand will be basic determinants of prices, in our view, short-run government policy actions should be used to supplement the operation of market forces and improve the economic environment in three primary ways. First, the government can implement a system of support prices, announced in advance of sowing and backed up with guaranteed purchases, to provide a minimum expected price to reduce the risk in planning production decisions. Second, it can ensure some degree of price stability from year to year and season to season so that economic waste from inefficient production, marketing and consumption decisions is minimized. Support prices provide the lower limit for harvest prices. The upper limit for harvest prices should be flexible enough so that producers' incomes are protected in years of poor crops. Third, government policy should ensure that attempts to correct supply/demand imbalances in specific commodities do not have undesirable effects on the production of competing crops via the effect of relative prices on hectarages sown.

Instability in farm income arises from three major sources of year-to-year income variations - fluctuations in yield, fluctuations in costs, and fluctuations in product prices. Support prices directly ensure against only the third source of income instability - that arising from product price fluctuations. But since this is a substantial risk, price supports contribute to income certainty in a broad sense. One potential effect of a price support programme is to increase the amounts of inputs used. If output prices are raised, the profit maximizing quantity of input is increased and if used, this greater quantity of input leads to larger volumes of output. This is the crux of what is meant by 'incentive'.

While we are arguing for 'incentive' prices, we are not advocating prices which are too high. At the point where input supplies are completely utilized, a higher product price will simply lead to bidding up of input prices, and inflation may result. A valid justification for support prices up to this point is that it provides assurance of sufficient profits to enable the producer to invest in production increasing capital such as land levelling and tubewells, improved implements and machineries, etc.

To be effective, the support price should be fixed at levels at which they have a possibility of becoming operational, and should be set at the beginning of each kharif and rabi period and maintained for the entire year. If stocks begin to rise above the desired level, this may be an economic signal for a downward adjustment in support prices; the reverse might be the reaction to a depletion of stocks. But adjustments must be made for the next crop year, not for the present one.

Price supports, if they are announced well in advance of the sowing season and are backed by full government purchase at the announced price, can provide the incentive prices which will make the adoption and continued use of new technology feasible. However, support prices cannot limit the upward rise of prices. A well-managed stock operation scheme for price stabilization can effectively do this, but consider first the issues involved in maintaining the upper level of harvest prices.

Perhaps the safest thing that can be said regarding the upper level of harvest prices is that it should reflect the overall demand and supply situation in the country. If a rigid upper limit is maintained for harvest prices (for example, the level of the previous year) and supply falls by 20 per cent, then producers' incomes would fall by 20 per cent. The other extreme, allowing harvest prices to rise above the normal level in order to stabilize producers' incomes, would shift the whole burden on to consumers whose real incomes would suffer. Therefore, some reconciliation between producer and consumer interests is required.

The basic support price should be set on an all-India basis, allowances being made for differences in transportation costs, so that the prices in some states will be higher than in others. In this way economic forces will be free to allocate hectarages on the all-India basis of comparative advantage. Seasonally, prices must be allowed to rise above the harvest level at least enough to cover holding costs of storage, interest, etc., but excessive seasonal fluctuations should be minimized. A sufficient risk factor should be allowed in addition to these holding costs, although the

risk will be reduced as price policy effectively stabilizes prices. In the past, traders have had a difficult time planning for storage. During some years price increases did not cover storage costs and stockists suffered losses. They must balance these losses with larger-than-minimum profits in other years in order to establish a break-even income over time. Thus, seasonal price increases must be permitted, otherwise private traders will be driven from business and the government will be forced to assume the entire burden of storage and distribution.

It is necessary, especially in the present context of economic liberalisation, that world prices be made the terms of reference for domestic agricultural prices. World prices presumably reflect the economic value placed on the use of resources on a world-wide or free trade basis of comparative advantage. Therefore, they are a guide to domestic resource allocation in the wider international setting.

The transition of the present price structure to the configuration of world prices should be carried out over a period of next 2 to 3 years. Once this transition is made, then support prices should be a risk insurance, covering only variable or cash costs of production. Acceptance of this long run role for support prices will allow the price structure to move towards its long run equilibrium. This policy will ensure continuing pressure on efficiency and introduction of cost reducing technology and lighten the otherwise growing load of supporting agricultural prices.

If the support price is too high, the government may have to buy all the foodgrains marketed; if it is too low the government may purchase none and have none for distribution. This dilemma means that the support price should be used primarily as a production incentive and that another instrument should be used to ensure that the necessary volume of foodgrains is procured for public distribution.

The buffer stocks - public distribution system is the instrument which can be simultaneously used to (i) increase the level of production, (ii) influence market prices, (iii) maintain a steady grain supply to urban areas, and (iv) protect the consumption levels of low-income groups. However, the system can effectively operate within the context of a mixed government and free market activity in the foodgrains sector only with the explicit recognition of the appropriate role of the two participants. The programme can be operated following certain procedures which are elaborated in the next section.

IV

OPERATIONAL STRATEGY FOR FOOD MANAGEMENT

We have argued in the previous section that to create a favourable economic environment for accelerating agricultural growth, the government must develop a programme to moderate short-term price fluctuations. This will ensure that resources are efficiently employed and contribute to attaining the long-term growth objectives in agricultural development. The buffer stock is a market-compatible policy instrument that can cope with short-term problems as well as allow economic signals to direct inter-crop and inter-spatial area and input allocations.

The rationale for considering buffer stocks operation as an instrument for price and farm income stabilization is that through proper control of inventory, prices can be manipulated to influence production, marketing and consumption decisions in predictable, economically rational ways. At the same time it must be clear that this position is not held in ignorance of the real and potential imperfections of the price system in the country. However, the price system can be a positive force which should be reinforced by better communication and wise government activity. The role of the government should be to moderate excess short-run price fluctuations while allowing prices to perform their long-run allocative function.

The compelling reason to seriously consider a buffer stock is that the new initiative for liberalisation of agriculture, if pursued seriously, has the potential to change the regional location of agricultural crops significantly during the next few years. If the market adjustment mechanism is allowed to operate, a new pattern of comparative advantage in crop production can be attained whereby resources are used most efficiently in all parts of the country. Maintaining an adequate buffer stock is a fundamental prerequisite for the

removal of foodgrain zones and the accompanying policies which interfere with market directed adjustments.

Buffer stocks, as we have conceived them, are the stocks maintained by the government with the objective not only of reducing price fluctuations around a specified level, but also of minimizing variability of farm income and consumption from their envisaged growth paths. The physical process of the buffer stock operation for attaining the above objectives is to release stocks during lean years and replenish stocks during good harvest years. The operational feasibility of such a buffer stock programme will depend on the following:

1. Over the long term, buffer stock will help to attain the stabilization goals only if (a) the rates of growth in demand and supply are kept approximately under equilibrium, and (b) variations in the rates of changes of prices, farm incomes and quantities consumed are reduced. The success of the programme will depend upon the price level around which stabilization is targeted. In general, this should be close to the price in the free market.
2. Successful operation of a buffer stock programme for reducing the variability in price, farm income and consumption is possible only if (i) the basic cause of instability in them is the fluctuation in output, and (ii) the demand and supply curves are inelastic. When these conditions are satisfied, the extent of relative stabilization of price and farm income will depend upon the operational strategy of the buffer stock agency. Evidently, complete stabilization of both price and farm income is not possible, and therefore, the operational strategy of the buffer stock agency ought to be to release and replenish a fraction of stock so that variability in price and farm income is reduced to desirable levels.[3]

A buffer stock programme to attain both the desired consumption-oriented and the production-oriented objectives should be built explicitly around the following four instruments:[4]

i) regular distribution to low-income persons;
ii) a mechanism for distribution to the general public in response to foodgrains price increases in order to preserve the upper limit on prices;
iii) guaranteed purchase of all grains delivered at the support prices announced prior to the sowing season in order to preserve the lower limit on prices;
iv) procurement at open market prices when necessary to meet distribution requirements.

The distribution to low-income groups has an explicit welfare objective. Its operation will require identification and estimation of low-income group in the population and also the minimum level of welfare that the society will be willing to provide to this group. The actual operation of the scheme will ultimately have to rest on certain degree of arbitrary choices on the part of the policy makers. Given these choices, the volume of distribution under this scheme will at any point in time depend on population growth and changes in income distribution.

The other function of distribution is the price dampening objective. In general, the quantity distributed for the low-income group and that under the price dampening policy will be related; the volume of withdrawal under price dampening policy will increase or decrease as the difference between free market price and issue price widens or narrows down.

In the procurement operation, the procurement under the price support will act as a direct incentive for increased production. Its volume will be inversely related to the difference between the market and support prices; the lower the difference in prices, the more will be available for procurement under this scheme. The remainder to be procured by open market purchases closes the system in the face of uncertainty. On the whole in the face of an inelastic supply, operation of a buffer stock programme will make the demand more elastic than the one in the absence of any such scheme.

The issue of food availability is perhaps the most important one for any government hoping to build a modern progressive state. The population must be assured that adequate supplies of

food will be available at 'normal' prices. Especially where there is a sizeable low-income group of consumers, a foodgrains distribution programme, perhaps run at a subsidy, is a necessary complement to the private market in order to assure minimum foodgrains availability. With development, as production increases more rapidly than demand, the need for such a system lessens, but weather-induced fluctuations in output mean that some kind of public distribution will continue to be required. Distribution is also a desirable component of the total buffer stock programme to facilitate stock turnover in order to avoid spoilage.

Large scale purchase and distribution of grains will be required only during good and bad harvests and buffer stocks will be built up over time through a clearly stated inter-year stabilization objective of the government. However, even in normal years, with output just matching aggregate demand, the government will have to purchase and distribute a certain quantity of foodgrains to fulfil its commitments for intra-year distribution. The quantum of such purchase will depend upon the extent to which the government would like to control intra-year price fluctuations and the degree to which it can involve itself in foodgrains operation.

Procurement and distribution of foodgrains in India have increased significantly since the introduction of New Strategy for Agricultural Development in the mid-1960s. However, even at the peak of operation in the past, government purchases have not exceeded 16 per cent of the production. But in no year, save the crisis period of 1966-67, did distribution exceed 15 per cent of the total consumption (Table 3). In fact, during the period 1957-62 when market prices were stable, the gap between market price and the issue price was large and the public distribution system had ample stocks from imports, the withdrawal from the fair price shops did not exceed 8 per cent of the total consumption. Therefore, under this favourable situation, the consumers who were drawing grains from the public distribution system were likely to be the needy poor who could hardly afford to purchase grains from the free market. These withdrawals probably did not fully meet the nutritional requirements of the low-income group in the population, but to provide their full requirement would have required even lower issue prices. An arbitrary fixation of issue price is, however, not possible if the requirement for intra-year distribution is obtained from a part withdrawal of the total domestic supplies from the market.[5]

Equitable distribution of foodgrains in the Indian context of instability in production and wide disparities in income is possible only if the level of consumption is so influenced through food management operations that each person consumes approximately the same quantity of food irrespective of his level of income. If the society decides to provide minimum subsistence to the poor, and at the same time, does not want to abolish the free market, equitable distribution can be obtained only by penalising those who can afford to pay more. In a free society, this is possible by deliberately following a discriminatory policy of distribution in which the rich pay a market-determined price and the poor are compensated with a subsidised low price.

The facts justify the suggestion. Public distribution of foodgrains in India is highly subsidised and the reasons for this are well known. However, what is not so clear is the logic for distribution of a uniform quantity per consuming unit at a uniform price to all sections of the society. If the justification for complete coverage by the public distribution system lies in the concern for protecting the consumers from the unscrupulous activities of the traders, then the appropriate policy should be to ensure the certainty of supply to the consumers at a price that reflects the market conditions - not guaranteed supply of a uniform quantity to all sections of the society at a subsidised price. If the justification is to provide relief to the low-income groups from high market prices of foodgrains, then their presence should be explicitly recognised by selling them grain at a low price. How low priced it should be, will of course depend upon the extent of the subsidy and the willingness of those who will be asked to bear the burden of subsidy.

TABLE - 3 NET AVAILABILITY, PROCUREMENT AND PUBLIC DISTRIBUTION OF FOODGRAINS

	Net Production of Foodgrains	Net Imports	Net Availability of Foodgrains @	Procurement	Public Distribution #	Col. 3 as % of col. 4	Col. 5 as % of col. 2	Col. 6 as % of col. 4
	(million tonnes)							
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1951	48.1	4.8	52.4	3.8	8.0	9.2	7.9	15.3
1952	48.7	3.9	52.0	3.5	6.8	7.5	7.2	13.1
1953	54.1	2.0	56.6	2.1	4.6	3.5	3.9	8.1
1954	63.3	0.8	63.9	1.4	2.2	1.3	2.2	3.4
1955	61.9	0.5	63.2	1.3	1.6	0.8	2.1	2.5
1956	60.7	1.4	62.6	Neg.	2:1	2.2	Neg.	3.4
1957	63.4	3.6	66.2	0.3	3.1	5.4	0.5	4.7
1958	58.3	3.2	61.8	0.5	4.0	5.2	0.9	6.5
1959	69.0	3.9	72.3	1.8	5.2	5.4	2.6	7.2
1960	67.5	5.1	71.2	1.3	4.9	7.2	1.9	6.9
1961	72.0	3.5	75.7	0.5	4.0	4.6	0.7	5.3
1962	72.1	3.6	76.1	0.5	4.4	4.8	0.7	5.7
1963	70.3	4.5	74.8	0.8	5.2	6.1	1.1	6.9
1964	70.6	6.2	78.1	1.4	8.7	8.0	2.0	11.1
1965	78.2	7.4	84.6	4.0	10.1	8.8	5.2	11.9
1966	63.3	10.3	73.5	4.0	14.1	14.0	6.3	19.2
1967	65.0	8.7	73.9	4.5	13.2	11.7	6.9	17.8
1968	83.2	5.7	86.8	6.8	10.2	6.5	8.2	11.8
1969	82.3	3.8	85.6	6.4	9.4	4.5	7.8	11.0
1970	87.1	3.6	89.5	6.7	8.8	4.0	7.7	9.9
1971	94.9	2.0	94.3	8.9	7.8	2.1	9.3	8.3
1972	92.0	(-)0.5	96.2	7.7	10.5	(-)0.5	8.3	10.9
1973	84.9	3.6	88.8	8.4	11.4	4.0	9.9	12.8
1974	91.6	5.2	97.1	5.6	10.8	5.3	6.2	11.1
1975	87.4	7.5	89.3	9.6	11.3	8.4	10.9	12.6
1976	105.9	0.7	95.8	12.8	9.2	0.7	12.1	9.6
1977	97.3	0.1	99.0	9.9	11.7	0.1	10.1	11.8
1978	110.6	(-)0.6	110.2	11.1	10.2	(-)0.5	10.0	9.2
1979	115.4	(-)0.2	114.9	13.8	11.7	(-)0.2	12.0	10.2
1980	96.0	(-)0.3	101.4	11.2	15.0	(-)0.3	11.6	14.8
1981	113.4	0.7	114.3	13.0	13.0	0.6	11.4	11.4
1982	116.6	1.6	116.9	15.4	14.8	1.4	13.2	12.6
1983	113.3	4.1	114.7	15.6	16.2	3.5	13.7	14.1
1984	133.3	2.4	128.6	18.7	13.3	1.8	14.0	10.4
1985	127.4	(-)0.4	124.3	20.1	15.8	(-)0.3	15.8	12.7
1986	131.6	0.5	133.8	19.7	17.3	0.4	15.0	12.9
1987	125.5	(-)0.2.	134.8	15.7	18.7	(-)0.1	12.5	13.8
1988	122.8	3.8	130.8	14.1	18.6	2.9	11.5	14.2
1989	148.7	1.2	147.2	18.9	16.4	0.8	12.7	11.1
1990	149.7	1.3	144.8	24.0	16.0	0.9	16.0	11.0
1991	154.3	(-)0.1	158.6	19.6	20.8	Neg.	12.7	13.1
1992*	146.2	1.1	148.9	17.9	19.1	0.7	12.2	12.5
1993*	157.4	2.4	150.2	28.0	15.1	1.6	14.8	10.1

* Provisional.
Neg. Negligible.
@ Net availability = Net production + Net imports - Changes in Government stocks.
# Includes quantities released under the Food for Work Programme during the years 1978 to 1990.
Notes: Production figures related to agricultural year: 1951 figures correspond to 1950-51 and so on. Figures for procurement and public distribution related to calender years.
Source: 1. Ministry of Food. 2. Directorate of Economics and Statistics, Department of Agriculture and Cooperation. Reproduced from *Economic Survey, 1993-94*, page S-25.

Many of the ills in the food management system have originated in the government's misplaced concern for distribution to all sections of the community at a uniform price. Fair distribution has been conceived as distribution at a reasonable price, but reasonableness has been viewed only in relation to the unweighted interests of all consumers. Consequently, the concept has led to the notion of a reasonable price being a consumer-oriented price below the market price.

Ironically, the operational procedure followed in running the present public distribution system denies access to a large number of deserving poor. As Jha observed [1992], 'The criterion used is to issue ration cards to all those households that have properly registered residential addresses. This of course means that many of the poor who are homeless, those in some institutional care and others without proper addresses, including migrant workers, are immediately left out of the scheme. Also, as the consumer quotas are sold in a lump sum for a minimum period of a week, a fortnight or a month, the workers on daily wages who cannot afford to buy such minimum quantities cannot take advantage of the subsidies, even if they have ration cards' [Jha, 1992, p. 103].

One argument is that since government has to distribute a large quantity of foodgrains to consumers in general, and urban consumers in particular, government should procure the entire quantity required for distribution at a lower than market price and thus realise part of the subsidy from the producers and traders. This need not and should not be the strategy in food management for two reasons. First, the public distribution system, especially in the urban areas, is now functioning primarily to ensure a steady supply to all categories of consumers, a substantial proportion of whom are employed in organised sectors and enjoy pay revisions according to changes in the cost of living. On the other hand, the unorganised rural and urban sectors are crowded by a large number of unemployed and under-employed who suffer severely from rising prices. Moreover, rural income is highly correlated with production. A non-targeted distribution programme with relatively easy accessibility to the consumers in urban areas thus goes against the policy of ensuring equitable distribution at reasonable prices, to all sections of the people [Howes and Jha, 1992]. Second, and what is more important, is the concern for viability of the food management system. The co-existence of a subsidised public distribution system with the free market in the absence of proper identification of the two categories of consumers (i.e. low-income consumers and the rest) may make the system vulnerable to the pressures of free market [GOI, 1966].

To the extent that distribution is made to the low-income groups, the need for subsidised distribution cannot be ignored. A careful identification and estimation of the low-income population is essential. Obviously it cannot include the entire urban and rural community. The prevailing socio-economic conditions should be weighted carefully to decide who qualifies as a low-income family and what measure of relief should be provided to them. A dual distribution scheme should then be introduced. Distribution of a uniform quantity per consuming unit may be made at two prices: a stable subsidised price for the low-income group and a price reflecting market conditions for others. Alternatively, a uniform subsidised price may be used and a quantum of distribution per consuming unit may be fixed at two levels: a fixed level determined on the basis of nutritional norms for the low-income group, and depending upon the market prices, a fraction of the above level to meet partly the requirements for others.

Theoretically, the government could distribute the entire marketable surplus by purchasing the grain at market prices. This would enable it to undertake a large distribution programme with certainty of supply. However, the presence of a large buyer like the government in the market with the intention of purchasing the entire marketable surplus at the market price might be exploited by the producers and traders. By withholding supplies prices will be unduly pushed up, thereby compelling the government ultimately to fix market prices.

Even as a partial buyer government will create a situation of high prices in the free market. Some corrective measures will therefore be necessary. These can largely be maintained through the buffer stock operations. Once the government

realistically fixes the price bounds after a careful assessment of the demand and supply conditions, its price-dampening distribution operation for containing price within the desired limits should be effective, if it has adequate stock. At the same time, those who attempt to cross the price bounds can be deterred through a mechanism compatible with the private market. This can take the form of a pre-emptive purchase scheme used in Punjab. Under this scheme, the government reserves the right to procure varying proportions of each day's total market arrivals. At the end of the day, however, government buys all or part of that proportion only if market price is favourable. The scheme penalises both the shy as well as the aggressive bidders and at the same time helps to fix the price bounds at appropriate levels. An increasing tendency of deviations registered in the market will signal the need to readjust the price bounds at levels reflecting more accurately the market conditions.

The distribution to low-income group and consequent question of sharing the burden of subsidy, however, still remains. The subsidy cannot be realised from the other consumers by charging a high price because a distribution price fixed above the market level will introduce instability in the system. The other possibility is to realise the subsidy from the producers. This can be in the form of procurement at lower than market prices. To the extent that subsidised distribution is made to low-income people, procurement of the required quantity at a lower than market price can be justified; but then, for effective redistribution of income, the strategy for procurement should be such that the burden of the subsidy falls increasingly on the big farmers.

A graded levy system might be imposed on producers in which each is asked to deliver a certain quantity of grain at the levy price depending on family holding size in standard hectares. There is a danger when the graded levy system is imposed on the basis of the area under the crop concerned because the affected producers may divert their resources to non-levied crops. To avoid this possibility, a graded food levy scheme may be imposed on all crop producers in which each producer may be given the option to deliver the grain or pay the cash equivalent of the levy based on their family holding size in standard hectares.

The operational strategy outlined above provides a package that may help the government to attain the objectives of food management. In recent months, much more bolder and imaginative programmes have also been suggested by others to make the food management system more efficient and target-oriented [Desai, 1993; Pursell and Gulati, 1993]. However, none of these suggestions and recommendations have influenced in any way in bringing changes in the government's existing food management operations. The reason for this is entirely political. Food management continues to remain politically so sensitive that the Centre feels hesitant to initiate reforms, lest the actions strain its relationship with the states and make it vulnerable to political attack, inside and outside the Parliament. Consider for example the suggestion for agricultural taxation which unfortunately has become a political issue in India. The states are not anxious to impose increased taxes on agriculture and the Centre has only a few options. The land revenue and income tax which can be designed to have minimum impact on incentive are immobilized by the recalcitrant states, while the alternatives open to the Centre have direct disincentive effects.

Again, the issue of moral responsibility for equitable distribution of food has been stretched to the hilt by the states for their own political advantages. The states, especially the major recipients of food from the Central Pool, consider it as the sole responsibility of the Centre. They resist any change in the universal character of the public distribution system, and run ambitious subsidised food distribution programmes without making attempts to support these through their own procurement efforts. Ironically, it is this lack of serious efforts to procure by the major food recipient states that makes difficult implementation of the government's announced support/procurement prices in these states, dampens the initiatives of their farmers to produce more, and thus increases their dependence on the Centre for running the public distribution system. Faced with the increasing demand for food for public distribution, the Centre falls heavily to procure

grains from the few food surplus states, where the farmers' lobby exploits the situation to pressurise the Centre for making upward revision of procurement prices. As the Centre yields to the pressure, and foodgrains start moving long distances through the porous pipes of the Food Corporation of India with the help of its 70,000 plus employees, the concomitant additions of storage, handling and interest charges make the economic costs of procured grains significantly higher than the politically acceptable levels of issue prices. The political compulsion for making allocation of fund for food subsidy thus falls again on the Centre, the burden of which goes on increasing with the growing demand for food for distribution, and the widening gaps between the economic costs and the politically acceptable issue prices for distribution through the fair price shops.

The extent to which political considerations can push up the food subsidy bill is illustrated by the indecisive and delayed actions of the government in 1993-94.[6] In the Central budget presented in February 1993, the Finance Ministry initially allocated Rs 3,000 crore for food subsidy against the projected demand for Rs 4,300 crore made by the Food Ministry. Later, the allocation was raised by another Rs 650 crore through supplementary demand to the budget. However, immediately after the budget presentation, the Agriculture Ministry yielded to the pressure of the farm lobby, and steeply raised from April 1993, the procurement price of wheat by a record 21 per cent. This was followed by another record increase of 23 per cent in the procurement prices of rice from October 1993. With hefty hike in the procurement prices of wheat and rice, and the open-ended procurement policy, government procured 12.8 million tonnes of wheat, and 10.65 million tonnes of rice by the end of January 1994, and incurred heavy expenditure. It is estimated that transport charges alone for moving foodgrains has crossed Rs 850 crore. Huge increases in storage prices and the bank credit required to procure grains have also contributed to the increase in cost. While the costs for this massive operation were steeply rising and demanding early actions, the government went on contemplating to raise the issue prices but failed to do so due to strong opposition from within and outside the government. It was only in January 1994, when the burden became too unbearable that the move to increase the issue prices became by and large unanimous. Effective from February 1994, the issue prices for rice and wheat have been raised but, even with these upward revisions, the actual costs to FCI for a kilogram of wheat would be still Rs 1.40 more than its revised issue price. It is estimated that the government has suffered a loss of Rs 1,000 crore alone due to delay in the announcement of hike in the issue price, which was due from April 1993 for wheat, and October 1993 for rice. The belated decision taken by the government has now pushed up the total food subsidy bill from the budgeted Rs 3,650 crore to about Rs 6,000 crore.

The hesitancy to initiate reforms due to political considerations is also evident from the contradictory recommendations made from time to time by the various committees. Thus, while the high-powered ministerial committee set up to evolve a national policy on the PDS recommended that it should be structured to exclude affluent sections from its purview, the parliamentary committee on food, civil supplies and public distribution strongly recommended in favour of continuing with the present universal character of the public distribution system. The Seventh Plan document argued that the PDS should be so developed that 'it remains hereafter a stable and permanent feature of our strategy to control prices, reduce fluctuations in them and achieve an equitable distribution of essential consumer goods' [GOI, 1986, Vol. II, p. 403]. These laudable objectives are not feasible to attain through the existing system of food management operations. Clearly, if the PDS is to become a 'stable and permanent feature', government's operational strategy should be so evolved that while it helps to provide the much needed food security to the poor, the burden of subsidy is also maintained at a bearable level. Keeping these in mind and assuming that political considerations are unlikely to permit immediate radical changes in the existing system of food management operations, we would therefore like to recommend the following:

1. The fair price shops system has been playing an important role of assuring a steady supply to the consumers in general. People, particularly those in the urban areas, have taken for granted continuance of its functioning as a necessary complement to private market in order to assure minimum foodgrains availability, especially to deal with emergency scarcities, such as those created by droughts and floods. Any proposal to 'dismantle' the system will thus be unacceptable, at least for some time to come. We are of the opinion that the fair price shops system should remain, and should function like the Mother Dairy booths/ consumer co-operative stores for retail distribution to the general public with some restrictions on the quantum of withdrawals.
2. If the fair price shops system has to function as a necessary complement to private market for distribution to the consumers in general, the following observation of the Study Team on Fair Price Shops [GOI, 1966, Pp. 13-15] should not be ignored:

   'The essential condition of co-existence of a fair price shops system with a free market is that it is able to protect itself from the pressures of the free market'.

   'If the fair price shops system is to protect itself from the pressures of the residual free market, it must aim at maximizing the quantities of grains it handles at appropriate prices rather than distributing certain quantities at a certain fixed price'.

   'This requires discarding the concept of fair price as a consumer oriented fixed, unchanging price. If the system of fair price shops is to function along side a free market, the price in the fair price shops must be neither consumer nor producer oriented. It must be market oriented'.

   'The fair price shops system functioning along side a free market is incapable of fulfilling any extra-market purposes. One such is to provide food in adequate quantities to those who cannot buy it at supply-demand price. This requires a programme of subsidised food distribution. Its objectives and purposes should be kept distinct and separate from those of the fair price shops system'.
3. Two clear directives follow from the above observations. Firstly, so long as the present universal character of the public distribution system is maintained, the issue prices must be adjusted to reflect the market situation. We suggest, these adjustments be made twice in a year, before the kharif and the rabi harvests respectively. Secondly, separate programmes must be designed for making subsidised food distribution to the low-income group. The problem of identification of low-income people and the consequent scope for 'leakages' are likely to be less if the subsidised distribution to the low-income group is channeled through more direct and action-oriented programmes. We are of the opinion that, through subsidised food distribution, the interests of low-income people can be better served, if the various employment generating food for work programmes are considerably expanded, and the distribution net works in the identified tribal and backward rural blocks and in urban slum areas are significantly improved.
4. Subsidised distribution inevitably becomes costlier if it is extended to cover more commodities. The wider the field of its operation the more difficult it is to apportion successfully. We suggest, subsidised distribution should cover only one basic source of calories such as coarse varieties of grains. Other items like sugar, edible oils, etc., should be withdrawn from the purview of its operation.
5. Although restrictions on the movement of foodgrains have been officially withdrawn from 1993, it has been reported that deliberate obstacles are still created to hamper free flow of foodgrains across the state boundaries. As mentioned in Section II, movement restrictions result in market imperfections and contribute in making inefficient utilization of resources. To reduce the regional disparities in open market prices and to make more

efficient utilization of resources, restrictions on movement of foodgrains should be completely removed.

6. For market price stabilization, the Centre should carry out open market purchases and sales operations.
7. Besides support price operations, the Centre should make only open market purchases with rights of pre-emption for meeting its requirement for intra-year distribution.
8. The Centre's requirement for intra-year distribution should be reduced over the next two years to the level of requirement for distribution to the low-income group through the schemes outlined in no. 3 above.
9. So long as the universal character of the present public distribution system is maintained, the states should be asked to take increasing responsibility to support the system through their own procurement efforts. Procurement operations should be carried out more aggressively in the present major food recipient states.
10. For market price stabilization, the Centre should maintain an 'adequate' level of foodgrains stock. The stock should not be allowed to fall below a minimum reserve level. If the reserve threatens to fall below the minimum level, prompt action should be taken to import grains through commercial channels.

V

STOCK REQUIREMENTS FOR PRICE AND FARM INCOME STABILIZATION

Successful implementation of the operational strategy outlined in the previous section will depend crucially on maintaining an 'adequate' level of foodgrains stock with the government. But how much stock the government should carry, and at what costs and benefits to the society?

Statistical storage rules can be used to determine the level of an 'adequate' size of buffer stock in probabilistic terms. The main objective of the storage programme is to reduce the variability in price and farm income due to output fluctuations by restricting consumption in years of good crops and augmenting it in lean years. Thus, if the quantity released or withdrawn is considered as a function of the current year's production, then a simple statistical rule for stock operation can be derived as follows: release or withdraw a fraction of the deviation of the current year's production from its expected level so that variability in price and farm income are reduced to desired levels. Evidently, this fraction is to be chosen at some pre-assigned probability level unless the plan is for complete price stabilization (in which case the value of the fraction should be 1), or unless the criteria is stated in terms of stabilization limits. The value of the fraction can be determined if the probability distribution function of output follows some standard probability models.[7]

The probability distribution of the fluctuations in India's cereals production has been examined by a number of research workers. The wide fluctuations in production arise primarily due to sharp variations in rainfall. Mixed evidence is available regarding the question of repetitive cycles in Indian rainfall data. However, historical analysis made by computing rainfall index for the cereals group with the rainfall data dating from 1876 did not show any cyclical pattern in the computed rainfall index series. Analysis of the past production data indicated that over 70 per cent of the variations in cereals production around its trend line could be explained by the computed rainfall index.[8]

Using the above historical analysis, some idea could be obtained about the quantity of the buffer stocks that would be required to meet the contingency of weather induced fluctuations in future cereals production. There appears to be roughly a 27 per cent chance (once in every 3.7 years) that cereals output fluctuations will be within 3 per cent of the trend, and a 31 per cent chance (once in every 3.2 years) that they will be between 3 and 6 per cent of the trend. Fluctuations of the order of 6 to 9 per cent of the trend are likely to occur once in every 4.4 years while those above 9 per cent of the trend will appear once in every 5.2 years. The historical analysis of rain-induced production fluctuations indicates that a reserve stock of about 12 per cent of the trend level (equivalent to twice the mean per cent deviation around the trend) will be adequate in 95 per cent

of the cases to offset any individual year's production fluctuations due to rainfall.

The historical analysis of rain-induced production fluctuations also suggests that in an exceptionally bad year cereals production might decline by 17 per cent. Similarly, in an exceptionally good year, production might increase by 22 per cent. Thus, to make a liberal provision for any individual best or worst year in the future it will be sufficient to maintain cereals reserve of about 20 per cent of the trend level production. However, the chances of these types of events occurring are about once in a century, and with such a remote chance, the need to maintain a huge reserve stock can be questioned.

In fact, when we look into the sequences of good or bad years of production, the need to maintain higher level of stock appears unnecessary. Using the rainfall indices as obtained from 1876 we find that there are six sequences in which the cumulative production deficits or surpluses were above 10 per cent. If we consider the averages of the three worst and the three best sequences, then the cumulative production deficits or surpluses could at best be of the order of 12.5 per cent of the trend level production.

The historical findings are used in deriving statistical storage rules for estimating the stock requirements in probabilistic terms. Table 4 provides at four different success probability levels (0.85, 0.90, 0.95 and 0.99), the estimates for cereals stock requirements, to carry out consumption stabilization programme over a five year period under four different storage rules and their corresponding implications on price and farm income stability. The rules are specified by estimating at four different success probability levels (0.85, 0.90, 0.95 and 0.99), the magnitude of the fraction of deviation in production from its expected level, which should be released or withdrawn so that consumption is stabilized within 5 per cent of its anticipated level. All calculations are based on the assumption of stationarity in mean and variance of the normally distributed cereals output with mean at 160 million tonnes (provisional level of production for the triennium average ending in 1992-93) and standard deviation at 9.6 million tonnes. The price elasticity of demand is assumed as 0.5 while that of supply is taken as 0.

TABLE-4. IMPLICATIONS OF DIFFERENT STATISTICAL STORAGE RULES FOR CEREALS (MEAN AND STANDARD DEVIATION OF CEREALS OUTPUT ARE TAKEN AS 160 AND 9.6 MILLION TONNES RESPECTIVELY)

	Without Storage Programme	With Storage Programme			
		Consumption to stabilize within 5% of its anticipated level with the probability of success at			
		0.85	0.90	0.95	0.99
(1)	(2)	(3)	(4)	(5)	(6)
1. Storage Rule: Fraction of the deviation from mean production level released or withdrawn	0	0.1960	0.3490	0.4919	0.6408
2. Stock requirement (in million tonnes) for a 5 year period with the probability of success at					
i) 0.85	0	4.36	7.76	10.94	14.25
ii) 0.90	0	5.38	9.59	13.52	17.61
iii) 0.95	0	6.90	12.29	17.32	22.56
iv) 0.99	0	9.76	17.38	24.50	31.91
3. Coefficient of variation (per cent) in					
i) Consumption	6.00	4.82	3.91	3.05	2.15
ii) Price	12.00	9.65	7.81	6.10	4.31
iii) Farm income	6.00	3.65	1.81	0.10	1.69

Some interesting results follow from these statistical rules. Without the storage programme, cereals consumption will record a variation of 6.00 per cent. With the storage programme, the buying and selling operations to reduce variability in consumption will also reduce the variability in farm income. But, the higher the magnitude of the price elasticity of demand, the more rapid will be the convergence of the farm income towards complete stabilization than that of consumption. In fact, corresponding to cereals price elasticity of demand at 0.5, farm income will be completely stabilised by the storage rule with the magnitude of the fraction at 0.5, but not price and consumption. Any attempt for further reduction in price and consumption variability beyond the complete farm income stabilization level can be obtained only at the cost of instability in farm income and maintaining huge stocks. Looking at the stock requirements under different storage rules and those based on the historical analysis, it seems appropriate to have a maximum stock of 14 million tonnes of cereals and follow the storage rules aimed at stabilizing consumption with about 3 per cent variation.

Table 5 illustrates what would have happened if the above recommendations were followed for the period 1981 to 1990. The computations presented in the table are self-explanatory. Actual per capita availability during the period had varied from a low of 144.9 kg. in 1983 to a high of 166.1 kg. in 1989 with mean at 155.4 kg. Opening stock with the government in 1981 was 11.74 million tonnes. If, during this period, government had attempted to stabilize per capita availability with a permissible ±3 per cent fluctuation in it (i.e., ±6 per cent fluctuation in price, if the price elasticity of demand and supply are taken as 0.5 and 0 respectively), and had restricted the level of carry-over stock to a maximum of 14 million tonnes, there would have been no need for imports, and per capita availability would have varied from 150.4 kg. to 159.6 kg. with mean at 154.4 kg. However, the government had pursued an entirely different operational strategy during this period. Not only did it allow sharp fluctuations in per capita availability, but also decided to accumulate stock to over 25 million tonnes, and imported grains totalling to 10.98 million tonnes.

The stock requirement suggested above is entirely from the consideration of estimated production fluctuations due to the historical variations in rainfall. Various other considerations are also equally important in determining the size of reserve, and the appropriateness for any specific level of reserve for the future can be judged only by examining the costs and benefits that it will accrue to the nation.

A two-stage procedure can be adopted for evaluating the buffer stock programme. To determine the storage capacity requirement for future years, statistical storage rules illustrated earlier can be used to examine, the consequences of operating with different storage capacities on price and farm income. A simulation approach can then be used for estimating the costs and benefits of operating the buffer stock programme with fixed storage capacities and given storage rules aimed at stabilizing price within specified limits.[9]

Suppose that the future production plans are such that under normal weather conditions annual production approximately equals corresponding demand. Also, suppose that the intention is to keep price within two specified limits over a given time period and with a given storage capacity. Because the magnitude of output fluctuation for any year is uncertain, the intentions of the government may or may not be realized throughout the period. It is constrained by available grain in storage or available empty space in storage which, in turn, is a function of the storage rule and the sequential occurrence of the magnitude of output fluctuation in prior years. For any year, the storage activity is thus determined by the level of production, storage rule and storage activity in preceding years.

TABLE 5. STABILIZATION OF PER CAPITA AVAILABILITY DURING 1981-90 AT 155 KG. WITHIN A LIMIT OF 3 PER CENT FLUCTUATION AND A MAXIMUM CARRY-OVER STOCK OF 14 MILLION TONNES

Year	Population (million)	Cereals requirement at 155 kg. per capita p.a. (million tonnes) (0.155)× (Col.2)	Actual net cereals production (million tonnes)	Permissable 3% deviation in requirement (million tonnes) (±0.03)× (Col.3)	Actual deviation (million tonnes) (Col.4)- (Col.5)	Purchase (+) or release (-) (million tonnes)	Opening stock (million tonnes)	Closing stock (million tonnes) (Col.8)+ (Col.7)	Net imports (million tonnes)	Net (availability million tonnes) (Col.4)- (Col.7)	Per capita net availability (kg/year) (Col.11)÷ (Col.2)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1981	688.5	106.72	104.09	±3.20	-2.63	0	11.74	11.74	0	104.09	151.2
								(11.50)	(0.52)	(104.86)	(151.9)
1982	703.8	109.09	106.56	±3.27	-2.53	0	11.74	11.74	0	106.56	151.4
								(12.77)	(1.58)	(106.82)	(151.4)
1983	718.9	111.43	102.95	±3.34	-8.48	-5.14	11.74	6.60	0	108.09	150.4
								(15.49)	(4.07)	(104.36)	(144.9)
1984	734.5	113.85	122.05	±3.41	+8.20	+4.79	6.60	11.39	0	117.26	159.6
								(22.55)	(2.37)	(117.35)	(159.6)
1985	750.4	116.31	116.88	±3.49	+0.57	0	11.39	11.39	0	116.88	155.8
								(25.21)	(-0.35)	(113.87)	(151.7)
1986	766.5	118.81	119.94	±3.56	+1.13	0	11.39	11.39	0	119.94	156.5
								(23.63)	(-0.06)	(121.46)	(158.5)
1987	782.7	121.32	115.25	±3.64	-6.07	-2.43	11.39	8.96	0	117.68	150.4
								(14.14)	(-0.37)	(124.36)	(159.1)
1988	799.2	123.88	113.22	±3.72	-10.66	-6.94	8.96	2.02	0	120.16	150.4
								(9.48)	(2.35)	(120.14)	(150.8)
1989	815.8	126.45	136.56	±3.79	+10.11	+6.32	2.02	8.34	0	130.24	159.6
								(12.13)	(0.83)	(134.83)	(166.1)
1990	832.6	129.05	138.26	±3.87	+9.21	+5.34	8.34	13.69	0	132.87	159.6
								(19.08)	(0.04)	(132.25)	(159.9)

Notes: Numbers in parentheses are the actuals as reported in Bulletin on Food Statistics, 1990. Columns 2 and 4 are taken from *Economic Survey*, 1993-94, Table 1.18. Column 7 is taken as 0 if |col. 6| is less than |col.5|; it is col. 6- |col. 5| if |col.6| is greater than |col. 5|.

It is now clear that the costs and benefits of the buffer stock programme aimed at a desired level of stabilization will be governed by the manner in which time-ordered production sets occur. Because future production fluctuation cannot be predicted accurately, the determination of costs and benefits of a buffer stock scheme also cannot be precise. These can only be expressed within some confidence limits. The evaluation of buffer stock programme for any specified future period can thus be made by generating a large number of sequentially ordered sample production sets and computing in each case, the discounted present value of various benefits and costs for each production set and, finally determining their expected values and standard deviations by combining the estimates derived from all the sample sets.

Results of a simulation exercise carried out earlier indicated that the total financial involvement in the stabilization programme was a net loss of a very high order.[10] In fact, comparing the estimated rate of decline in price and farm income fluctuations and the corresponding rise in the financial cost, the wisdom of a large storage programme can be seriously questioned. It appears that an ideal approach would be to have a relatively smaller storage plan (a minimum reserve level of about 5 million tonnes and a maximum reserve level of about 15 million tonnes) supported by imports and exports. Even if the country imports and exports at competitive international prices, the net benefits would be greater than following a rigid self-support policy in food. Political consideration may however dictate the adoption of the latter but then the programme no longer remains in the realms of economics.

VI

CONCLUDING OBSERVATION

As our revisit comes to an end, an uneasy feeling overwhelms us. The political and economic cost of not being able to take advantage of the new environment for policy reforms is so high that decision-makers must pay immediate attention to make the functioning of the food economy more efficient. However, after our extensive review, we find that food management in India is now so deeply enmeshed in the competitive politics of populism that economic considerations are likely to be overshadowed by political expediencies. The steep hike in the food subsidy bill of 1993-94 strengthens this apprehension. We are, therefore, somewhat sceptical regarding the recognition and acceptance of the suggestions and recommendations made in scholarly studies. Probably, they will receive attention when the growing load of subsidy arising from the maximizing goals of vested interest groups brings ruin to all.

NOTES

1. Cochrane [1968] listed four government arguments in favour of food zones. These are:

(i) *a political and administrative argument* which stems from the belief that each state has a responsibility of seeing to it that its people are properly fed. It thus becomes necessary to wall-off the state in question from the conflicting actions and incongruous programmes of surrounding states;

(ii) *a physical concept of procurement* which is based on the assumption that for the government to effectively procure food, either Centre or state, it is necessary to build barriers around food production areas, literally crowd the surplus output of an area into a corner and then catch up the penned-up supply through a levy, or requisitioning procedure;

(iii) *a big-city excess purchasing power argument* based on which it becomes necessary to cordon off the big cities and impose statutory rationing in these cities; by this device supplies of foodgrains are equalized between the high income cities and the low income rural areas; and,

iv) *a cost argument* on the ground that government costs can be minimized by purchasing supplies in low-priced surplus areas and distributing these supplies in higher-priced deficit areas.

Cochrane was critical of all these arguments except the first which in his view was 'at the heart of the whole matter, and in a political sense a valid argument.'

Commenting against zones Krishna [1965] observed: 'In general, the market would carry away from a surplus state a large quantity of the surplus to the deficit states than any Governmental Agency. For the impersonal market goes on transferring surpluses until inter-state price differentials are minimized. But when Governments determine transfers, the quantities to be taken out of surplus states, the quantities demanded by deficit states, and the quantities allocated by the Centre - all these become political rather than economic quantities. Transfers so determined can hardly be expected to minimize price disparities'.

2. Khusro [1967] gave four economic arguments against zones. These are: (i) by keeping producer prices in surplus areas lower than they would otherwise be, zones depress production in surplus areas where precisely it ought to be encouraged for reasons of better endowment; (ii) by keeping consumer prices in surplus areas lower than they would

otherwise be, zones encourage consumption in these areas; (iii) by keeping consumer prices in deficit regions higher than they would be, zones depress consumption in these regions, hit the consumers here harder than is necessary and make for national disharmony; and (iv) by keeping producer prices in deficit areas higher than they would be, zones perpetuate production in regions badly endowed and tie up resources precisely where these should not be tied.

3. For a mathematical exposition of the necessary and sufficient conditions mentioned in the text, see Ray [1987]. It can be shown that for a stable demand function $f(P_t)$ with constant elasticity 'a' and a variable supply function $g(p_t) + B_t$ with a constant elasticity 'b' at its average position, if a fraction 'k' of the supply shift is bought or sold by the buffer stock agency, then the variabilities of price (P) and producers' incomes (R) over time are given by

$$V(P) = [\bar{P}(1-k)/\bar{Q}(a+b)]^2 \cdot V(B_t)$$

$$V(R) \doteq [\bar{P}(kb+a+k-1)/(a+b)]^2 \cdot V(B_t)$$

Thus, if C_x is the coefficient of variation in supply, then the coefficient of variation in quantity consumed, price and producers' incomes are given by $(1-k)C_x$, $[(1-k)/(a+b)]C_x$ and $[(kb+a+k-1)/(a+b)]C_x$ respectively.

4. For a detailed discussion for a systems approach for buffer stock operation, see Cummings, Jr. [1969]; and Ray [1979].

5. For a more elaborate exposition of the argument, see GOI [1966].

6. See, *The Times of India*, February, 2 and 10, 1994; see *also, The Economic Times*, February 10, 1994.

7. For instance, if the probability distribution of variations in cereals production follows a normal distribution with mean 'm' and variance 'v^2', then

Production $X_t \sim N(m, v^2)$

Quantity released or withdrawn $Y_t = k(X_t - m) \sim N(o, k^2v^2)$

and Consumption $S_t = X_t - Y_t \sim N[m, (1-k)^2v^2]$

For a given percentage deviation in production (say p) from the average, the value of k can then be determined from the normal table as follows:

If Prob. of $[|(X_t - m)/v| > p]$ is, say f_1, then choose k, such that

Prob. of $[|(S_t - m)/(1-k)v| > p]$ is reduced to some pre-assigned probability level f_2, where $f_2 < f_1$.

Y_t can of course become positive or negative and since

$$\sum_1^T Y_t \sim N[O, T \cdot k^2v^2]$$

it follows that the total amount added to storage after operating the rule for T years is

$$\sum_1^T Y_t$$

with mean zero and standard deviation $(\sqrt{T}) \cdot kv$. Thus, the initial stock requirement (Z) to run a successful stabilization programme over a period of T years, with the probability of success at 'g' can be estimated from the normal probability distribution table where Prob. of $[Z/(\sqrt{T}) \cdot kv] = g$. The impact of running the stabilization programme on the coefficient of variation in price, consumption and farm income can be calculated from the relations given in the footnote no. 3.

8. For details, see Ray [1971].

9. For details, see Reutlinger [1976].

10. For details of the model used for the simulation exercise, see Ray [1979].

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DOCUMENTATION

The purpose of this section is to make available to the readers official documents such as reports of committees, commissions, working groups, task forces, etc., appointed by various ministries, departments, and agencies of central and state governments which are not readily accessible either because they are old, or because of the usual problems of acquiring governmental publications, or because they were printed but not published, or because they were not printed and remained in mimeographed form. It will be difficult and probably not worthwhile to publish the documents entirely. We shall publish only such parts of them as we think will interest our readers. The readers are requested to send their suggestions regarding official documents or parts thereof for inclusion in this section.

In the present section we publish:

1. A Technical Note on the Approach to the Fifth Plan of India, 1974-79, Planning Commission, Government of India, April 1973 - Pages 1-23.
2. A Technical Note on the Sixth Plan of India, 1980-85, Planning Commission, Government of India, July 1981 - Pages 1-8.
3. A Technical Note on the Seventh Plan of India, 1985-90, Perspective Planning Division, Planning Commission, Government of India, June 1986 - Pages 1-5.
4. Eighth Five Year Plan, Executive Summary, Published in the *Reserve Bank of India Bulletin,* June 1993, Pages 841-854.

A TECHNICAL NOTE ON THE APPROACH TO THE FIFTH PLAN OF INDIA 1974-79

1. BASIC FRAMEWORK

The present note deals with the description of the framework of calculation that has been adopted for arriving at the numerical results adopted in the Approach Paper for the Fifth Five Year Plan. The heart of the framework of reasoning consists in applying an open static Leontief model for ensuring terminal year consistency amongst the output levels of different sectors. For arriving at terminal year investment levels, a macro-economic growth model has been used. For estimating consumption, a special consumption model has been developed through which the redistribution of consumption amongst different sections of the population is directly linked with the inter-industry model. Imports have been endogenously estimated through constructing suitable import coefficient matrices. Formulation of the model, assumptions made therein in respect of the estimation of macro-economic variables and the sectoral final demand levels are discussed below, this is followed by a brief account of the results. Annexures give more detailed information.

2. MODEL FORMULATION

The model consists of three parts:

(i) macro-economic model;
(ii) input-output model; and
(iii) consumption model.

The algebraic formulation of the model is given in Annexure I.

2.1. MACRO-MODEL

The macro-model gives information on the macro-economic projections based on a gradualistic time path for gross domestic product at factor cost which is consistent with a desired average compound growth rate over the plan period as a whole. Total gross investment levels for the Fifth Five Year Plan period have been estimated by applying a global incremental capital output ratio to alternative growth rates, on the basis of postulated value for gross domestic product in 1973-74. The incremental capital output ratio used in this exercise is consistent with the past data. However, it is well-known that the incremental capital output ratio for a particular sector is liable to fluctuate with the degree of excess capacity prevailing in that sector as well as vary in the light of time structure of investment envisaged for the sector. Hence, independent checks have been carried out on the overall marginal capital output ratio by drawing upon the reports of various Task Forces appointed by the Planning Commission for computing sectoral investment requirements in the light of specific conditions pertaining to these sectors. The aggregate terminal year net imports of all types of goods and services are obtained with the help of the input-output model and is used to derive domestic savings necessary for achieving the desired level of investment. The aggregate private consumption is consequently obtained as a residual after allowing for public consumption. It should be mentioned that aggregate public consumption as well as exports are exogenously estimated.

2.2. INPUT-OUTPUT MODEL

As already stated, the model considered is a static Leontief inter-industry model with provisions made for endogenous estimates of import requirements and for redistribution of private consumption from the richer to the poorer sections of the population. The mathematical structure of the model is described in Annexure I.

Deliveries of different sectors to public consumption, exports and to gross fixed investment have been estimated exogenously in this model, while those relating to private consumption have been estimated through a separate consumption model. Sectoral changes in stocks have been obtained as fixed proportions of the increase in output levels of the different sectors. Control has been exercised with the aggregate change in the stock level of the different sectors. Sectoral imports have been treated endogenously.

An alternative treatment of capital formation could be attempted endogenously provided reliable information on incremental capital coefficient matrix, lead time and pipeline investment could be built up. Considerable efforts

in this direction have already been made and we hope that in our subsequent studies we should be able to make use of the dynamic model for endogenous determination of sectoral investment levels by the receiving sectors.

2.3. Consumption Model

Sectoral private consumption vector used in the input-output model has been estimated separately for rural and for urban areas through a separate consumption model, after taking into consideration the desired levels of monthly aggregate per capita consumption for the lowest 30 per cent of the population.

The mathematical structure and working of this model have been described in Part (c) of Annexure I.

3. BASE YEAR DATA

3.1. Input-Output Tables

The year 1973-74 has been adopted as the base year for the purpose of projection for the Approach Paper of the Fifth Five Year Plan. The basis for the projection of output levels is the inter-industry current flow matrix for the year 1965-66, which has been constructed in the Perspective Planning Division of the Planning Commission from a very extensive analysis of different data sources, like the Annual Survey of Industries, the National Sample Survey of unorganised industries (14th Round), the Brochure on Revised Series of National Product, the White Paper of the Central Statistical Organisation, Annual Reports of Railway Board, Bureau of Mines, etc. The input-output table considered is for 66 sectors, representing current flows in value terms at producers' prices. The co-efficient matrix based upon producers' prices is more stable than one based on market prices as the latter distorts the true production co-efficients due to imposition of non-uniform indirect taxes. However, in this table, the indirect taxes comprising of union excise duties, import and export duties, sugarcane cess, electricity duty and taxes on motor vehicles, have been taken into account, and a row representing the indirect taxes on the inputs going into the different inter-industry sectors as well as on the final demand components has been separated out. The residual of the total indirect taxes made up of state excise duties and other local taxes on private consumption, as the commodity-wise breakups of these taxes are not available. The sectoral classification of the table is given in Annexure II.

The base year (1973-74) table has been constructed in two stages. The 1965-66 table was first updated to 1970-71 using available information on output levels, exports, investment, imports, and public consumption consistent with national income data. The updated table of 1970-71 has been then recast to fit in with the various sectoral output figures and final demand for the base year 1973-74 as well as with the national income estimates. For this purpose, all the values were readjusted to the 1971-72 producers' prices.

3.2. Sectoral Output Levels

The estimates of sectoral output levels for the manufacturing sectors for 1973-74 have been based on estimates of production levels made in the Perspective Planning Division of the Planning Commission, of over 500 items of the registered sectors of organised industries, accounting for about 90 per cent of the value of output in the registered manufacturing sectors. The output of the industrial sectors have, however, been adjusted for total coverage, by comparison with 1965-66 output levels. The estimates of foodgrains, other agriculture, electricity, etc., for 1973-74 were based on the position papers of the different Working Groups. For sectors like construction, other services, etc., estimates of output have been based on the growth in the past years.

3.3. Final Demands

Final demand vectors for the year 1973-74 have been estimated as follows:

3.3.1. Private Consumption

Private consumption of different sectors has been estimated on the basis of consumption proportions by different expenditure classes

based on the National Sample Survey data relating to the household expenditure, and also by using information from other sources.

In computing the private consumption vector it is necessary to find out the fraction of output of a specified type consumed by a specified expenditure class. The information is obtainable on the basis of the 22 product classifications adopted in the Twentythird Round of National Sample Survey, which is the latest round for which the quick tabulation of the household expenditure data are available. However, the product classification that is used in the N.S.S. is not necessarily the same as the one used in the input-output model. It has, therefore, been necessary to convert the N.S.S. product classification into comparable input-output sector to be fed into our model. In respect of items, such as cereals, cereal substitutes and pulses constituting foodgrains, the classificatory schemes used in the input-output model are largely the same as in the N.S.S.

The N.S.S. data on household expenditure on items like fruits, vegetables, spices, etc., correspond to the input-output sector, "other agriculture". In addition, for estimating the private consumption of this sector, we have taken into account the expenditure on items like sugarcane, betel nuts and leaves, tobacco, coconut, groundnut, etc., in the raw form (unprocessed) and also such other items like house-made 'gur' and home-made vegetable oils, straw and husk (used for fuel purposes), etc., especially in the rural areas. The above items are mostly products and by-products of "other agriculture" and in some cases home processed and not accounted for in the output of the corresponding manufacturing sector. In view of the above, we have taken the consumption of the above items as consumption of the output of the sector "other agriculture". In this process, we have estimated the private consumption of this sector and also of sectors like foodgrains, sugar and 'gur', vegetable oils, other food, etc., by supplementing the N.S.S. Data with the estimates obtained by commodity-flow approach covering as many items as given in the "Brochure on Revised Series of National Product for 196-61 to 1964-65" (published by the Central Statistical Organisation, Government of India). This approach is considered necessary as the N.S.S. Data on consumer expenditure, especially in the rural areas, include some components of imputed values for items flowing out of home-grown or home-processed products, but which actually fall in the category of products and by-products of the input-output sector, "other agriculture".

With respect to consumer durables, the N.S.S. figures are given generally in a lumped fashion. These overall proportions have been divided into component sub-proportions in the light of commodity-flow estimates and all other sources of information, including other rounds of N.S.S. data, which were available with us.

Thus on the basis of utilising all possible sources of information, it has been possible for us to broadly convert N.S.S. product classification into input-output model classification even though there may be an element of error margin which is likely to vary from commodity to commodity. In the present stage of knowledge exact correspondence between the N.S.S. commodities and their input-output sectoral classification cannot be obtained. It is, however, important for further analysis and refinement, that efforts should be made to make the consumption classification for the expenditure surveys and the classification used in the input-output model to be more exact than at present.

N.S.S. Data are available for 12-13 size classes or fractile groups of household for rural and urban areas separately, and are in purchasers' prices. They have been recast to 27 expenditure classes after converting them to factor cost and to 1971-72 prices, in order to conform to the private consumption vector for 1973-74 obtained as above.

3.3.2. Public Consumption

Estimates of public consumption for 1973-74 have been based on trend analysis of aggregate public consumption as well as of different components of public consumption. Wherever no trend is clearly discernible for a particular

commodity, the aggregate rate of growth has been utilised. In other cases, projections have been made on commodity-specific trends.

3.3.3. Gross Fixed Investment and Inventory Investment

Estimates of capital goods delivered by different sectors have been made partly by using the sectoral proportion to the total as in 1965-66 and partly on the basis of composition revealed by trend analysis of past data. The estimates of the gross fixed investment of various items made by the C.S.O., as obtained from their work sheets, have also been used in this connection.

Estimates of inventory held by different sectors have been mainly based on the inventory to output relationships in the past years. However, the trend in the changes in the level of inventories held in some of the important sectors like foodgrains, other food crops, animal husbandry, etc., has also been taken into account in the estimation of changes in inventories for 1973-74.

3.3.4. Exports

Estimates of different commodities and services have been first obtained by studying the trend during the last decade of various items of exports. The recent report of the Working Group on Exports has also been taken into account. The exports of different commodities have been grouped to get sectoral exports. The export vector thus estimated is at F.O.B. and has been converted to ex-factory prices by independently estimated ratios of ex-factory to F.O.B. prices.

3.3.5. Imports

The sectoral imports for 1973-74 at 1971-72 prices have been based on the estimates of commodity-wise imports for 1973-74 contained in the report of the Working Group on Imports. For determining the import vector in a future year, we have, however, utilised two import coefficient matrices. The first is a 66 x 66 technological matrix indicating the amount of import used as a current input in the production process. The use of such import coefficient matrix ties up a specific quantum of flow of imported inputs to each of the receiving sectors strictly depending upon the output levels of the receiving sectors. The second matrix corresponds to the proportion of final use of a particular commodity/sector which is met at the moment by imports. We have not distinguished for these exercises between competitive imports, as they would not appear to be particularly relevant on the degree of aggregation that has been chosen for this model. On the other hand, distinction between the two matrices, one referring to imports for inter-industry use and the other for imports to sustain final uses, is crucial to our understanding of the import substitution process. For obtaining these two matrices we have used the actual levels of commodity-wise imports for the year 1969-70 with necessary correction for 1971-72 prices, allocating them to into different intermediate and final uses on the basis of 66 x 66 input-output table. The commodity-wise imports were obtained from Monthly Statistics of Foreign Trade of India published by the Department of Commercial Intelligence and Statistics. The proportions of imports in the final uses of every commodity have been obtained separately for private consumption, public consumption and gross fixed investment. The two import coefficient matrices have been first updated to take into account the available commodity-wise import data of 1970-71 and then suitably modified to agree with the sectoral imports for 1973-74 obtained on the basis of commodity-wise imports estimated by the Working Group on Imports. Such modifications are called for in view of the fact that the ratio of imports to the total availability of a commodity may be different in 1973-74 from what was observed in the recent past.

3.4 Guide to the Base Year Tables in Annexure III

The base year information is presented in Annexure III. The transactions for the inter-industry and final use are given separately for domestic and imported supplies in Annexure III-1 and III-2. The complete picture involving the national income accounts is shown in the

domestic part. The total input-output coefficients as well as the import coefficient matrix are given separately in Annexure III-3 and III-4.

Proportions of consumption for 66 sectors and 27 expenditure classes are given separately for the rural and urban areas in Annexures IV-6 and IV-7.

A 66 x 6 Matrix giving the proportion of domestic and imported final use has also been appended in Annexure III-5. The sectoral excise duty rates and import duty rates together with ratios of ex-factory to F.O.B. prices of exports are given in Annexure III-6. These have been derived from the detailed commodity-wise information. It may be mentioned that the sectoral excise and import duty rates have been estimated on the basis of the detailed commodity-wise tax rates and revenues published in the budget documents, customs and excise revenue statements of the Indian Union, Indian Customs and Central Excise Tariff (both published by the DGCIS, Department of Commercial Intelligence and Statistics). Unpublished detailed records on customs revenues of the Statistical Wing, Central Board of Indirect Taxes, Government of India, have also been made use of in this connection.

4. PROJECTIONS OF FINAL DEMAND FOR 1978-79

4.1. Private Consumption

Sectoral private consumption has been estimated by projecting the consumer demand for a sector by different expenditure classes with the help of a consumption model, where the total private consumption as endogenously estimated in the macro-model has been used. The following assumptions are also made for this purpose.

(i) The pattern of consumption of the product of a sector by persons in different classes would remain practically same throughout the Plan period.

(ii) Two variants with regard to the per capita monthly consumption for the poorest 30 per cent of the population, separately for rural and urban areas, have been considered. In the first case, it is assumed that the inequality in expenditure in 1978-79 would remain the same as in the base year 1973-74. In this case the average private consumption for the poorest 30 per cent of the population will amount to Rs 26.33 in the rural area and Rs 28.44 in the urban area. In the second case, the corresponding per capita expenditure in rural and urban areas are taken as Rs 36.64 and Rs 39.64 respectively. It may be mentioned here that in the case of the second variant the per capita monthly consumption for the second decile amounts to approximately Rs 20 at 1960-61 prices for all India.

(iii) The per capita consumption is assumed to increase at a faster rate in rural India than in urban India in order to fulfil the objective of narrowing down the gap between urban and rural areas in terms of per capita consumption.

(iv) The distribution of monthly per capita aggregate expenditure amongst population in urban and rural areas is assumed to be log normal for each. This assumption is supported by various studies on the National Sample Survey data.

The sectoral private consumption has been estimated by using the base year consumption proportions in 27 expenditure classes and the total private consumption is determined by the macro-model.

Private consumption for each sector has been obtained separately for rural and urban areas, and for the purpose, the total private consumption levels for the rural and urban areas have been obtained through applying an assigned ratio of per capita consumption in the urban area to that in the rural area. In view of assumption (iii) this ratio as adopted is 1.238 in 1978-79 and 1.26 in 1973-74, as against the observed value of 1.356 in 1968-69. Using the aggregate monthly per capita consumption in 1978-79 and the monthly per capita consumption of the lowest 30 per cent of the population as indicated in assumption (ii), the parameters of the log normal expenditure distribution are first determined, and then used to find out the monthly per capita expenditure and percentage of population in each expenditure class, separately for the rural and urban areas. Using these and the proportions of consumption of different sectors in each expenditure class, the

estimates of consumer demand for different sectors have been arrived at. The rural and urban population for 1978-79 have been taken from the estimates prepared by the Office of the Registrar General for official use. The rural and urban estimates are then combined for each sector to give the sectoral private consumption vector for the model.

4.2 Public Consumption

The aggregate public consumption has been estimated for terminal year of the Plan period at an overall growth rate of about 7 per cent over the base year. The sectoral public consumption, has been estimated in three different ways. First the trends in the public consumption of different commodities have been adopted for projection. Where there is no significant trend, the growth rate of total public consumption has been adopted as a guide. However, in the case of certain sectors, the estimates have been made taking into account the possible changes in the pattern of public consumption. For example, the use of wood products has been substituted to a large extent by the use of metal products. Similarly, the public consumption of electricity, coal, transport and construction sectors has been assumed to grow at a faster rate envisaging more investment in public construction on account of increase in the outlay for social services like education, health, etc.

The same sectoral public consumption vector in 1978-79 has been used for all alternative variants of the model.

4.3 Gross Fixed Investment

The endogenous treatment of capital formation in an inter-industry model raises a number of practical problems, on account of the non-availability of suitable data for the construction of a capital coefficients matrix for a model involving 66 sectors. As already stated, considerable efforts have been made and we can expect to come out with endogenous estimates of capital formation by receiving sectors in future.

In the present exercise, the treatment of gross fixed investment has been made exogenously using all the available data on various capital goods for the past few years. On the basis of this information the composition of the different types of capital goods in the total gross fixed investment has been estimated by considering their trend behaviour. The estimates of the capital goods delivered by different sectors in the year 1978-79 have been made on the basis of the composition which has been obtained from the trend analysis.

The same sectoral composition of the gross fixed investment in 1978-79 has been used for different cases with alternative growth rates in gross domestic product, though the total gross fixed investment is different for the cases with different growth rates in gross domestic product. The composition of investment by the *delivering sector* as well as the aggregate amount of investment have been assumed invariant with respect to changes in the degree of inequality in the distribution of consumer expenditure. In more complete models where the investment requirements by the receiving sector and the size distribution of income can be endogenously determined, an element of feed-back between investment vector and the consumption vector cannot be ruled out, although there are no *a priori* ways of estimating its quantitative importance. For our present exercises, while the element of feed-back cannot be formally taken care of, empirical checks have been employed to ensure the feasibility of the sectoral growth rates in each case, with or without reduction in inequality, subject to the stipulation that the aggregate amount of investment stays the same. Due to non-availability of appropriate data required for constructing such a model, one is obliged to use a much less ambitious approach in the Indian context.

4.4 Inventory Investment

The change in stock of different sectors has been partly endogenously estimated in the model by using stock coefficients and the increase in output over the base year and then adjusting them to the exogenously fixed total stock. The total inventory investment has been taken to be 12.12 per cent of the gross investment at market prices for the terminal year.

The stock coefficients for different sectors have

been derived partly by considering the stock flow conversion factors and partly by means of observed inventory to output relationships.

4.5 EXPORTS

The level of export earnings, aggregate and commodity-wise, adopted in the Plan framework indicates reasonable targets. Thus they are in the nature of reasonable aims expressed in quantitative terms and related to other macro economic variables aimed at in the Plan.

In fact, the target rate of growth of exports is a policy issue but in deciding on this we have also to take into account unit value realised during the immediate past and the share of exports in national income. The 7 per cent rate of growth judged by these considerations does not seem to be unrealistic. This gives the level of export earnings around Rs 24,387 millions on commodity account by 1978-79 with the base around Rs 17,380 million in 1973-74, while the earnings on account of transportation and other non-factor services are estimated to increase from Rs 2,307 million in 1973-74 to Rs 3,390 million in 1978-79.

The figures are based on the past trends during the last decade of various items of export and possibilities of export promotion. The commodities have been grouped into various groups like agriculture, and allied products, ores and minerals, textiles, etc., and then groupwise projections have been made. Commodities under various groups happen to grow at different rates of growth e.g., engineering goods are expected to grow at a compound rate of about 15 per cent per year, and iron and steel at 16 per cent; while manufacture of coir and jute would be increasing only at a rate less than one per cent per year; and textiles, handicrafts and agriculture and allied products at about 4 per cent per year or slightly more.

4.6 IMPORTS

The sectoral imported inputs have been estimated endogenously in the model by using the same import coefficient matrix as for the base year, while import content of the final use has been estimated by the base year matrix of proportions of the final use of imported goods and services. The import coefficients and proportions have, however, been reduced suitably in cases of import substitution, the extent of the reduction being judged by the feasibility of increased domestic production of the individual sector including investment goods sector on the basis of the information provided in the reports of the Task Forces for the different industries set up by the Planning Commission. The reduced amount of each of the coefficients and proportions has been added to the corresponding domestic part.

5. PROJECTION OF COEFFICIENTS FOR 1978-79

Most of the input-output coefficients of the base year transaction matrix have been directly used for the year 1978-79. The remaining norms have been altered in the light of independent information on anticipated changes in the product and technological mix. The basis of projecting some of the input coefficients is briefly discussed below:

The inputs of fertilisers and electricity to the foodgrains and other agriculture sectors have been increased to take account of the increased and balanced doses of fertiliser inputs and increased use of pump-sets for irrigation along with the extension of rural electrification programmes to more areas. Self input to foodgrains has been increased to take account of the extension of high yielding variety programmes to larger areas. Inputs of sector 29 (other chemicals) to foodgrains and other agriculture sectors have been increased on the basis of increasing use of pesticides for plant protection measures, both preventive and curative.

Input of coal to electricity has been increased in view of the additional thermal power generation schemes compared to hydro during the Fifth Five Year Plan.

The animal husbandry development programmes envisage stepping up of the production of various animal husbandry products through improved health. With this in view, the inputs from the drug sector (sector 27) to the animal husbandry sector have been increased.

Taking into consideration that there would be rapid increase in the dieselisation and in electric transaction compared to the steam locomotives in the railways, the coal input to the railways has been decreased while inputs from both electricity and petroleum sectors have been increased.

Inputs from the 'other services' sector to most of the other sectors have been increased keeping in view the increase in expenditure incurred by the producing units, both large and small, on services like banking, insurance, advertisements, etc. Inputs from a few sectors to the 'other services' sector have also been increased to take account of the increasing trend of some of the services sub-sectors to provide better and efficient services.

6. GUIDE TO THE TERMINAL YEAR TABLES IN ANNEXURE IV

The terminal year information are presented in Annexure IV-1 to IV-7. These data, however, correspond to the preferred variant of the model (case 3D). In this variant an average compound growth rate of 5.5 per cent in the gross domestic product at factor cost, 7.0 per cent in total commodity exports at F.O.B., import substitution and reduction in expenditure inequality have been considered.

The total input-output coefficient matrix given in Annexure IV-3 differs from that of the base year (Annexure III-3) due to projection of coefficients. On the other hand, the import coefficients of a few sectors presented in Annexure IV-4 for 1978-79 are less than the corresponding coefficients for the base year because of the intended adoption of import substitution in these sectors. The amount of reduction in the import coefficients would be given by the difference between the two sets of import coefficients. However, considering the limitation on the domestic production possibility of crude oil, imported inputs of crude oil to petroleum have been increased instead of being reduced.

For the alternative cases without import substitution, the base year import coefficient matrix has been used except for the coefficient of crude oil (sector 9) to petroleum (sector 30), which has been taken the same as in Annexure IV-4. Similarly, for such cases, the imported part of a particular type of final use of a sector has been estimated by using the base year proportion of imported final use to the total final use of the sector (Annexure III-5).

The total coefficient matrix for the terminal year is, however, the same in all cases with or without import substitution.

The sectoral proportions of private consumption in 27 expenditure classes for the rural and urban areas are given in Annexures IV-6 and IV-7 respectively. The same consumption proportion matrices have been used for all alternative cases of the model. The cases with or without reduction in expenditure inequality differ only in the estimates of total private consumption in different expenditure classes. The procedure of their estimation is explained in Annexure I dealing with the consumption model.

In estimating the total indirect taxes for the terminal year, the report of the Working Group on Financial Resources has been taken into consideration where additional resource mobilisation has been envisaged during the Fifth Plan period through increased tax-rates. However, in the absence of the sectoral break-up of the increase in tax-rates by the terminal year, the sectoral excise duty rates and import duty-rates for the terminal year have been taken to be the same as in the base-year (as given in Annexure III-6) for estimating the indirect taxes on inputs. In addition, an estimated yield of Rs 180 million on account of cess on sugarcane has been taken into consideration, gross fixed investment and total export duties have been estimated on the basis of the analysis of the past data. The residual out of the total indirect taxes for the terminal year has been accounted for under private consumption.

The sectoral stock coefficients are given in Annexure III-6.

All the relevant data relating to the workability of the model have been presented with the hope that they would be useful for further studies.

7. DISCUSSION ON RESULTS

Several alternative exercises with the model have been carried out with different assumptions

on the growth of gross domestic product and exports, in some cases considering import substitution and the reduction in the inequality in the expenditure distribution. The criteria for the reduction in the expenditure inequality have been based on the average minimum level of Rs 20 at 1960-61 prices of monthly per capita expenditure in 1978-79 for the lowest 30 per cent of the population. For this class of population, more or less, this amounts to a monthly per capita consumption of RS 36.64 in the rural area and Rs 39.64 in the urban area at 1971-72 prices in 1978-79. The extent of import substitution has been judged partly by the capacity constraint on the domestic production levels and by the objective of self-reliance with regard to the balance of payments. The various alternative cases for which results are presented in this paper are identified in Table 1.

TABLE 1: DESCRIPTION OF ALTERNATIVE VARIANTS OF MODEL

Group No.	Case No.	growth rate (%) in 1978-79 over 1973-74 in		Inequality in expenditure distribution	Import substitution
		GDP (at factor cost)	total commodity exports		
(1)	(2)	(3)	(4)	(5)	(6)
1.	1A	5.5	7.5	without reduction	without import substitution
	1B	5.5	7.5	with reduction	without import substitution
	1C	5.5	7.5	without reduction	with import substitution
	1D	5.5	7.5	with reduction	with import substitution
2.	2A	6.0	7.5	without reduction	without import substitution
	2B	6.0	7.5	with reduction	without import substitution
	2C	6.0	7.5	without reduction	with import substitution
	2D	6.0	7.5	with reduction	with import substitution
3.	3A	5.5	7.0	without reduction	without import substitution
	3B	5.5	7.0	with reduction	without import substitution
	3C	5.5	7.0	without reduction	with import substitution
	3D*	5.5	7.0	with reduction	with import substitution
4.	4A	5.0	6.5	without reduction	without import substitution
	4B	5.0	6.5	with reduction	without import substitution
	4C	5.0	6.5	without reduction	with import substitution
	4D	5.0	6.5	with reduction	with import substitution
5.	5A	6.0	8.0	without reduction	without import substitution
	5B	6.0	8.0	with reduction	without import substitution
	5C	6.0	8.0	without reduction	with import substitution
	5D	6.0	8.0	with reduction	with import substitution
6.	6A	5.0	7.0	without reduction	without import substitution
	6B	5.0	7.0	with reduction	without import substitution
	6C	5.0	7.0	without reduction	with import substitution
	6D	5.0	7.0	with reduction	with import substitution

* This is the preferred variant adopted for the Approach Paper for the Fifth Five Year Plan.

The reduction in inequality in expenditure distribution corresponds to a monthly per capita consumption of Rs 36.64 in the rural area and Rs 39.64 in the urban area at 1971-72 prices for the lowest 30 per cent of the population in 1978-79. When there is no reduction in the expenditure inequality the same expenditure distribution as in 1973-74 has been considered. For case 3C which is similar to the preferred case (3D) except that there is no reduction in the inequality in expenditure distribution, the monthly per capita expenditure works out to Rs 26.33 in the rural area and to Rs 28.44 in the urban area for the lowest 30 per cent of the population in 1978-79 at 1971-72 prices.

Within each group of cases, the difference between the results of cases B and D or A and C would give the effect of import substitution, while the difference between the results of cases A and B or C and D would give the effect of reduction in the expenditure inequality.

TABLE 2: MACRO-ECONOMIC PROJECTIONS OF ALTERNATIVE CASES

(Rs million at 1971-72 prices)

	1973-74	1978-79 alternative case no.											
		1A	1B	1C	1D	2A	2B	2C	2D	3A	3B	3C	3D*
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
1. gross domestic product at factor cost	430730.0	562998.6	562998.6	562998.6	562998.6	576474.3	576474.3	576474.3	576474.3	562998.6	562998.6	562998.6	562998.6
2. indirect taxes	46900.0	70890.0	70890.0	70890.0	70890.0	73334.5	73334.5	73334.5	73334.5	70890.0	70890.0	70890.0	70890.0
3. gross domestic product at market prices	477630.0	633888.6	633888.6	633888.6	633888.6	649808.8	649808.0	649808.8	649808.8	633888.6	633888.6	633888.6	633888.6
4. private consumption (market prices)	358400.0	457206.4	456769.7	451604.2	451189.1	460141.3	459709.5	454095.4	453687.0	457723.2	457288.8	452139.8	451716.8
5. public consumption (market prices) including sl.no.9.2	54000.0	74670.0	74670.0	74670.0	74670.0	74670.0	74670.0	74670.0	74670.0	74670.0	74670.0	74670.0	74670.0
6. gross investment (market prices)	70880.0	109391.6	109391.6	109391.6	109391.6	124081.0	124081.0	124081.0	124081.0	109391.6	109391.6	109391.6	109391.6
6.1 gross fixed investment	63080.0	96131.6	96131.6	96131.6	96131.6	109042.4	109042.4	109042.4	109042.4	96131.6	96131.6	96131.6	96131.6
6.2 stock	7800.0	13260.0	13260.0	13260.0	13260.0	15038.6	15038.6	15038.6	15038.6	13260.0	13260.0	13260.0	13260.0
7. exports (f.o.b)	19687.0	28339.1	28339.1	28339.1	28339.1	28339.1	28339.1	28339.1	28339.1	27777.4	27777.4	27777.4	27777.4
8. imports (c.i.f.) including sl.no.9.2	25337.0	35718.5	35281.8	30116.3	29701.2	37422.6	36990.8	31376.7	30968.3	35673.6	35239.2	30090.2	29667.2
9. net imports of goods and services (8-7)	5650.0	7379.4	6942.7	1777.2	1362.1	9083.5	8651.7	3037.6	2629.2	7896.2	7461.8	2312.8	1889.8
9.1 net imports goods and non-factor services	2030.0	3509.4	3072.7	-2092.8	-2507.9	5213.5	4781.7	-832.4	-1240.8	4026.2	3591.8	-1557.2	-1980.2
9.2 current transfers & other invisibles (net)	3620.0	3870.0	3870.0	3870.0	3870.0	3870.0	3870.0	3870.0	3870.0	3870.0	3870.0	3870.0	3870.0
10. savings (6-9)	65230.0	102012.2	102448.9	107614.4	108029.5	114997.5	115429.3	121043.4	121451.8	101495.4	101929.8	107078.8	107501.8
11. m.p. to save (% over 73-74)	....	23.54	23.82	27.12	27.39	28.9	29.16	32.42	32.65	23.21	23.49	26.78	27.05
12. capital account payment and out-goes	4860.0	4510.0	4510.0	4510.0	4510.0	4510.0	4510.0	4510.0	4510.0	4510.0	4510.0	4510.0	4510.0
13. capital account gross receipts	720.0	740.0	740.0	740.0	740.0	740.0	740.0	740.0	740.0	740.0	740.0	740.0	740.0
14. capital account deficit (12-13)	4140.0	3770.0	3770.0	3770.0	3770.0	3770.0	3770.0	3770.0	3770.0	3770.0	3770.0	3770.0	3770.0
15. balance of payments gap both on current & capital account combined (9+14)	9790.0	11149.4	10712.7	5547.2	5132.1	12853.5	12421.7	6807.6	6399.2	11666.2	11231.8	6082.8	5659.8

* Preferred variant adopted for the Approach Paper

(Contd.)

TABLE 2 (CONCLD.)

	1978-79											
	alternative case no.											
	4A	4B	4C	4D	5A	5B	5C	5D	6A	6B	6C	6D
	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)
1. gross domestic product at factor cost	549790.7	549790.7	549790.7	549790.7	576474.3	576474.3	576474.3	576474.3	549790.7	549790.7	549790.7	549790.7
2. indirect taxes	68494.8	68494.8	68494.8	68494.8	73334.5	73334.5	73334.5	73334.5	68494.8	68494.8	68494.8	68494.8
3. gross domestic product at market prices	618285.5	618285.5	618285.5	618285.5	649808.8	649808.8	649808.8	649808.8	618285.5	618285.5	618285.5	618285.5
4. private consumption (market prices)	455925.2	455485.5	450771.5	450360.8	459657.2	459224.2	453603.9	453194.1	455207.9	454766.7	450015.4	449587.8
5. public consumption (market prices) including sl.no.9.2	74670.0	74670.0	74670.0	74670.0	74670.0	74670.0	74670.0	74670.0	74670.0	74670.0	74670.0	74670.0
6. gross investment (market prices)	94632.8	94632.8	94632.8	94632.8	124081.0	124081.0	124081.0	124081.0	94632.8	94632.8	94632.8	94632.8
6.1 gross fixed investment	83163.3	83163.3	83163.3	83163.3	109042.4	109042.4	109042.4	109042.4	83163.3	83163.3	83163.3	83163.3
6.2 stock	11469.5	11469.5	11469.5	11469.5	15038.6	15038.6	15038.6	15038.6	11469.5	11469.5	11469.5	11469.5
7. exports (f.o.b)	27047.9	27047.9	27047.9	27047.9	28877.4	28877.4	28877.4	28877.4	27777.4	27777.4	27777.4	27777.4
8. imports (c.i.f.) including sl.no.9.2	33990.4	33550.7	28836.7	28426.0	37476.8	37043.8	31423.5	31013.7	34002.6	33561.4	28810.1	28382.5
9. net imports of goods and services (8-7)	6942.5	6502.8	1788.8	1378.1	8599.4	8166.4	2546.1	2136.3	6225.2	5784.0	1032.7	605.1
9.1 net imports goods and non-factor services	3072.5	2632.8	-2081.2	-2491.9	4729.4	4296.4	-1323.9	-1733.7	2355.2	1914.0	-2837.3	-3264.9
9.2 current transfers & other invisibles (net)	3870.0	3870.0	3870.0	3870.0	3870.0	3870.0	3870.0	3870.0	3870.0	3870.0	3870.0	3870.0
10. savings (6-9)	87690.3	88130.0	92844.0	93254.7	115481.6	115914.6	121534.9	121944.7	88407.6	88848.8	93600.1	94027.7
11. m.p. to save (% over 73-74)	15.97	16.28	19.63	19.92	29.19	29.44	32.70	32.94	16.48	16.79	20.17	20.47
12. capital account payment and out-goes	4510.0	4510.0	4510.0	4510.0	4510.0	4510.0	4510.0	4510.0	4510.0	4510.0	4510.0	4510.0
13. capital account gross receipts	740.0	740.0	740.0	740.0	740.0	740.0	740.0	740.0	740.0	740.0	740.0	740.0
14. capital account deficit (12-13)	3770.0	3770.0	3770.0	3770.0	3770.0	3770.0	3770.0	3770.0	3770.0	3770.0	3770.0	3770.0
15. balance of payments gap both on current & capital account combined (9+14)	10712.5	10272.8	5558.8	5148.1	12369.4	11936.4	6316.1	5906.3	9995.2	9554.0	4802.7	4375.1

Case 3D has been chosen as the preferred variant for the Approach Paper for the Fifth Five Year Plan. As already mentioned, all the details of this case including inter-industry coefficients and final use are presented in Annexure IV. For the remaining cases, however, the salient features of the results are presented.

7.1 Macro-Economic Results

The macro-economic results for the different alternative cases ar presented in Table 2, while total indirect taxes on different macro variables are given in Table 3. The effect of different alternative assumptions on the balance of payments, together with the net imports of goods and non-factor services and the marginal propensity to save, is indicated in Table 2.

It may be seen that the results of any two variants within a group differ only in the estimates of private consumption, savings and net imports of goods and services. The total private consumption under the variant 3D (preferred variant - with reduction in inequality), for example, has gone down by about Rs 423 million compared to case 3C, with an increase in domestic saving by the same amount, with a consequent decrease in the imports of goods and services by the same amount. The two cases differ only with regard to the inequality in expenditure distribution.

Table 3: Indirect Taxes on Different Macro-Variables (Exogenous)

(Rs million at 1971-72 prices)

Group no. of alternative cases	Indirect taxes on			
	Gross domestic product	Public consumption	Gross fixed investment	Exports
(1)	(2)	(3)	(4)	(5)
1978-79:				
1....	70890.0	3732.5	5433.7	1526.6
2....	73334.5	3732.5	6161.0	1526.6
3....	70890.0	3732.5	5433.7	1491.4
4....	68494.8	3732.5	4698.0	1457.1
5....	73334.5	3732.5	6161.0	1559.5
6....	68494.8	3732.5	4698.0	1491.4
1973-74	46900.0	2063.6	2775.4	1029.1

N.B. 1. Indirect taxes for all cases within each group are same.
2. Indirect taxes on inputs and private consumption are endogenously determined.

7.2 Physical Production Targets

The estimates of physical production levels of some items for the base year 1973-74 and for the terminal year 1978-79 for the preferred case (3D) are presented in Table 4. For sectors like coal, iron ore, etc., comprising of a single commodity, and also for foodgrains, the estimates of physical output for 1978-79 are based on growth rates as obtained from the model. For other sectors, composition of commodities within the sector as revealed by material balances worked out independently, has been used for the purpose.

7.3 Sectoral Growth Rates

The growth rates of the estimated outputs for the different sectors in 1978-79 over the base year, 1973-74, are presented in Table 5 for all the alternative cases. The sectoral growth rates in value-added in 1978-79 over 1973-74 for the preferred variant (case 3D) are also furnished in Table 6.

The effect of redistribution of private consumption in favour of the poorer classes of the population adopted under variants B and D is reflected in the increase in the output level of

some of the essential commodities and a decrease in the output levels of some of the non-essential and luxury goods sectors. It can be seen from Table 5 that the growth rates in sectors like foodgrains, other agriculture, cotton textiles, etc., have gone up under variants B and D compared to those under the corresponding variants A and C, while the growth rates in sectors like other textiles (woollen, silk and synthetic fibres), watches and clocks, etc., have gone down.

TABLE 4: PROJECTED ESTIMATES OF OUTPUT IN PHYSICAL TERMS OF SOME ITEMS, 1973-74 AND 1978-79 (CASE 3D)

	(1)	Unit (2)	1973-74 (3)	1978-79 (4)
1.	foodgrains	mill. tonnes	115.00	139.90
2.	coal	do.	80.00	141.20
3.	iron ore	do.	42.20	66.50
4.	crude oil	do.	7.70	7.77
5.	sugar	do.	4.20	5.88
6.	cotton yarn for sale	mill.kg.	475.00	642.20
7.	cotton cloth	mill.meters	8500.00	10703.00
8.	art silk fabrics	do.	1200.00	1513.00
9.	woollen fabrics	do.	17.00	24.20
10.	jute manufactures	'000 tonnes	1300.00	1636.00
11.	paper and paper board	do.	850.00	1327.00
12.	newsprint	do.	65.00	159.30
13.	fertilisers (nitrogenous)	'000 tonnes N	1600.00	3912.00
14.	fertilisers (phosphatic)	'000 tonnes P2O5	450.00	1174.00
15.	sulphuric acid	'000 tonnes	1500.00	3349.00
16.	petroleum products	mill. tonnes	20.50	36.00
17.	cement	mill. tonnes	18.00	26.80
18.	mild steel	do.	5.80	9.40
19.	pig iron for sale	do.	2.00	3.80
20.	alloy and special steel	'000 tonnes	350.00	518.00
21.	aluminium ingots	do.	210.00	423.00
22.	electric motors	mill h.p.	3.45	5.65
23.	radios	mill. nos.	3.25	3.85
24.	watches and clocks	'000 nos.	1575.00	2186.00
25.	electricity generation	bill. kwh	78.00	129.30
26.	electricity consumption	bill. kwh	62.40	106.00

The import substitution has, as expected, caused higher growth rates in the domestic production, particularly in sectors where import substitution has been envisaged.

While the observations made in the Approach Paper on the sectoral growth rates for the preferred case (3D) in comparison with the corresponding case without reduction in expenditure inequality (case 3C) broadly stand, the results presented here would show some differences in a few sectors consequent on further scrutiny of the results. However, all these changes do not affect any of the qualitative aspects of the growth strategy adopted in the Approach document.

TABLE 5: SECTORAL GROWTH RATES IN DIFFERENT ALTERNATIVES IN 19778-79 OVER 1973-74

(per cent)

SECTOR	CASE-1A	CASE-1B	CASE-1C	CASE-1D	CASE-2A	CASE-2B	CASE-2C	CASE-2D	CASE 3A	CASE 3B	CASE 3C	CASE 3D
1. Food Grains	3.25	4.05	3.13	4.00	3.28	4.07	3.16	4.01	3.24	4.05	3.13	3.99
2. Other Agriculture	4.27	5.14	4.04	4.93	4.43	5.28	4.17	5.05	4.25	5.11	4.02	4.90
3. Animal Husbandry	5.56	6.20	5.21	5.87	5.66	6.28	5.27	5.93	5.54	6.18	5.21	5.84
4. Plantation	5.97	5.37	5.75	5.11	6.16	5.57	5.91	5.31	5.79	5.18	5.59	4.94
5. Forestry	5.37	6.19	5.63	6.44	6.04	6.82	6.30	7.09	5.35	6.16	5.61	6.42
6. Coal	9.43	12.01	9.49	12.07	9.93	12.44	9.99	12.51	9.39	11.97	9.47	12.03
7. Misc. Coal, Petr Prod.	10.87	11.09	12.31	12.51	11.99	12.19	13.48	13.67	10.81	11.03	12.26	12.46
8. Iron Ore	9.59	9.40	10.09	9.89	10.75	10.56	11.29	11.09	9.31	9.13	9.82	9.62
9. Crude oil	-1.32	-1.67	0.64	0.23	-0.97	-1.31	1.00	0.61	-1.38	-1.73	0.59	0.19
10. Other Minerals	10.20	10.20	11.71	11.69	11.41	11.40	12.94	12.93	10.11	10.11	11.63	11.61
11. Sugar and Gur	3.73	5.20	3.46	4.97	3.79	5.24	3.51	5.00	3.69	5.16	3.45	4.94
12. Vegetable oil	4.60	5.40	4.52	5.34	4.69	5.46	4.58	5.40	4.51	5.30	4.45	5.25
13. Tea and Coffee	4.33	4.07	4.14	3.86	4.38	4.12	4.17	3.90	4.13	3.86	3.95	3.66
14. Other food products	6.51	5.37	6.25	5.04	6.63	5.51	6.33	5.15	6.49	5.35	6.24	5.03
15. Cotton textiles	4.91	5.44	4.62	5.15	4.99	5.51	4.68	5.20	4.86	5.38	4.59	5.10
16. Jute textiles	4.76	4.82	4.87	4.93	5.07	5.13	5.18	5.24	4.53	4.59	4.65	4.70
17. Other textiles	7.89	5.95	7.38	5.27	8.05	6.17	7.50	5.45	7.84	5.90	7.35	5.22
18. Misc. textile products	7.59	6.45	7.13	5.84	7.84	6.75	7.34	6.10	7.51	6.37	7.08	5.77
19. Wood products	8.58	5.48	8.23	4.94	9.25	6.30	8.88	5.73	8.54	5.45	8.21	4.91
20. Paper, paper products	7.34	6.27	11.05	9.89	7.56	6.52	11.32	10.19	7.29	6.23	11.02	9.85
21. Leather products	6.71	6.42	6.53	6.24	6.75	6.47	6.56	6.27	6.44	6.15	6.27	5.96
22. Rubber products	12.14	9.57	11.98	9.33	13.12	10.66	12.95	10.23	12.10	9.52	11.95	9.30
23. Fertilizer	17.73	18.59	18.79	19.73	17.90	18.75	18.95	19.87	17.72	18.59	18.79	19.73
24. Inorg. Heavy Chemicals	9.27	9.04	13.31	13.08	9.86	9.65	13.90	13.69	9.23	9.01	13.28	13.05
25. Org. Heavy Chemicals	6.30	6.87	10.73	11.33	6.57	7.14	10.98	11.60	6.25	6.82	10.71	11.31
26. Plastics	7.70	10.27	8.02	10.57	8.15	10.65	8.45	10.96	7.63	10.19	7.95	10.50
27. Cosmetics and Drugs	4.84	5.39	4.68	5.28	4.93	5.47	4.75	5.35	4.83	5.38	4.68	5.28
28. Manmade Fibre	8.65	6.58	8.08	5.84	8.85	6.84	8.24	6.06	8.60	6.53	8.05	5.80
29. Other Chemicals	10.68	10.98	10.98	11.26	11.20	11.50	11.50	11.78	10.57	10.87	10.88	11.16
30. Petroleum products	10.32	9.95	12.38	11.96	10.69	10.33	12.76	12.35	10.26	9.89	12.33	11.90

(Contd.)

TABLE 5: (CONTD.)

SECTOR	CASE-1A	CASE-1B	CASE-1C	CASE-1D	CASE-2A	CASE-2B	CASE-2C	CASE-2D	CASE 3A	CASE 3B	CASE 3C	CASE 3D
31. Cement	8.78	8.36	8.72	8.29	10.71	10.32	10.64	10.25	8.76	8.35	8.71	8.28
32. Refractory	10.21	9.82	10.77	10.37	12.29	11.92	12.88	12.50	10.17	9.79	10.74	10.34
33. Other nonmet. min. pro.	8.17	8.01	8.22	8.02	9.54	9.39	9.58	9.40	8.15	7.99	8.21	8.00
34. Iron and Steel	9.87	9.61	10.79	10.50	11.83	11.58	12.79	12.52	9.80	9.54	10.73	10.44
35. Nonferrous metals	10.54	10.41	13.99	13.79	12.46	12.33	16.00	15.81	10.48	10.37	13.95	13.75
36. Bolts and Nuts	9.84	9.47	10.89	10.51	11.99	11.64	13.09	12.74	9.82	9.45	10.88	10.50
37. Metal containers	7.06	6.79	7.13	6.84	7.30	7.05	7.36	7.08	7.01	6.74	7.11	6.80
38. Other metal products	9.44	9.70	9.41	9.68	11.19	11.43	11.14	11.39	9.38	9.64	9.35	9.61
39. Ball bearings	18.14	18.01	18.25	18.14	21.38	21.25	21.48	21.36	18.14	18.02	8.26	18.14
40. Office, domestic equip.	11.60	11.38	11.67	11.38	12.92	12.73	12.98	12.72	11.57	11.35	11.66	11.36
41. Agri. implements	8.78	8.73	8.74	8.69	11.83	11.77	11.77	11.72	8.78	8.74	8.74	8.70
42. Machine Tools	15.73	15.71	16.23	16.21	18.72	18.70	19.23	19.21	15.73	15.71	16.23	16.21
43. Other Machinery	8.44	8.44	16.45	16.40	10.89	10.87	19.21	19.15	8.34	8.34	16.38	16.33
44. Electric Motors	9.53	9.44	10.65	10.55	12.37	12.27	13.52	13.41	9.53	9.43	10.65	10.54
45. Electric Wires	8.84	8.40	8.92	8.45	10.54	10.13	10.61	10.18	8.84	8.40	8.91	8.45
46. Electronics	12.24	12.11	12.21	12.08	14.01	13.88	13.97	13.84	12.25	12.11	12.22	12.08
47. Batteries	9.66	7.65	9.29	7.05	10.64	8.77	10.24	8.15	9.65	7.64	9.30	7.05
48. Elec. household goods	9.96	8.01	9.55	7.27	10.92	9.14	10.49	8.38	9.94	8.01	9.56	7.27
49. Radio	9.77	4.72	9.10	3.45	9.99	5.16	9.27	3.84	9.74	4.71	9.11	3.46
50. Teleph. Telger Eqip.	9.93	9.85	9.89	9.81	12.74	12.65	12.68	12.60	9.94	9.86	9.89	9.82
51. Other Electricals	11.52	11.39	12.54	12.37	13.20	13.07	14.27	14.09	11.44	11.31	12.47	12.30
52. Motor cycles	9.46	8.54	9.15	8.03	10.98	10.16	10.65	9.64	9.42	8.50	9.12	7.99
53. Motor vehicles	12.10	7.43	11.71	7.05	13.19	8.72	12.77	8.30	12.08	7.41	11.70	7.04
54. Ships and Boats	9.69	9.62	9.64	9.57	11.94	11.86	11.87	11.80	9.69	9.62	9.64	9.57
55. Aircraft	10.37	10.31	12.58	12.52	12.99	12.92	15.27	15.20	10.38	10.32	12.59	12.52
56. Rail equipment	12.84	12.69	13.13	12.98	15.27	15.12	15.56	15.42	12.79	12.64	13.08	12.93
57. Other Transport Eqip.	7.11	7.02	7.07	6.98	8.48	8.40	8.45	8.36	7.11	7.02	7.08	6.99
58. Watches and Clocks	10.28	8.81	9.83	8.10	10.59	9.23	10.12	8.48	10.18	8.72	9.76	8.01
59. Misc. Scient. Instr.	10.28	10.19	10.28	10.20	12.04	11.95	12.04	11.95	10.19	10.10	10.19	10.10
60. Other Industries	8.42	10.47	8.20	10.20	8.55	10.59	8.30	10.30	8.29	10.34	8.09	10.07
61. Printing	7.42	6.42	7.42	6.36	7.95	7.01	7.97	6.95	7.38	6.39	7.40	6.33
62. Electricity	10.91	10.49	11.11	10.65	11.41	11.01	11.61	11.18	10.88	10.46	11.08	10.63
63. Construction	8.86	8.17	8.52	8.13	10.41	10.06	10.38	10.02	8.55	8.17	8.52	8.13
64. Railways	7.42	6.68	7.47	6.69	7.83	7.11	7.88	7.14	7.40	6.65	7.46	6.67
65. Other Transport	6.61	6.15	6.53	6.04	7.01	6.57	6.93	6.47	6.58	6.12	6.51	6.02
66. Other Services	7.28	6.46	7.21	6.35	7.70	6.91	7.63	6.80	7.26	6.44	7.20	6.33

(Contd.)

TABLE 5: (CONTD.)

(per cent)

SECTOR	CASE-4A	CASE-4B	CASE-4C	CASE-4D	CASE-5A	CASE-5B	CASE-5C	CASE-5D	CASE-6A	CASE-6B	CASE-6C	CASE-6D
1. Food Grains	3.23	4.04	3.12	3.99	3.29	4.08	3.17	4.02	3.22	4.04	3.09	3.97
2. Other Agriculture	4.13	5.00	3.93	4.83	4.46	5.32	4.21	5.10	4.12	5.00	3.87	4.76
3. Animal Husbandry	5.54	6.17	5.21	5.88	5.70	6.32	5.32	5.97	5.50	6.14	5.11	5.75
4. Plantation	5.49	4.86	5.28	4.65	6.35	5.75	6.12	5.49	5.65	5.02	5.41	4.75
5. Forestry	4.67	5.51	4.93	5.79	6.07	6.85	6.33	7.12	4.67	5.52	4.92	5.76
6. Coal	8.91	11.55	8.98	11.63	9.97	12.49	10.04	12.57	8.91	11.55	8.94	11.55
7. Misc. Coal, Petr Prod.	9.59	9.83	11.00	11.23	12.04	12.25	13.53	13.72	9.64	9.87	11.04	11.25
8. Iron Ore	7.78	7.59	8.25	8.06	11.01	10.82	11.54	11.34	8.08	7.89	8.55	8.35
9. Crude oil	-1.78	-2.14	0.19	-0.21	-0.91	-1.25	0.96	0.67	-1.73	-2.08	0.22	-0.19
10. Other Minerals	8.75	8.76	10.25	10.25	11.49	11.49	13.03	13.01	8.83	8.84	10.33	10.32
11. Sugar and Gur	3.68	5.16	3.44	4.96	3.84	5.29	3.55	5.05	3.67	5.16	3.38	4.88
12. Vegetable oil	4.41	5.19	4.33	5.16	4.80	5.57	4.71	5.50	4.47	5.26	4.37	5.17
13. Tea and Coffee	3.94	3.67	3.76	3.48	4.58	4.32	4.37	4.10	4.12	3.85	3.90	3.61
14. Other food products	6.48	5.33	6.25	5.05	6.67	5.56	6.37	5.20	6.44	5.28	6.13	4.88
15. Cotton textiles	4.83	5.35	4.56	5.10	5.05	5.57	4.74	5.27	4.83	5.36	4.51	5.02
16. Jute textiles	3.99	4.05	4.11	4.17	5.29	5.35	5.40	5.46	4.22	4.28	4.33	4.38
17. Other textiles	7.76	5.79	7.30	5.20	8.12	6.26	7.58	5.53	7.74	5.76	7.20	5.01
18. Misc. textile products	7.33	6.18	6.91	5.63	7.92	6.85	7.44	6.20	7.33	6.16	6.83	5.46
19. Wood products	7.94	4.74	7.62	4.24	9.30	6.35	8.94	5.79	7.92	4.69	7.52	4.07
20. Paper, paper products	7.11	6.02	10.77	9.61	7.62	6.58	11.38	10.25	7.11	6.02	10.72	9.53
21. Leather products	6.18	5.88	6.01	5.71	7.02	6.74	6.83	6.54	6.43	6.14	6.23	5.91
22. Rubber products	11.09	8.42	10.96	8.23	13.17	10.72	13.00	10.48	11.11	8.43	10.93	8.17
23. Fertilizer	17.56	18.43	18.65	19.58	17.90	18.76	18.96	19.89	17.55	18.42	18.61	19.55
24. Inorg. Heavy Chemicals	8.64	8.40	12.69	12.47	9.91	9.70	13.95	13.74	8.64	8.40	12.67	12.42
25. Org. Heavy Chemicals	6.01	6.57	10.47	11.10	6.62	7.20	11.04	11.66	6.01	6.57	10.44	11.03
26. Plastics	7.17	9.80	7.50	10.13	8.23	10.75	8.54	11.05	7.21	9.83	7.49	10.07
27. Cosmetics and Drugs	4.80	5.35	4.66	5.27	4.95	5.49	4.78	5.37	4.77	5.33	4.59	5.19
28. Manmade Fibre	8.48	6.39	7.98	5.75	8.92	6.93	8.32	6.15	8.46	6.35	7.87	5.56
29. Other Chemicals	9.98	10.29	10.28	10.59	11.31	11.61	11.61	11.90	10.06	10.37	10.33	10.61
30. Petroleum products	9.85	9.47	11.91	11.48	10.76	10.39	12.81	12.41	9.90	9.52	11.93	11.50

(Contd.)

TABLE 5: (CONCLD.)

SECTOR	CASE-4A	CASE-4B	CASE-4C	CASE-4D	CASE-5A	CASE-5B	CASE-5C	CASE-5D	CASE-6A	CASE-6B	CASE-6C	CASE-6D
31. Cement	6.69	6.24	6.64	6.19	10.72	10.34	10.66	10.26	6.69	6.24	6.63	6.17
32. Refractory	7.89	7.48	8.44	8.02	12.32	11.95	12.91	12.53	7.92	7.51	8.46	8.04
33. Other nonmet. min. pro.	6.75	6.58	6.81	6.61	9.57	9.42	9.61	9.43	6.74	6.57	6.77	6.54
34. Iron and Steel	7.63	7.36	8.50	8.22	11.89	11.64	12.85	12.58	7.70	7.43	8.56	8.27
35. Nonferrous metals	8.38	8.27	11.73	11.56	12.50	12.38	16.04	15.85	8.42	8.31	11.79	11.59
36. Bolts and Nuts	7.48	7.09	8.48	8.08	12.01	11.65	13.11	12.75	7.50	7.11	8.49	8.09
37. Metal containers	6.81	6.53	6.90	6.42	7.37	7.11	7.42	7.14	6.81	6.53	6.85	6.53
38. Other metal products	7.46	7.76	7.44	7.74	11.25	11.49	11.21	11.45	7.52	7.82	7.48	7.77
39. Ball bearings	14.51	14.39	14.63	14.52	21.37	21.23	21.47	21.35	14.52	14.40	14.65	14.53
40. Office, domestic equip.	10.21	9.99	10.30	10.01	12.96	12.76	13.01	12.75	10.22	9.98	10.27	9.93
41. Agri. implements	5.36	5.33	5.33	5.30	11.82	11.76	11.76	11.71	5.36	5.33	5.34	5.31
42. Machine Tools	12.39	12.37	12.87	12.85	18.72	18.70	19.23	19.20	12.39	12.37	12.88	12.86
43. Other Machinery	5.53	5.54	13.23	13.19	10.98	10.95	19.27	19.21	5.65	5.66	13.32	13.28
44. Electric Motors	6.36	6.27	7.45	7.35	12.38	12.27	13.52	13.41	6.37	6.28	7.46	7.36
45. Electric Wires	7.04	6.58	7.12	6.64	10.54	10.13	10.62	10.19	7.04	6.57	7.10	6.61
46. Electronics	10.36	10.22	10.34	10.20	14.01	13.87	13.97	13.83	10.36	10.22	10.34	10.20
47. Batteries	8.74	6.64	8.39	6.08	10.67	8.80	10.27	8.17	8.70	6.57	8.28	5.88
48. Elec.household goods	9.06	7.02	8.68	6.33	10.95	9.18	10.52	8.41	9.01	6.93	8.55	6.07
49. Radio	9.70	4.57	9.10	3.46	10.04	5.22	9.34	3.89	9.62	4.42	8.90	3.04
50. Teleph. Telger Eqip.	6.82	6.75	6.79	6.72	12.73	12.65	12.68	12.60	6.82	6.75	6.79	6.72
51. Other Electricals	9.56	9.43	10.55	10.37	13.26	13.13	14.33	14.16	9.65	9.52	0.64	10.45
52. Motor cycles	7.85	6.87	7.56	6.40	11.03	10.22	10.71	9.70	7.86	6.85	7.52	6.26
53. Motor vehicles	11.00	6.11	10.64	5.77	13.22	8.74	12.80	8.33	10.99	6.10	0.58	5.73
54. Ships and Boats	7.24	7.17	7.19	7.13	11.94	11.86	11.87	11.79	7.25	7.18	7.21	7.14
55. Aircraft	7.49	7.44	9.61	9.56	12.98	12.92	15.26	15.19	7.49	7.44	9.62	9.56
56. Rail equipment	10.08	9.93	10.36	10.21	15.32	15.17	15.61	15.46	10.14	9.99	10.42	10.27
57. Other Transport Eqip.	5.66	5.57	5.63	5.54	8.48	8.39	8.44	8.36	5.66	5.57	5.63	5.54
58. Watches and Clocks	9.91	8.41	9.50	7.75	10.70	9.35	10.23	8.60	9.94	8.40	9.44	7.57
59. Misc. Scient. Instr.	8.19	8.11	8.20	8.12	12.13	12.04	12.12	12.03	8.30	8.21	8.31	8.23
60. Other Industries	8.13	10.21	7.92	9.97	8.68	10.73	8.44	10.44	8.21	10.28	7.95	9.92
61. Printing	6.88	5.86	6.89	5.81	8.00	7.06	8.02	7.00	6.88	5.84	6.83	5.71
62. Electricity	10.41	9.97	10.61	10.15	11.45	11.05	11.65	11.22	10.41	9.96	10.56	10.07
63. Construction	6.57	6.15	6.54	6.11	10.42	10.07	10.39	10.03	6.56	6.15	6.51	6.08
64. Railways	7.06	6.29	7.10	6.31	7.87	7.15	7.92	7.17	7.03	6.26	7.01	6.20
65. Other Transport	6.13	5.65	6.04	5.55	7.04	6.60	6.97	6.50	6.21	5.73	6.08	5.56
66. Other Services	6.87	6.03	6.81	5.94	7.73	6.94	7.66	6.83	6.87	6.02	6.76	5.86

TABLE 6: PROJECTED SECTORAL RATES OF GROWTH IN GROSS VALUE ADDED AT FACTOR COST IN 1978-79 OVER 1973-74 (CASE 3D)

Sector No.	Name of sector	Per cent	Sector No.	Name of sector	Per cent
1.	Food grains	3.23	35.	Non ferrous metals	13.31
2.	Other agriculture	4.14	36.	Bolts and nuts	10.06
3.	Animal husbandry	5.26	37.	Metal containers	6.38
4.	Plantations	4.15	38.	Other metal products	9.18
5.	Forestry	5.62	39.	Ball bearings	17.67
6.	Coal	11.69	40.	Office and domestic equipments	10.92
7.	Misc. coal, and petroleum products	12.01	41.	Agricultural implements	8.27
8.	Iron ore	9.18	42.	Machine tools	15.75
9.	Crude oil	-0.21	43.	Other machinery	15.87
10.	Other minerals	11.17	44.	Electric motors	10.11
11.	Sugar and gur	4.52	45.	Electric wires	8.02
12.	Vegetable oil	4.83	46.	Electronics	11.64
13.	Tea and coffee	3.25	47.	Batteries	6.63
14.	Other food products	4.61	48.	Electrical household goods	6.85
15.	Cotton textiles	4.69	49.	Radio	3.06
16.	Jute textiles	4.29	50.	Telephone and telegraphic equipments	9.38
17.	Other textiles	4.81	51.	Other electricals	11.85
18.	Misc. textile products	5.35	52.	Motor cycles	7.57
19.	Wood products	4.50	53.	Motor vehicles	6.61
20.	Paper and paper products	9.42	54.	Ships and boats	9.13
21.	Leather products	5.55	55.	Aircraft	12.08
22.	Rubber products	8.87	56.	Rail equipments	12.49
23.	Fertilizers	19.26	57.	Other transport equipments	6.56
24.	Inorganic heavy chemicals	12.61	58.	Watches and clocks	7.59
25.	Organic heavy chemicals	10.87	59.	Misc. scientific instruments	9.67
26.	Plastics	10.06	60.	Other industries	9.64
27.	Cosmetics and drugs	4.86	61.	Printing	5.92
28.	Man made fibres	5.38	62.	Electricity	10.31
29.	Other chemicals	10.72	63.	Construction	8.13
30.	Petroleum products	11.46	64.	Railways	5.95
31.	Cement	7.85	65.	Other transport	5.30
32.	Refractories	9.91	66.	Other services	5.65
33.	Other non-metallic mineral products	7.58		Total	5.50
34.	Iron and steel	10.01			

7.4 SHARE AND GROWTH RATE OF CONSUMPTION BY DIFFERENT FRACTILE GROUPS

The share of consumption to total consumption and the growth rates of aggregate consumption in 1978-79 over 1973-74 by different fractile groups are presented in Tables 7.1 to 7.3, separately for rural, urban and all India, for the preferred variant (case 3D - with reduction in inequality) as well as for case 3C (without reduction in inequality). The monthly per capita consumption for the lowest 30 per cent and richest 30 per cent of the population along with the aggregate monthly per capita consumption are also given in these tables. Some of these per capita figures differ in the decimals from those furnished in the Approach Paper owing to subsequent scrutiny of the results.

It may be seen that the consumption in the

highest decile in the rural area and the highest quintile in the urban area would be less in 1978-79 for preferred case than in 1973-74, as a result of reduction in expenditure inequality so that the lowest 30 per cent of the population would get a per capita consumption of Rs 36.64 in the rural area and Rs 39.64 in the urban area by 1978-79. By way of reduction in inequality in expenditure distribution the growth rate in the total consumption of the people in the first few deciles would be much higher than the growth rate in the aggregate consumption. However, it may be noted that these high growth rates have been obtained because of the very low base, so that in actual magnitudes the consumption, on per capita basis, in these deciles in the terminal year would be much less than the aggregate per capita consumption even when the envisaged order of redistribution is carried out. Detailed policies, programmes and projects for achieving the above objective are currently being worked out for inclusion in the Fifth Plan in the light of the broad indications already contained in the "Approach" document.

If we postulate that inequality will remain unchanged, the growth rate in the total consumption of people in any fractile group would be the same as the growth rate in the aggregate consumption, but in actual magnitudes the consumption of the lowest 70 per cent, in particular that of the lowest 30 per cent, of the population would be much less in this case as compared with the preferred case.

TABLE 7.1 SHARE OF CONSUMPTION TO TOTAL CONSUMPTION AND GROWTH RATE OF AGGREGATE CONSUMPTION BY FRACTILE GROUPS - RURAL

Fractile group (%)	Share of consumption(%)			Growth rate of aggregate consumption in 1978-79 over 1973-74 (%)	
		1978-79			
	1973-74	Case 3C	Case 3D	Case 3C	Case 3D
(1)	(2)	(3)	(4)	(5)	(6)
0-5	1.38	1.38	2.37	4.48	16.40
5-10	1.91	1.91	2.90	4.48	13.53
10-20	4.79	4.79	6.64	4.48	11.53
20-30	5.87	5.87	7.52	4.48	9.75
30-40	6.90	6.90	8.29	4.48	8.36
40-50	7.98	7.98	9.05	4.48	7.12
50-60	9.19	9.19	9.85	4.48	5.94
60-70	10.63	10.63	10.77	4.48	4.73
70-80	12.50	12.50	11.88	4.48	3.39
80-90	15.37	15.37	13.46	4.48	1.71
90-95	9.62	9.62	7.71	4.48	-0.07
95-100	13.86	13.86	9.56	4.48	-3.02
0-100	100.00	100.00	100.00	4.48	4.45
0-30	13.95	13.95	19.43		
70-100	51.35	51.35	42.61		
mild-year population (million)	460	498	498		
	Monthly per capita consumption (Rs)				
0-30	22.90	26.33	36.64		
70-100	84.35	96.98	80.38		
0-100	49.27	56.65	56.59		

TABLE 7.2 SHARE OF CONSUMPTION TO TOTAL CONSUMPTION AND GROWTH RATE OF AGGREGATE CONSUMPTION BY FRACTILE GROUPS - URBAN

Fractile group (%)	Share of consumption(%)			Growth rate of aggregate consumption in 1978-79 over 1973-74 (%)	
		1978-79			
(1)	1973-74 (2)	Case 3C (3)	Case 3D (4)	Case 3C (5)	Case 3D (6)
0-5	1.11	1.11	1.90	5.62	17.56
5-10	1.61	1.61	2.44	5.62	14.82
10-20	4.17	4.17	5.82	5.62	12.87
20-30	5.27	5.27	6.81	5.62	11.15
30-40	6.36	6.36	7.72	5.62	9.80
40-50	7.51	7.51	8.63	5.62	8.59
50-60	8.83	8.83	9.63	5.62	7.44
60-70	10.44	10.44	10.77	5.62	6.26
70-80	12.59	12.59	12.21	5.62	4.96
80-90	15.97	15.97	14.32	5.62	5.32
90-95	10.33	10.33	8.51	5.62	1.59
95-100	15.81	15.81	11.24	5.62	-1.36
0-100	100.00	100.00	100.00	5.62	5.60
0-30	12.16	12.16	16.97		
70-100	54.70	54.70	46.28		
mild-year population (million)	116	135	135		
	Monthly per capita consumption (Rs)				
0-30	25.17	28.44	39.64		
70-100	113.19	127.87	108.07		
0-100	62.08	70.13	70.06		

TABLE 7.3 SHARE OF CONSUMPTION TO TOTAL CONSUMPTION AND GROWTH RATE OF AGGREGATE CONSUMPTION BY FRACTILE GROUPS - ALL INDIA

Fractile group (%)	Share of consumption(%)			Growth rate of aggregate consumption in 1978-79 over 1973-74 (%)	
		1978-79			
(1)	1973-74 (2)	Case 3C (3)	Case 3D (4)	Case 3C (5)	Case 3D (6)
0-5	1.31	1.31	2.25	4.72	16.75
5-10	1.83	1.83	2.78	4.74	13.80
10-20	4.62	4.62	6.40	4.75	11.80
20-30	5.70	5.70	7.29	4.75	10.02
30-40	6.73	6.73	8.08	4.76	8.64
40-50	7.82	7.82	8.80	4.76	7.40
50-60	9.04	9.04	9.70	4.76	6.23
60-70	10.51	10.51	10.77	4.76	5.04
70-80	12.52	12.52	11.89	4.76	3.73
80-90	15.47	15.47	13.64	4.76	2.13
90-95	9.75	9.75	7.93	4.76	0.48
95-100	14.70	14.70	10.47	4.74	-2.09
0-100	100.00	100.00	100.00	4.75	4.74
0-30	13.46	13.46	18.72		
70-100	52.44	52.44	43.93		
mild-year population (million)	576	633	633		
	Monthly per capita consumption (Rs)				
0-30	23.27	26.70	37.10		
70-100	90.64	104.05	87.17		
0-100	51.85	59.52	59.47		

7.5 BALANCE OF PAYMENTS

Total gap on balance of payments for the five-year period (1974-75 to 1978-79) as a whole has also been estimated in Table 8. While the gap for the terminal year is based on the detailed inter-industry model outlined in Annexure I, the aggregate gap for the Plan as a whole has been obtained by combining the results obtained from our macro-model with the desired configuration for the terminal year. It would have been perfectly possible, although somewhat mechanical, to use the inter-industry model to obtain the gap on the balance of payments for each year. In view of the leads and lags involved in creating additional capacity, especially where significant import substitution is involved, the procedure adopted combines a desirable degree of inter-temporal flexibility in the process of import substitution with a precisely defined disaggregated vector terminal year output levels.

While it is clear that a reduction in expenditure inequality helps in saving foreign exchange, the amount given here is likely to be an under-estimate because of the level and type of aggregation adopted in the input-output table. In addition, we have not been able to distinguish between different types of construction. In view of the fact that some construction goes to meet the need of upper income brackets exclusively and is also highly demanding in terms of scarce resources such as cement, steel, etc., the total reduction in foreign exchange can be shown to be larger if more precise quantitative information could be obtained on the extent of such construction activity and the nature of the curb that may be accepted as part of the policy outlined in the "Approach" document.

The results obtained in our exercises on balance of payments position confirm the view that the net aid can be reduced to zero in the terminal year of the Plan provided an appropriate phasing is used with respect to the gross aid expected over the five year period, which has been tentatively put at Rs. 3,000 crores. This is borne out by the fact that net imports of goods and non-factor services will be negative in the terminal year to the extent of Rs. 1,980 million implying the possibility of meeting the current transfers and other invisibles on current account except interest payments on foreign loans.

A TECHNICAL NOTE ON THE SIXTH PLAN OF INDIA, 1980-85

CHAPTER 1

INTRODUCTION

This technical note presents a description of the quantitative model that has been used in the formulation of the Sixth Five Year Plan (1980-85) of India. The present five year plan is the sixth in a row covering a period of nearly 35 years. The quantitative model used in consecutive plans is continuously updated and amended to suit the changed socio-economic conditions, availability of new data and to take advantage of improved modelling methodology. The present model structure is an extension of what has been used during the Fifth Plan period. The new features built into this model have been intended partly for removing the model's earlier deficiencies in capturing few key developmental issues as experienced in the past and partly for tackling many of the recent changes that have taken place both within the country and outside in the international economic situation and which have crucial bearing on the success of our development efforts. The basic objectives of our plan have not changed since the formulation of the first plan. As Jawaharlal Nehru said in his introduction to the Third Five Year Plan "Planning is a continuous movement towards desired goals. While the precise formulation of the plan objectives have varied from plan to plan, essential goals of Indian planning have remained unchanged." These goals can be mainly described as (1) reduction in poverty and unemployment and improvement in the quality of life, (2) modernization and building of a self-reliant economy, and (3) removal of regional disparity and strengthening the redistribution bias of public policies and services in favour of the poor and weaker sections of the community. But the strategy needs reformulation

from one plan to the other, with changed circumstances and experience. The strategy of the Sixth Plan accordingly has been defined as mainly to step up the rate of growth of the economy by removing the constraining elements in the growth process and to take measures so that the plan benefits will reach the section of the community which is the weakest. The structure of the Sixth Plan model has been so reformulated that the identification of the constraining elements in our growth process would be easy and specific policies thereby could be devised in order to make the best use of the economy's potentialities.

In addition to identifying the growth constraints that have been generated from the past, specific provisions in the Sixth Plan model were devised to deal with certain growth inhibiting factors which have presently gained significance. They are (1) high uncertainty in the international climate regarding trade and aid, (2) the ever increasing deterioration in the terms of trade mainly originating from high price of crude oil and (3) the domestic inflation or at least that part of it which cannot be explained by rising import prices.

All these complex issues can only be captured by the use of a detailed intersectoral, intertemporal analytical model which can simultaneously treat both supply and demand and their interactions between sectors and time. By the use of such a model the planners can get an early indication regarding the likely shortages or surpluses that may develop in any sector of the economy so that adequate measures can be taken to bridge these gaps. This is where the need for a new generation model in Indian planning was felt. The model used in the first and second plans concentrated mainly on the growth potentialities of the country, determined by the economy's savings potential and the incremental capital output ratio. This model belonged to the Harrod Domar and Feldman-Mahalanobis family. It comprised of a single sector and had no foreign trade. As a result its demand and supply equations were the same. Since the third plan and until the end of the fifth plan, the input output models of the different variants, basically belonging to the Leontief group, came into increasing use. These models focussed on the need for establishing intersectoral consistencies in building the production targets; these targets were mainly estimated from the demand side. The supply side was rather neglected in the sense that no sectoral supply constraints were formulated in these models, although in a limited and indirect way, they were checked for few specific sectors only by the use of material balances. These input-output models were increasingly articulated during the fourth and fifth plans by making them "closed", i.e., by endogenising imports and consumption in the final demand vector respectively. The Sixth Plan has attempted to integrate both the Harrod Domar and the input-output approaches of the earlier plans in a demand-supply frame. For this purpose an investment planning model has been developed and integrated to the existing input-output system. By this, the demand supply balances for all sectors are checked over time. Furthermore, the problems of balancing the demand and supply are tackled not only in the commodity and services market but also in the markets dealing with primary inputs like labour and capital and other important non-renewable resources of the country.

In brief, there are three salient features of the Sixth Plan model:

I. A system of supply quotations, which in fact is an extended and modified version of the Harrod Domar equation, primarily meant to accommodate (a) sectoral disaggregations, (b) questions of investment lags, and (c) existence of a foreign trade sector. The Harrod Domar equation of the Ist and IInd Plans can be presented in a simplified form as follows:

$$V_T = V_o + \sum_{t=0}^{4} I_t^* \quad ICOR^{-1} \qquad (1)$$

$$\& \quad I_t = V_t(1 - B) \qquad (2)$$

where T = 5th year (Terminal period)
V_o = Value added, base year
I = New investment
ICOR = Incremental capital-value added ratio
B = Average propensity to consume.

This equation is modified in the sixth plan and presented in simplified form as following.

$$X_{si} = \tilde{c}X_{si(T-k_iL_i)} + \sum_{r}^{k_i} I_{i(T-rL_i)} \left(V_{iT} * ICOR^{-1}\right) \quad (3)$$

$$I_{it} = (I_{iT}/I_{io})^{1/5} * I_{it-1} \quad (4)$$

$$\& \; I_{iT} = \dot{I}_{iT} \quad (5)$$

when X_{si} = Supply of i^{th} sector
$\tilde{c}$ = Capacity utilization factor
L_i = Gestation lag for the the i^{th} sector
k_i = Any integer such that $T-k_iL_i$ is minimum negative
V_i = Value added to output ratio
I_{iT} = Investment in the i^{th} sector in the last (5th) year of plan
$\dot{I}_{iT}$ = Exogenously determined investment in i^{th} sector & T^{th} period.

II. A *system of demand equations* which is again an extended version of Leontief's input-output system by endogenising not only consumption and imports (as was done in the Fifth Plan) but also investment.

The Leontief model used in the third, fourth and fifth Plans can be presented in a very simplified form as following:

$$X_T = (I-A)^{-1}\{C+I+E-M+PC\}: \text{The Third Plan} .. \quad (6)$$

$$X_T = B^{-1}\{C+I+E+PC\}: \text{The Fourth Plan} .. \quad (7)$$

$$X_T = B^{*-1}\{I+E+PC\}: \text{The Fifth Plan} .. \quad (8)$$

where $(I-A)^{-1}$ = Leontief inverse.
B^{-1} = Extended Leontief inverse, with import and consumption both endogenised.
B^{*-1} = Further extended Leontief inverse, with import and consumption both endogenised.
PC = Public consumption.

Presented in this illustrative form, the Sixth Plan Input-Output Demand System is:

$$X_T = B^{**-1}\{E+PC\} \quad (9)$$ where

B^{**-1} = Extended Leontief inverse with consumption, imports & investment endogenised.

III. A set of inequality relations with given upper bounds as $Mx \leq R$ to ensure that the demand should not exceed the supply in any of the markets dealing with commodities, services, capital, labour, foreign exchange and non-renewable resources. In the same way, a set of inequality relations with lower bounds given as $M^*x^* \geq R^*$ are used to ensure the attainment of minimum welfare targets of the community. Here R and R* refer to the resources availability and the welfare targets and M are technical and behavioural coefficients.

In order to cope with the uncertainties in international climate, provisions of contingency planning for import has been made. Also, alternative sensitivity analyses with different likely international situations have been worked out. In estimating the real value of foreign saving, appropriate calculations are made regarding the erosion in its value because of increasing deterioration in the terms of trade arising out of changes in the relative prices of exports and imports. Similarly, the effect of domestic inflation on domestic saving and plan's resources mobilisation has been taken care of by switching over from the concept of savings at constant price, used in all earlier plans, to the concept of saving at a given accounting price. The difference between the two approaches is very significant. The former calculates the estimates of saving assuming a zero rate of inflation over the plan period. The latter, on the other hand, estimates saving in response to certain assumed rate of inflation in the future and subsequently deflates this saving in order to derive "savings at constant accounting price". But by basing all plan programmes on resources calculated in this way, the planners can protect the real content of the plan if realised inflation does not exceed the assumed inflation rate. This new approach has been thought necessary because of the finding that the public sector's source of income is to some extent inflation inelastic, whereas its expenditure responds almost equally to a rise in price. The obvious result under the circumstances will be to reduce the real size of public saving with every dose of inflation. Furthermore, as the public sector invests mainly in infrastructure and because the infrastructure investment in the economy has a

very high forward or backward linkage, every dose of inflation which will reduce the real content of the public sector plan will also increase the infrastructure bottlenecks in the society and retard the real growth of the economy especially if there exists a significant parallel economy.

Furthermore, a new approach has been given to the employment and poverty blocks of the model which deal with the major public sector welfare programmes. Far more care has been taken to work out the employment generation capacity of each of the major projects and programmes mainly in the field of social service. There is another feature in the Sixth Plan model which differs significantly from the earlier ones. This is in the treatment of its "perspectives", i.e. the post plan long term development scenario. Because of the nature of long investment lags in major infrastructures, an integration of the long term perspective with a medium five year plan is thought to be highly imperative. In the past, perspective scenarios were always developed but were not technically and behaviourally integrated with the medium term investment and output decisions. Last but not the least, the present Plan has made significant improvement regarding estimations and updating of all technical and behavioural parameters in the light of availability of more reliable data.

It may be appropriate at this stage to explain the role of these models in the "plan formulation process" of India. Any planning process, in a mixed economy of the size of India with a federal structure and democratic planning organisation, is likely to be highly flexible and complex. This planning process operates in a decentralised form and at the same time the plan's overall resources allocation is done by a centralised decision making body. Thus the decision making regarding the plan structure ranges from a gross-root block level unit to a single centralised apex planning body - National Development Council (NDC). All these units in the end are integrated by a general consensus process....

National Development Council (NDC) is the highest decision making body in planning. It is composed of Prime Minister as the Chairman of the Planning Commission, Deputy Chairman of the Planning Commission, Chief Ministers, Cabinet Ministers and Members of the Planning Commission. The NDC decides the broad objectives and goals of a plan. This is normally done with the help of a plan outline prepared by the Planning Commission. Objectives and goals of the plan are then fed as inputs into the detailed planning model developed within the Planning Commission. The Planning Commission then requests the Central Ministries .... to send their plan outlays, sector and projectwise, to the Planning Commission in the light of broad development directions prepared (with the instructions received from NDC) and sent by the Planning Commission. There are two different flows (1) Those plan outlays which are to be adjusted by iterative process and (2) few other outlays which are unchangeable and branded as autonomous investments flowing from Ministries to the Planning Commission. The former category of plan outlays are finalised by mutual agreement between the Ministries and the Planning Commission. The second type of outlays refer to flows which are one-sided only, i.e., they are regarded in the plan formulation process as exogenous.

From few Ministries, instructions regarding the targets of the plan come as one-way inputs to the Planning Commission. .... One simple example in the present Sixth Plan exercise is the export targets which are fed by the Ministry of Commerce. Similarly, each State planning department consolidates the plan programmes and projects from block levels and plant levels, in the light of broad signals regarding the size and priority of the plan rendered by the Planning Commission. Then they are transmitted to the Planning Commission in terms of detailed programmes, projects and sectoral investments. These proposals on plan outlay coming from the States in most cases pass through different working groups constituted by the Planning Commission comprising of experts drawn from other Ministries, Planning Commission itself and at times from the private sector. The proposals from the Central Ministries similarly, in many cases, pass through working groups.

On the resources side, initial resources calculations are done by the Ministry of Finance and Reserve Bank in the light of broad macro information regarding the future growth of the

economy, again supplied by the Planning Commission. This exercise of resources estimates is done in close collaboration with the Planning Commission by forming a series of relevant working groups and committees. ..... Again, this exercise after finalisation, feeds into the Planning Commission as a starting point determining the resources base of the plan. In addition to these inputs, on plan resources and outlays received from the different Ministries and States, the Planning Commission independently undertakes an analysis of the economy, its past and present, in order to develop relevant behaviour, technology and policy parameters for the plan. All these inputs finally enter into a formalised model system as shown in the diagram as sectoral and general equilibrium model. These models are summarised in detail in subsequent chapters. This modelling exercise tries to check the feasibility and consistency of all the programmes and projects and resources estimates fed as inputs by the Ministries and States and assesses their contributions in attaining the goals and objectives set by the NDC. If the goals cannot be achieved or if the configuration of the programmes and projects provided by the Ministries and States are seen to be inconsistent or infeasible in the light of the behaviour and technical relations given in the model, then all the proposals on plan outlays will go back to respective Ministries and States asking for revision, shown by the dotted lines. On some occasions, after they have been considered by the Planning Commission meeting (PCM), which consists of Prime Minister, Finance Minister, Deputy Chairman and members of the Planning Commission & senior officials, these may even be referred back to the NDC for the reformulation of the plan objectives.

These to and fro movements will continue until a complete consensus between the States, Central Ministries, Planning Commission and the NDC regarding the feasibility of the different plan programmes and attaining desired objective is reached.

This is the stage when the Planing Commission brings out the draft plan, which after being approved by the NDC becomes a final plan document. This plan document ultimately is placed before the Parliament and the people for discussion. As for the private sector, the relevant macro plans are formulated by the Planning Commission, in complete tune with the general development strategy of the country and of the public sector. This part of the plan is regarded as indicative and subsequently appropriate measures are undertaken by different Ministries through fiscal, monetary and income policies, to ensure their fulfilment.

CHAPTER II

STRUCTURE OF THE MODEL

The Sixth Plan modelling exercise comprises of a core model and several sub-models. The sub-models are primarily designed to process the inputs (as exogenous variables) for the core model.

The model system covers a 15 year period from 1980-81 to 1994-95, divided into two sub-periods:

(1) Medium term span of 5 years from 1980-81 to 1984-85 coinciding with the Sixth Five Year Plan and

(2) Long time span of 10 years covering 1985-86 to 1994-95 defined as the long term perspective plan.

A. Core model is composed of the following blocks:

1. Input output
2. Investment
3. Private consumption
4. Financial resources (domestic saving, both private and public)
5. Import
6. Employment
7. Perspective planning.

These blocks are inter-dependent. The degree of inter-dependence differs between the different blocks.

B. Sub models

There are five major sub models. They are

1. Agriculture
2. Exports
3. Demography
4. Autonomous investment and public consumption
5. Long term objectives, with both cardinal and ordinal values.

The agricultural sub model provides estimates of capacity outputs in agriculture which are fed into the core model as exogenous variables. Alternative estimates are made for alternative weather scenarios.

The export sub model estimates export values, sector-wise and time-wise, by econometric, technical and other normative assumptions which again enter as exogenous values in the core model.

Similarly, the demographic model works out by relevant demographic relations, population, its rural and urban break up and the labour force, feeding these as inputs into the core model.

The last two sub-models try to quantify the social and economic goals of the plan as the planners perceive them. They appear as targets in the plan and would enter as exogenous variables into the core model.

There is a separate sub system on material balances, which is used to disaggregate the macro and sectoral dimensions into their detailed physical units and to check overall consistency.

II. 1. Economics of the Model

The model tries to capture all the constraints in the form of equations. Each block of equations represents a class of constraints. They are as follows:

Block (system) of equations	Class of constraints
A	Demand constraint
C	Financial resources constraint
D	Supply/capacity constraint for activity sectors
E	Demand, supply balancing constraint
H	Foreign exchange constraint
I	Land and natural resources constraint
J	Manpower constraint
K	Welfare programme constraint
L	Public sector financial constraint
N	Tax/fiscal constraint
O	Private sector investment financing constraint
Q	Long range perspective Plan ("Welfare" goal) constraint

The remaining blocks of equations B, F, G, M, P, etc., represent the plan assumptions and definitions used in the model.

All these constraints, when formulated as a system of equations, represent a typical case of a non-linear programming problem which can be solved conceptually in the light of an optimising function.

But because of the nature of the planning system in India, with its multistage decision process between central ministries, states and other public private bodies, a large number of endogenous variables of the above system are taken as given decisions (exogenous) in working out the resources allocation process, both intertemporal and intersectoral.

Besides, because of the high non-linearity of the different blocks of the system, a programming solution was found to be very complicated. Therefore, the above system is solved, uniquely, by giving alternative values to the remaining key policy variables until the system is reduced to a state with only one degree of freedom. This is shown in the equation system given in following sections.

By iteration with the imputed alternative values as referred, a maximum growth path is chosen which fulfils all the constraints; theoretically, the growth rate is dictated by the full utilisation of the most constraining sector. In this convergence position, at the minimum, one sector will have zero slack value (i.e., positive duality price). In the case of degenerate solution, more than one sector will have zero slack values.

Described in this form, the model becomes a hybrid of a dynamic inter-temporal input-output model, with effective supply constraints as seen in a programming solution. It runs at constant price in the accounting sense. It incorporates the effects of price changes in the foreign sector by calculating the impact of terms of trade changes on foreign saving. It adjusts domestic resources on the basis of actual (ex-post) price changes. If necessary, it could also accommodate (ex-ante) price changes arising out of projected inflation based on cost considerations. It does not take into account relative price changes in the domestic sector although it is capable of doing so. The algebra of the model and its computation sequence will now be described.

A TECHNICAL NOTE ON THE SEVENTH PLAN OF INDIA (1985-90)

CHAPTER 1

The Model Frame

1.1 The Seventh Plan uses a Model Frame which is an extension of the one used during the Sixth Plan formulation. It has been adopted to incorporate three basic objectives of the Seventh Plan: food, work and productivity. For these, the strategies chosen are (1) a faster growth of agriculture in the Eastern Region of the economy which has a large percentage of small and marginal farmers, a high incidence of poverty and where the agriculture is largely labour-intensive, (2) a significantly high priority in investment allocation to human resources development, infrastructure and science & technology with their implications for improvements in productivity and technology.

The basic model structure and its working are the same as in the Technical Note on the Sixth Plan of India (1980-85). In the present Technical Note we highlight only the major areas where the model is modified.

In brief, the model comprises of a 'core-model' and seven major 'sub-models' viz., agriculture, industry, consumption, poverty, export and import, financial resources and demography and employment.

To begin with, estimates are made of the requirements of the economy (demand) against certain basic objectives of growth, equity and self-reliance as recommended by the National Development Council (N.D.C.) and outlined in the Approach to the Seventh Plan. This is done with the help of an input-output model referred to as a 'core-model'. This core model has been developed, extended and continuously updated since the Fourth Plan. The demand is decomposed into four main groups (i) Demand for consumption, both public and private, (ii) Demand for investment, again separated into public and private, (iii) Demand for exports and (iv) Demand for the intermediate goods. The output levels needed to satisfy these demands are calculated by the input-output model, thereby ensuring a consistency between the different sectors in output structure. However, for ensuring that these outputs are feasible, i.e., there is a matching with their supply capability, several sub-models have been used. The main role of these sub-models is to estimate the supply potentialities of the different sectors *vis-a-vis* (1) the investment allocation made in the different plans (2) the rate of completion of the existing projects and programmes and (3) the utilisation of the capacity available in the course of the implementation of the plan.

The main Model and all the sub-models have two distinctive parts (i) the model structure is presented in the form of system of equations, which estimate the inter-relationships between all major plan variables, like consumption, investment, export, import and the different policy instruments of the Government: (ii) Appropriate estimation procedures are adopted for estimating various paramcters either based on observed behaviour or technology.

1.2 Core Model

The core models consists of:-

(i) a macro economic model;
(ii) an input-output model; and
(iii) an investment model.

Macro economic model consists of a number of national income and expenditure identities and this in combination with input-output model determines investment in the terminal year endogenously. Given a target rate of growth and base year GDP saving and consumption decisions of public and private sector and certain other exogenous variables, macro-economic model determines resources available for investment.

In the input-output model, vectors are developed which correspond to scalars in macro-model for government consumption, gross fixed investment and changes in stock. Private final consumption vector is obtained by making use of consumption/poverty sub-models. Adding together private final consumption vector and exports vector to other final demand vectors, input-output matrices are used to derive sectoral output, import (originating) and value added

profiles. Net indirect tax rates of the base year are incidentally prorated to match indirect tax targets given in the macro-model. Crucial link between macro-economic model and Input-Output model is provided by the value of total imports. Iterative process between macro-economic model and input-output model ends when the value of investible resources in the terminal year coverage to same value in successive runs. Investment model derives investment requirements at broad aggregate sector levels and converts investment by destination into that by origin. In case of mismatch between available resources and required resources for investment, the latter is adjusted by moderating on the post-terminal rates of growth. At the end of a run of investment model, investment by type of assets (Construction, machinery, and equipment and changes in stock) is obtained and this in turn is fed into the input-output model for a re-run. Iterative process for the core and model concludes only when investment level and its asset composition remains the same in successive Iterations.

A few observations on the data base used for the core model are worth mentioning here. For the Input-Output model, coefficient matrices for the technological thrusts of Seventh Plan are based on 115 sector I/O table for 1973-74 of Central Statistical Organisation duly updated and revised. Import use coefficients have been estimated by using information obtained from C.S.O regarding destination and imports and allocations in proportions to total input use flows among identified destination sectors, moderated to reflect import substitution compulsions of Seventh Plan. Capital coefficient matrix and ICORs have drawn heavily on past observations, findings of the Working Group on ICORs for Seventh Plan, material obtained from CSO and in the light of Seventh Plan emphasis on completion of existing projects rather than new starts.

1.3 Interaction between sub-models and the core model

Sub-models are constructed to go into details of certain phenomena that are complementary to the core input-output model. Some of these sub-models are precursive to the main model, like demographic projections and assumptions of saving behaviour of different institutions in the economy. Certain other sub-models are recursive like the employment. By its very specification the core model excludes certain variables like land and water, aggregates certain commodity production activities like the petroleum sectors; assumes some variables as given exogenously for example export vector. Sub-models have been constructed to pay the attention which is technically necessary but which is not at present integrated in the main input output model.

Agriculture sub-model goes into the allocation of land area among different uses and also distribution of irrigated area among different crops. These two basic inputs into agriculture taken together with desired fertiliser application results in agricultural output as determined from the supply side. The emphasis of the Seventh Plan on the faster development of agriculture in the eastern region of the country has also been given a special dimension in the agriculture sub-model. Supply potential of the agriculture sectors as derived from the agriculture sub-model is contrasted with the agriculture output from the demand dominating input-output model and the two are brought together by suitable variation either in the supply or demand variables.

Poverty sub-model captures the income distribution process which underlies the main input-output model. Certain anti-poverty programme like IRDP, NREP and RLEGP which have direct impact on the income distribution are also accounted in the poverty sub-model. This model is used to set the poverty target and in conjunction with the consumption sub-model it generates the private consumption vector which is used in the input-output model.

Employment sub-model estimates employment generation implied by the plan activities based on the output projected in the main model for non-agriculture sectors and land allocation made in sub-model estimates the investible resources for the plan period and its sources. It throws light on the saving propensities of the public and private sectors which determine aggregate saving used in the macro model.

Export sub-model determines the export vector which is exogenous to the input-output model. The export vector which is derived in the export

sub-model takes into account balance of payment situation forecast during the plan period and certain assumptions on the performance of the rest of the world which obviously is external to the main model. It must be borne in mind that apart from linkages with the main input-output model sub-models are also linked among themselves in particular ways. This is especially true of the group of sub-models consisting of poverty, demography and employment and agriculture. For completeness various sub-models are summarised in what follows:

1.4 Sub-Models

1.4.1. *Agricultural Sub-Models*

The need for agricultural sub-model arises because certain critical inputs in agriculture such as land and water (irrigation) cannot be adequately captured in the input-output framework. In addition, special locational aspects of agricultural developments in Seventh Plan as contained in its strategy of faster development of eastern region merit particular attention in a sub-model framework.

The demand targets of foodgrains output (cropwise) are based on the Consumption sub-model which takes into account the consumption for people below and above the poverty line separately for rural and urban areas and associated requirements for inter-industry use and stocks through input-output model. These targets are examined for their feasibility using Agricultural Sub-model by relating the production with the area and its composition into irrigated and unirrigated parts. In the Seventh Plan, all relevant parameters have been estimated separately also for Eastern Region. This has been done in order to incorporate specific policy changes designed for the Eastern Region.

1.4.2. *Poverty Sub-model*

Poverty sub-model captures the income distribution process underlying Seventh Plan and estimates the number of people crossing the poverty line through the combined effects of general economic development and anti-poverty programmes articulated in the plan strategies. The concept of poverty line used in the Seventh Five Year Plan together with the consumption basket of the persons near the poverty line and the price rise in the consumption basket between 1973-74 and 1983-84 are also discussed. Based on the All-India poverty line, the estimates of percentages of persons below the poverty line statewise and alsc for Scheduled Castes and Schedule Tribes are also presented for the periods 1977-78 and 1983-84.

1.4.3. *The Industry Sub-Model*

The structure of this sub-model is the same as has been used in the Sixth Plan. This material balance approach has been an essential feature in our planning since the Third Plan. It has helped in assessing the feasibility of targets stipulated mainly from the demand estimates derived by the input-output model. In these material balances apart from major manufacturing activities coal and power are also included.

1.4.4. *Consumption Sub-Model*

This model attempts to forecast the demand for different goods and services for private consumption, given a certain growth pattern of the economy, a projected growth in population, its rural-urban composition and a base period consumption distribution. Subsequently, the consumption patterns are adjusted in the light of likely changes in income distribution resulting from specified redistributive policy measures proposed by the Government for the future.

For estimating the consumption demand for different goods and services, econometric estimations of expenditure elasticity of demand are derived from the past data. For this purpose, LES consumption functions are used. In the model, the private consumers have been divided into four segments - rural, urban separately for below and above the poverty line. A very detailed modelling is done for assessing the poverty cut-off point in each plan and the pattern of distribution of consumption below and above poverty line. Both time series and cross section information has been used for estimating the consumption behaviour of

these four segments of population.

The consumption distribution over time is changed on the basis of specific poverty alleviation programmes like IRDP, NREP and RLEGP. On the basis of coverage, the amount of subsidy and financial backing per household, the identification of the beneficiaries from the population, the nature of activities chosen in the programme, and the number of man-days employment made available to them with the minimum wage rates, a detailed model is used to estimate the improvement in per capita consumption of all the poor, together with the number of people crossing the poverty line.

The consumption basket estimated in this procedure is dovetailed with the main model, again to ensure supply-demand balances. In case of a mismatching, other policy measures are worked out which will enable necessary adjustment either in the consumption behaviour of the consumers or in the production structure (supply constraints) of the economy. Finally, it will ensure equilibrium by iterative processes between the main model and consumption sub-model.

1.4.5. *Investment Planning Sub-Model*

For projecting investment by destination, econometric simulation model has been used. Later on these estimated investments by destination are converted into sources by the use of a capital flow matrix. Finally, they are dovetailed with the main input-output model to check their consistencies.

For the purpose of the plan exercises investment has been separated into 11 national income subgroups. Besides, they have been also separated between public and private sectors.

The parameters relating to investment to output ratios are estimated from time series given by the national income accounts. Parameters are changed in the light of productivity improvements by relating them to specific policy measures of the Government or to specific technological, engineering and organisational information available. They have been separately done for the public and private sectors. However, in order to assess their feasibility or deviation from the past, implied capital output ratios by the conventional methods for the future years from the projected time series are estimated. The conventional ICOR is defined as investment divided by increase in value added over any given period of time.

1.4.6. *Export-Import Sub-Model*

The Plan projections for exports are done in this sub-model. The functional relation in this model. The functional relation in this model and the estimation procedures are almost the same as in other sub-models, i.e., it is a simulation model and parameters are basically estimated by econometric estimation procedures derived either from time series or from cross section. It has three specifications in estimating the future export projections:

(1) Certain exports are seen to be dependent on domestic production capability and therefore their volume of export is derived by calculating exportable surplus.
(2) Certain exports are dependent on world demand, their relative prices and the degree of India's penetration into the international market.
(3) Certain exports of new commodities where past data are not available for making econometric estimation, their growth potentialities are derived from the documentations of the export promotion councils, their export organisations and by appropriate judgemental factors.

Given the exogenous policy packages, their impacts on exports are assessed and built into these projections, when the final plan scenario is chosen.

Imports have been separated into three groups: foodgrains imports, bulk imports and non-bulk imports. The bulk imports include 20 major items, mostly canalised. Non-bulk imports mainly include machinery and other engineering products. The import requirements are estimated partly in the main model (the input-output frame) and partly in the import-export sub-model. The non-bulk imports are determined by a simulation model where standard econometric methods are used for estimating major parameters.

The bulk imports are derived as a residual after

subtracting domestic production from demand, as determined in the base year. But in the plan run, given the availability of foreign exchange and the broader industrial policy of the Government they are revised. Import substitutions are built in either by restraining domestic demand or by using different policy measures to increase the outputs. Regarding non-bulk imports, keeping in view the overall trade and industrial policy of the Government *vis-a-vis* import liberalisation, export promotion and productivity increase, their elasticities are properly adjusted over the plan period. Overall foreign exchange constraint has, however, acted as the binding factor for choosing the final plan imports.

Any choice between alternative import allocation and their effects on balance of payments and the growth of the economy have been explored by choosing from several alternative scenerios.

Keeping in view the uncertainties, specially due to weather and changes in terms of trade which have been experienced often in all other earlier plans, a provision for contingency import has been built into the import sub-model. The level of contingency, however, has been very much conditioned by foreign exchange availability rather than strictly on a requirement basis, considering all possible uncertainties in the future.

1.4.7. *Financial Resources Sub-Model*

The main model estimates the requirements of output in the different sectors, given a certain development scenario. In the financial sub-model, attempts are made to estimate the financial resources available to support these necessary investment requirements. In this attempt, not only the financial requirements and availabilities are assessed by destinations, i.e., production sector-wise, but also by the needs of different institutions like private, corporate, public, household and financial institutions. The estimation of financial requirements in this sub-model is to be done simultaneously with the main model since savings are generated by income (Financial Resources Sub-Model) and income is augmented by saving (main model).

This sub-model also has two stages: a base scenario and a finally selected scenario. This is again an econometric model where the behaviour from time series and cross-section are estimated and subsequently suitably changed, in response to contemplated changes in the fiscal, monetary and other economic policies for the Seventh Plan.

The financial sector sub-model again can be broadly divided into three groups (a) for the public sector, (b) for the private sector separated between corporate and non-corporate, and (c) for the rest of the economy. In the Seventh Plan a further detailed flow of funds system has been developed bringing explicitly the role of financial institutions. For the household sector, the behaviour is largely related to disposable income and rate of inflation and composition of the savings has been disaggregated into currency, deposits with the banks, life insurance, small savings, provident funds, corporate securities, cooperative shares, etc. For the corporate sector they have been estimated separately for own saving from the non-corporate and household sector. An elaborate modelling for the public sector saving has been also attempted, separated into budgetary savings and surplus from public enterprises. For the foreign sector, the information on capital inflow including invisibles are supplied by RBI and Ministry of Finance. These latter information are obtained from other Ministries and then are fed into our models. The operation of capital market and flow of funds between financial institutions and other sectors have also been formalised.

1.5 The Parameter Estimation

The above model system runs on the basis of a set of lagged endogenous variables, a set of relevant parameters and selected exogenous variables including the policy variables. The basic set of parameters in the core model are the input-output coefficient matrix, the capital output ratios. Besides, there are other parameters relating to different sub-models. They are mainly referring to consumption propensities/expenditure elasticities, all demography related parameters, functions relating to costs and use of natural resources, transport coefficients, etc. The basic parameters of the I/O table are based on 1973-74 I/O table of 115 sectors brought out by C.S.O.,

updated by RAS method. The ICORs of the different sectors are presented for the Fifth Plan, Sixth Plan and Seventh Plan (projected). They are based on econometric estimations on the past data on capital output ratio worked out by the Working Group, constituted in connection with the Seventh Plan.

As it can be seen from these tables, the value added ratios are declining fast in agriculture and in general in many other sectors. A general decline in the value added ratios is the experience of most developing countries and it reflects the interdependence and roundaboutness in the production system. For agriculture it reflects a modernisation when more and more fertiliser and irrigation inputs are presented with 11 sector disaggregation for the Seventh Plan and comparable figures for the Sixth Plan. As is evident after adjustment for the low base of 1979-80 the growth rates in the Seventh Plan are in line with what has been achieved in the Sixth Plan. Sectorwise it has been made significantly higher in manufacturing, construction, railways and mining. This is the reflection of a high priority that has been given in the Seventh Plan for industrial development and development of infrastructures.

EIGHTH FIVE YEAR PLAN EXECUTIVE SUMMARY*

The Eighth Plan is being launched at a time which marks a turning point in both international domestic economic environment. All over the world centralised economies are disintegrating. On the other hand, economies of several regions are getting integrated under a common philosophy of growth, guided by the market forces and liberal policies. The emphasis is on autonomy and efficiency induced by competition. We cannot remain untouched by these trends. If planning has to retain its relevance, it must be willing to make appropriate adjustments. It may be necessary to shed off some of the practices and precepts of the past which have outlived their utility and to adopt new practices and precepts, in the light of the experience gained by us and by other nations.

The Backdrop

2. The Indian economy has been beset with many problems and difficulties. Poverty has been one of the major problems. The problem of poverty could not be tackled through growth, which itself was slow over a long period time. Hence, direct intervention through poverty alleviation programmes became necessary. Self-employment and wage-employment programmes were taken up in the Government component of the public sector plan. But the constraints on Government resources permit only a limited role for such programmes. Moreover, the orientation in these programmes has shifted from building assets of durable nature to providing relief jobs, and the programmes are beset with tremendous amount of leakages.

3. A sustained high growth rate has taken the Indian population to new heights. The 1991 Census revealed a population of 844 million. Such dizzying rate of population growth negates whatever gains the nation has been able to achieve in agricultural, industrial and services sectors. Also, this leads to an unbearable burden on health, education and housing sectors. If this trend is not halted, it will never be possible to render social and economic justice to millions of our masses.

4. The growing unemployment has been a major problem of the eighties and is going to be even worse in the nineties. Provision of employment to all the job-seeking persons is going to be a major challenge for the planners during this decade.

5. The entire population does not have access to all the basic necessities of life - drinking water and health facilities, in particular. Infant mortality is still high and literacy levels, particularly among the women are low. The social infrastructure has to be attended to with a degree of urgency in the next phase of development.

6. There has been a marked acceleration in

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urbanisation over the past two decades. If the present trends continue, urban population may account for about one-third of the total population by the turn of the century. Urban infrastructure, even at a minimum level, for this size of population will need considerable resources.

7. Although in the eighties some signs of improvement in certain less advanced States have been observed, regional disparities continue to exist. Development institutions and organisational capabilities in the backward regions of the country and the delivery system for development programmes would need to be strengthened to deal effectively with the problems of development and redistributive justice.

8. Technological change in agriculture has led to increases in cropping intensities. But, in areas of developed agriculture, further absorption of labour is declining and there is need for greater economic diversification. In the face of the shrinking size of average holdings, the special needs of inputs, capital, processing and marketing for small land holdings should be paid attention.

9. From the point of view of long-range sustainability, the need for greater efficiency in the management of natural resources - land, water, minerals, etc. - has become urgent. A vigorous effort has to be made for recovering the wastelands and extending the green cover. A package of incentives to promote efficiency in the use of nature-based resources needs to be devised as a matter of priority. Energy use efficiency and energy conservation need particular attention in view of expanding needs and shrinking sources of fossil fuel.

10. There is a high backlog in the provision of social consumption needs of the people, particularly the rural people and the poor. There is a reduced, but still unacceptably high level of poverty and hunger in the country, with high concentration in some regions. Illiteracy, particularly among women, is very high. There is high incidence of infant mortality. Decadent social practices like scavenging still prevail in large parts of the country.

11. The imperatives of growth in the face of these challenges require an innovative approach to development which is based on a re-examination and reorientation of the role of the Government, the harnessing of the latent energies of the people through people's involvement in the process of nation building and the creation of an environment which encourages and builds up people's initiative rather than their dependence on the Government and which sets free the forces of growth and modernisation. The State has to play more of a facilitating role and has to concentrate on protecting the interests of the poor and the underprivileged.

Objectives

12. In the light of the trends outlined above, the approach to the Eighth Plan will have the following fourfold focus:

(i) Clear prioritisation of sectors/projects for investment in order to facilitate operationalisation and implementation of the policy initiatives taken in the areas of fiscal, trade and industrial sectors and human development;

(ii) Making available the resources for these priority sectors and ensuring their effective utilisation; and completion of projects on schedule avoiding cost and time overruns;

(iii) Creation of a social security net through employment generation, improved health care and provision of extensive education facilities throughout the country; and

(iv) Creation of appropriate organisations and delivery systems to ensure that the benefits of investment in the social sectors reach the intended beneficiaries.

13. Based on this approach, the following objectives will be accorded priority:

(i) Generation of adequate employment to achieve near full employment level by the turn of the century;

(ii) Containment of population growth through active people's cooperation and an effective scheme of incentives and disincentives;

(iii) Universalisation of elementary education and complete eradication of illiteracy among the people in the age group of 15to 35 years;

(iv) Provision of safe drinking water and primary health facilities, including immunisation, accessible to all the villages and the entire population, and complete elimination of scavenging;

(v) Growth and diversification of agriculture to achieve self-sufficiency in food and generate surpluses for exports;

(vi) Strengthening the infrastructure (energy, transport, communication, irrigation) in order to support the growth process on a sustainable basis.

14. The Eighth Plan will concentrate on these objectives keeping in view the need for (a) continued reliance on domestic resources for financing investment, (b) increasing the technical capabilities for the development of science and technology, (c) modernisation and competitive efficiency so that the Indian economy can keep pace with and take advantage of the global developments.

15. Human development will be the ultimate goal of the Eighth Plan. It is towards this that employment generation, population control, literacy, education, health, drinking water and provision of adequate food and basic infrastructure are listed as the priorities. The provision of the basic elements, which help development of human capital, will remain the primary responsibility of the Government.

16. It also needs to be recognised that in addition to the generation of new stable employment opportunities of the order of 10 million per year, which will take care of the open unemployment, it should be ensured that those underemployed and employed at very low levels of earnings, are able to raise their productivity and income levels. Upgradation of technologies of the self-employment in the traditional and unorganised sectors and improved access to credit and markets would need to be ensured. It would also be necessary, in the meantime, to continue programmes for providing supplementary work to the underemployed poor in infrastructure building and other activities.

17. The country will cross 1,000 million population mark by the year 2001. This trend has to be halted. The Eighth Plan will make vigorous efforts to contain the population growth.

18. Health facilities should reach the entire population by the end of the Eighth Plan. The 'Health for all' (HFA) paradigm must take into account not only the high risk vulnerable groups, i.e., mother and child (as done so far) but must also focus sharply on the underprivileged segments with the vulnerable groups. 'Towards Health for the Underprivileged' may be the key strategy for the H.F.A. by the year 2000, a declaration to which India is a signatory.

19. The accessibility of drinking water supply to the people will have to be progressively improved upon. Water quality monitoring is to be streamlined and given proper emphasis to ensure safe drinking water. Simultaneously, steps will have to be taken for replacement and rejuvenation of drinking water sources. Measures for conservation of water and recharge of aquifers have to be implemented on a larger scale to provide for sustained supply of water.

20. Achievement of a high growth rate and sustaining it over the decade will be an important goal of the Eighth Plan. Employment generation and poverty alleviation objectives are ultimately related to growth. However, the growth has to be accompanied with a sharper regional focus of reduced disparity and more dispersed benefits. The backward regions and the weaker sections of the society, if not protected fully, are more likely to be left behind in the natural process of growth. Adequate protection will have to be continued to be provided to the poor and the weaker sections of the society. Adequate food supply, control on inflation, effective working of public distribution system and developmental programmes which generate adequate employment are among the main components of the strategy to take care of the poor. Similarly children and particularly the girl child need to be paid particular attention. One of the targets in this context would be to equalise the enrolment and retention rate of the girl child with that of the boy child through the elementary education period.

21. It is clear that a strong and vibrant public sector cannot be one with financially weak foundations. For the public sector to perform the role expected of it in the 90s the issue of loss making public sector enterprises will have to be squarely addressed. A policy of the Government meeting the cash losses of so many enterprises for all times to come is just not sustainable. This prevents scarce resources from being used in high priority social sectors or in economic activities that promise a return. Efforts must be made to

restructure and revitalise public sector units which are potentially viable through infusion of new technology, rationalisation of labour and even infusion of resources for diversification or modernisation. Equally, patently unviable PSUs may have to be closed down with suitable social safety net mechanisms, including retrenching and redeployment, being devised to protect the interests of workers. It should be recognised that in many cases the very rationale of the public sector entering certain industrial areas needs to be re-examined. There may have been very good reasons in the past for the public sector to take the initiatives in industrial areas where the private sector would ordinarily either not enter or would hesitate to do so. This may not be the case today and the restructuring of the public sector would essentially entail vacating such areas for private sector initiatives in coming years. Recent Government policies have already vacated large areas for private sector initiatives and this process of restructuring and reform would need to be carried further.

People's Institutions

22. Our primary task is to build up and strengthen the institutions with which people are directly involved. The small community and village level institutions could be regarded as the cellular institutions, of which the entire body of the nation is built. Accordingly, the Eighth Plan lays greater emphasis on institution building. It envisages that people's initiative and participation should be made a key element in the process of development. A lot in the area of education, literacy, health, family planning and development of land and forests can be achieved by creating people's movement for these activities.

Role of Government

23. The role of government should be to facilitate the process of people's involvement in developmental activities by creating the right type of institutional infrastructure, particularly in rural areas. These institutions are very weak particularly in those States where they are needed the most for bringing about an improvement in the socio-demographic indicators. Encouraging voluntary agencies as well as schools, colleges, and universities, to get them involved in social tasks and social mobilisation, strengthening of the Panchayat Raj institutions, reorientation and participation of all the village-level programmes under the charge of the Panchayat Raj institutions, and helping the co-operatives to come up in the organisation and support of local economic activities, for example, are some of the steps which the Government must earnestly initiate. A genuine push towards decentralistion and people's participation has become necessary.

The Planning Process

24. Planning and market mechanism should be so dovetailed that one is complementary to the other. Market mechanism must serve as an "efficiency promoting device", while planning will be the larger guiding force, keeping the long term social goals in the perspective.

25. Planning in so far as it relates to the public sector has to be detailed, setting forth not only the objectives but also examining the alternatives and identifying specific projects in the various sectors. Besides, the Plan of the Centre will have to be appropriately linked with the State Plans as both the Centre and the States have responsibilities in almost all areas. All this is analogous to corporate planning. For the rest of the system, however, the Plan will be indicative outlining the broad directions in which the economy should be growing. The Plan will, therefore, consist of (a) providing a vision of the future, (b) constructing economy, (c) evolving a system of information pooling and dissemination, (d) identifying areas of development where the country needs to build up strengths, (e) evolving appropriate policy measures to achieve the desired goals and (f) ensuring a degree of consensus in the system through meaningful dialogue with 'social partners' of the Government, namely, the farmers, the trade unions, the business group, etc. In a more deregulated environment, policy formulation and coordination will assume greater importance.

26. As a corollary to this, the role of Planning Commission needs to be redefined. It has to play an integrative role in developing a holistic

approach to the policy formulation in critical and inter-sectoral areas of human and economic development. In the social sector, schemes have to be subjected to coordinated policy formulation. The existing multiplicity of agencies is not only wasteful but also counter-productive because of the long repetitive procedures and the diffusion of authority involved. An integrated approach can lead to better results at much lower costs.

Development Perspective

27. Some of the major concerns to be taken care of by the pattern and the pace of growth in the long run are:

(i) Need for expanding employment in the face of ever-diminishing elasticity of employment to output growth, particularly in the processing and manufacturing activities;

(ii) Need for maintaining "food security";

(iii) Ensuring that the vast differential between average agricultural incomes (and productivity) and non-agricultural incomes (and productivity) narrows down;

(iv) Need for meeting the social needs and minimum requirements of the population within the ambits of a prudent fiscal system;

(v) A realisation that in the past mere investment in quantitative terms did not necessarily mean the economic and social benefits trickling down to the poor masses leading to visible improvements in terms of standard of living and income for which social measures are necessary.

28. An important imperative of growth in the face of basic resource constraints is that the best of the technology is used in every economic activity and more particularly in those activities which are related to the processing of basic raw materials, manufacture and conversion of fuel into energy. This is cost-saving and also resource-saving in the ultimate analysis. However, the technology mostly comes embodied in machines, i.e., capital equipment and makes the production processes capital-intensive as well as labour-replacing. The process which economises most on the use of energy, avoids wastages of raw materials and reduces the time span of processing, also tends to involve more automation and thus saves on labour use. The higher the pace of growth we desire, the more advanced is the technology we need to adopt, and consequently the lower is the elasticity of labour absorption to growth. This trend has been observed in the development history of most of the countries. Recent experience of trends in labour absorption in manufacturing in India also conforms to this. In the perspective of the next 15 years or so, population will still be rising at a significant rate and there will be substantial additions to the labour force. While the per capita income and productivity will definitely increase, it does not follow as a matter of course that all those seeking jobs will get jobs. Special care will have to be taken and policies devised for making jobs available to all, which is a national goal. This would be possible by broadly following two strategies in the long run.

29. The first strategy is related to using the foreign trade, i.e., imports and exports for balancing the internal production and demands in such a way that we tilt our structure of production more in favour of employment intensive industries and exchange its products with the imported products which are less employment intensive.

30. The second strategy would be to facilitate and encourage the creation of services which are productivity-raising for the economic system as a whole. Transport, trade, and a variety of professional services are examples of such services. Services by their very nature are more labour absorbing. This has been the historical experience of many countries.

31. The development of under developed agriculture in large parts of the country will create demand for additional labour during the period in which agriculture gets transformed from a less developed to a highly developed stage. Depending on the intensity of our efforts and investments, this transformation may take anywhere around 10 years. And hence, during this period agriculture does offer additional opportunities for labour absorption as industry has shown in recent periods. In fact, at present

the agriculture in North-West India is already showing such tendencies.

32. Maintaining food security and relative self-sufficiency in food production is a strategically desirable long-term goal for the country. A reasonable degree of food self-sufficiency or supply of "wage goods" is seen to have a very positive influence on stability and growth even in our limited experience of development. It may be largely due to the factor of relative food self-sufficiency, among others, that India achieved a higher rate of growth and better economic stability and resilience during the Eighties. This was the only decade as a whole when we felt somewhat comfortable on the food front. Hence, it seems appropriate that food self-sufficiency remains an important element of the strategy of development even in the perspective of a period of next fifteen years or so.

33. Food security implies not only sufficient supplies but also supplies at prices affordable by the poorer sections of the society. Appropriate institutional mechanisms, such as a public distribution system, sharply focussed on the poorer sections should be put in place to protect the poor from the rise in food prices. However, this task would be rendered difficult if food prices in general rise very sharply.

34. A moderate increase in food prices consistent with remunerative returns to the farmers should be the desired objective. In order to enable farmers to earn higher incomes a combination of processing and business activity with the farming activity is necessary. In other words, farming must be encouraged to grow into "agri-business". In order to bring this about, efforts will be required in building the infrastructure and creating conditions for the growth of agri-business. Innovative organisational methods and forms in which large number of small farmers could come together to take advantage of the economies of scale which are important for agro-processing and agri-business are needed. This direction has to be kept clearly in view while evolving the pattern of long term growth. The Eighth Plan will take some major steps in this direction.

35. Our areas of strength which can be developed further are:

(i) Ability to perfect production techniques if an adequate scale of demand (offtake) is assured (e.g., power equipment and the conventional machine tools and bulk commodities such as sugar and cement).

(ii) A stock of skilled manpower that can sustain a high growth in manufacturing and in the services sectors;

(iii) A reserve of unexploited natural resources in hydel power, natural gas, atomic minerals;

(iv) An expanding consumer market for goods and services which can afford scale advantages in consumer durables, telecommunication, transport and certain commercial services;

(v) Existence of a base of a diversified modern infrastructure, like electricity, transport, repair services, communication, education, banking and a variety of professional and technical services. This base can gain strength and grow, given the right type of environment;

(vi) A well developed capital market from which massive resources can be raised on the strength of attractive projects.

36. These advantages can be used in manufacturing the bulk commodities such as sugar, cement and petrochemicals duly supported by import of technology (and capital). These advantages can also be used to integrate better with the more open developing economies (Far East and Latin America) and expand the output of simpler ancillary equipment and components for the capital goods and consumer durables supplied by them to the Japanese, American and European markets. We could establish linkages with the leading marketing chains for clothing and other consumer items and manufacture according to the designs specified by them. We can also plan for economic benefits from the availability of skilled manpower in "information technology" and "computer software" by organising the availability and utilisation of such manpower more effectively.

37. Since resources are limited, we should avoid channelising our resources to the activities where

the nation cannot in the long run have a comparative advantage. Examples of areas that we can progressively vacate and utilise the imports options are ship building, atomic power equipment, technology intensive electronic components, i.e., chips and metallurgical industries except in the context of specific markets abroad.

38. In building strengths in areas in which we have comparative advantage, we need to pay particular attention to technology. The long term objective is to evolve a technology mix in production which conforms to our resources and needs. The experience in the past shows that wherever our thrust was purposive with clear perspective of economic options and goals, we achieved results. Notable successes have been in agriculture and to an extent in the application of medical research. In these areas, we set about the task with the establishment of purpose-oriented research network and institutions, put in necessary investments with a certain degree of liberalism in imports of essential equipment, etc.

The research done in the laboratories was in accordance with our needs which could be successfully translated into economic benefits. Similar approach is required in the fields of industry and energy. These areas did not benefit to the same extent from research in the past, since technological excellence was, in general, pursued in isolation from the economic needs. The result was that scarce resources got tied up for a longer period due to the gap between research effort and a reasonable scale of economic benefits. Institutional reform has to be brought about in technology development. A variety of institutional set-ups (models) have been tried in the past. The successful ones need to be emulated. The role of the public sector in technology development should be confined to areas of high strategic significance on considerations of national and long-term economic security.

39. Identification of areas in which we have comparative advantage and channelling the resources to those areas are an integral part of planning. This is an ongoing process. Positive efforts will, however, be needed to convert potential areas of strength into reality. In an increasingly deregulated environment, while individual economic agents will make their own decisions where to expand, it should be possible through a mix of policies to steer the economy along desired direction. This, indeed, is the positive role of planning.

Macro-Dimensions

40. Macro-economic and sectoral implications of alternative rates of growth in the Eighth Five Year Plan were considered by the National Development Council (NDC). The NDC approved, in December 1991, a growth target of 5.6 per cent per annum for GDP. More detailed exercises and availability of further information since then indicate that this growth is feasible. Some of the macro implications of the target rate of growth are set out in Table 1.

TABLE-1: IMPLICATIONS OF TARGET RATE OF GROWTH DURING THE EIGHTH PLAN (1992-97)

GDP Growth Rate (% per annum)	ICOR	Average Rate of Domestic Savings	Current Account Deficit	Average Rate of Investment
		(Per cent of GDP at market price)		
5.6	4.1	21.6	1.6	23.2

ICOR - Incremental Capital Output Ratio
GDP - Gross Domestic Product

41. The macro-economic aggregates and macro-parameters for the Eighth Plan are presented in Table 2 and 3. It will be seen that an improvement in the rate of saving is expected. The marginal rate of savings over the Eighth Plan would be 23.7 per cent. Investment rate would be only marginally higher than the average of the last seven years. The current account deficit as a proportion of GDP is projected to decline. This will have a more favourable impact on foreign debt accumulation and debt service ratio. The Eighth Plan is expected to bring about a significant improvement in export performance.

TABLE-2 : MACRO AGGREGATES FOR THE EIGHTH PLAN
(1992-97)

(Rs Crore at 1991-92 prices)

Item	1991-92	1996-97 (Target)	Total 8th Plan
(1)	(2)	(3)	(4)
1. GDP at Factor Cost	5,19,716	6,82,473	30,69,138
2. GDP at Market Prices	5,82,356	7,64,730	34,39,053
3. Gross Domestic Savings	1,25,789	1,65,182	7,42,835
4. Private Consumption	3,89,211	5,04,000	22,66,530
5. Gross Domestic Capital Formation	1,40,348	1,72,295	7,97,698
6. Foreign Savings @	14,559	7,113	54,863
7. Export of Goods **	44,292	83,869	3,30,153
8. Export of Goods and Non-Factor Services**	55,762	1,02,366	40,734
9. Imports of Goods**	62,345	93,314	3,99,650
10. Imports of Goods and Non-Factor Services**	72,848	1,12,797	4,77,128

Note: Foreign trade figures for 1991-92 are estimated as normalised base for projections during the Eighth Plan.
@ The abnormally low imports in 1991-92 compared to 1990-91 resulted in lower foreign savings than the normal base which is shown here. Preliminary RBI data indicates foreign savings of Rs 9,000 Cr. but the national accounts data is not yet available for the year.
** Exports and Imports projections for 1991-92 are the normalised projections, since the actuals are expected to be exceptionally low in this year.

TABLE-3 : MACRO PARAMETERS FOR THE EIGHTH PLAN (1992-97)

Rates/Ratios	Seventh Plan (1985-90)	Seven years including seventh plan (1985-92)	Eighth Plan (1992-97)
(1)	(2)	(3)	(4)
1. Rate of growth in GDP (% per annum)	5.8	5.3	5.6
2. Domestic Savings (% of GDP)	20.4	20.7	21.6
3. Investment (% of GDP)	22.7	23.0	23.2
4. Current Account Deficit (% of GDP) @@	2.4	2.4	1.6
5. ICOR	3.9	4.3	4.1
6. Growth Rate in: Exports of Goods (% per annum)	# 8.1	*8.5	13.6
Imports of Goods (% per annum)	10.0	*7.5	8.4

@@ In the Seventh Plan, the interest paid on NRI deposits was not included as part of Current Account Deficit (CAD) since RBI released the NRI capital inflow data after accounting for the interest paid. The CAD projection for Eighth plan includes the interest paid on NRI deposits, as an item of non factor services. Current Account Deficit and the rate of domestic saving do not exactly add up to rate of investment in this table because of rounding of errors.
# This is estimated on the basis of National Accounts Statistics for five years of the Seventh Plan period. As per D.G.C.I & S. quantum index, the estimates are 7.6% for Plan period and 11.6% during the last four years of the Seventh Plan.
* These represents only six years average since the year 1991-92 has been an abnormal year in respect of foreign trade.

42. An outlay of RS 4,34,100 crore is planned for public sector. This will have an investment component of Rs 3,61,000 crore and a current outlay component of Rs 73,100 crore.

The public sector investment, then, will amount to 45.2 per cent of the total domestic investment, allowing for a much larger space for the private sector than has hitherto been given. The sectoral pattern of investment and its financing in the Eighth Plan is presented in Table 4.

TABLE-4 : SECTORAL PATTERN OF INVESTMENT AND ITS FINANCING IN THE EIGHTH PLAN (1992-97)

(Rs Crore at 1991-92 Prices)

Sector	Sources of financing the Investment			Investment	Current Outlay	Aggregate Outlay
	Own Saving	Transfer from Household Sector's Savings	Rest of the world			
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1 Public Sector	68,900	2,58,400	33,700	3,61,000	73,100	4,34,100
2 Private Corporate Sector	68,930	58,770	21,300	1,49,000		
3 Household Sector	6,05,170	-3,17,170		-2,88,000		
	7,43,000		55,000	7,98,000		

43. The distribution of public sector Plan outlay of Rs 4,34,100 crore between the States and the Centre is arrived at on the following considerations:

i) A careful evaluation of the resource position of the Centre and the States and the need to maintain a certain degree of fiscal discipline;

ii) The need to improve the share of States in the public sector plan since important sectors like agriculture, (irrigation), health, education and other programmes contributing to human development are mainly the responsibility of the States.

iii) The requirement of investment in the Central Plan for the development of basic infrastructure for sustaining long-term growth, such as petroleum, coal, railways and telecommunications, etc.

TABLE-5 : SHARES OF CENTRE AND STATES IN PUBLIC SECTOR PLAN OUTLAY

(Rs Crore)

Item	Annual Plan 1991-92 (At current prices)	Annual Plan (1992-93) (At current prices)	Eighth Plan At 1991-92 prices
1. Central Deptts.			
1.1 Outlay	42,969	48,407	2,47,865
1.2 Budgetary Support	19,015	18,501	1,03,725
1.3 IEBR	23,954	29,906	1,44,140
States & UTs			
Outlay	28,110	32,291	1,86,235
2. Union Territories			
2.1 Outlay	1,282	1,291	6,250
2.2 Budgetary Support	1,282	1,291	6,250
3. States			
3.1 Outlay(1)	26,828	30,000	1,79,985
3.2 Central Assistance	13,428	14,820	78,500
3.3 States own Resources	13,400	15,180	1,01,485
Total Plan outlay (1.1 + 2.1 + 3.1)	71,079	76,698	4,34,100

(1) Includes outlay for Area programmes

Consistent with the expected resource position, the size of the States' Plans is projected at Rs 1,79,985 crore and the Central Plan at Rs 2,54,115 crore (including Rs 6,250 crore for the UTs). These are shown in Table 5. The share of the States in the public sector Plan which has been declining through the Fifth, Sixth and the Seventh Plan, is sought to be raised from realised level of 39 per cent in the Seventh Plan to 41.5 per cent in the Eighth Plan. The States will be required to improve their resources, curb expenditure and improve and realise a positive contribution to the resources from their enterprises particularly in the electricity and transport sectors.

Savings & Plan Finance

44. The rate of savings is projected at an average of 21.6 per cent of GDP during the Plan period. The realised average rate of savings was 19.7 per cent of GDP during the Sixth Plan and 20.4 per cent during the Seventh Plan. The slow pace of increase in domestic savings during the eighties as compared to the rate of improvement in savings in the earlier decades is accounted for by two factors. While the savings of the household sector has shown a smaller rise than in the previous decades partly influenced by the larger availability of consumer goods, both durable and non durable, the savings of the government sector has a sharp deterioration. The rates of savings during the Sixth and the Seventh Plans and the projected rates of savings for the Eighth Plan are shown in Table 6.

TABLE-6 : RATES OF SAVINGS

(As percentage of GDPmp)

Item	(At Current Prices)			Projected (At 1991-92 Prices)	
	Sixth Plan	Seventh Plan	Average of 7 years 1985-86 to 1991-92*	1991-92	Eighth Plan (1991-97)
(1)	(2)	(3)	(4)	(5)	(6)
1. Public Sector (1.1 + 1.2)	3.69	2.33	2.00	1.44	2.00
1.1 Govt Sector	1.10	-1.36	-1.74	-2.37	-1.11
1.2 Public Enterprises	2.59	3.69	3.74	3.81	3.11
2. Private Corporate Sector	1.63	2.04	2.15	2.39	2.00
3. Household Sector	14.33	16.00	16.60	17.77	17.60
4. Gross Domestic Savings (1 + 2 + 3)	19.65	20.37	20.75	21.60	21.60

Notes: (*) Based on data from Quick Estimates for 1990-91 and projections for 1991-92.
Abbreviation: GDPmp = Gross Domestic Product at market prices.

45. The public sector Plan relies heavily on a larger availability of internal resources of the enterprises. Many of the public enterprises, such as the financial enterprises, airlines and the consultancy organisations have large surpluses available from their operations. These will be channelised to other enterprises whose capital expenditure requires extra budgetary resources over and above their own internal resources. This will be done either through the budget or through the capital market or by transfers among enterprises within the administrative control of the same Department.

46. The Eighth Plan emphasises that the State public sector enterprises would, in reversion of their negative contribution, generate Rs 4,000 crore by means of imparting operational efficiency and by appropriate pricing of the products of utilities like electricity, transport services, etc.

47. The ability of the economy to mobilise resources from abroad on affordable terms was put to severe test in recent years. The current account deficit rose to 2.4 per cent of GDP during the Seventh Plan as against the targetted 1.6 per cent. The economy tended to rely, beyond its means, on external capital. Increase in the imports from hard currency areas and diversion of substantial part of our exports to rupee payment areas increased our external debt of hard currency foreign exchange. The decline in soft aid for infrastructure development made us borrow in the external commercial market at high costs. While resort to exceptional financing from donors could

salvage the situation to an extent, it is imperative that during the Eighth Plan the dependence on inflow of external capital (foreign savings) should be reduced. The current account deficit is projected at Rs 55,000 crore, i.e., 1.6 per cent of GDP. If the growth of the economy is not to be starved of the required raw-materials, capital goods and technology, adequate imports will have to be provided for. Therefore, in containing the current account deficit to a low level, exports will have to assume a dominant role. Exports are, therefore, projected to grow at 13.6 per cent per annum in real terms during the Eighth Plan period.

Sectoral Pattern of Growth & Investment

48. Given the overall growth target of the economy during the Eighth Plan, the sectoral pattern of output and the related growth rates are obtained through the consistency model which starts with the final demand and fully takes into account the inter-sectoral linkages via inputs and output. The main components of the final demand are private final consumption, the government final consumption, exports, import and capital formation. While consumption and exports are exogenously determined, imports and capital formation are endogenous to the model. Each one of these components is worked out through a sub-model which takes into account the dominant parameters obtained from analysis of past data. The resultant pattern of growth, both in terms of gross value added and in terms of value of gross output, is described in Table 7.

TABLE-7 : SECTORAL GROWTH RATES OF GROSS VALUE ADDED AT FACTOR COST (GVA) AND VALUE OF GROSS OUTPUT

Sector	Projected Growth Rate		Sectoral share in GDP		
	Trend Growth Rate of G.V.A. 81-82 to 90-91 (10 years)	92-93 to 96-97 (per cent per annum) G.V.A.	Value of Gross Output	1991-92 (per cent)	1996-97 (per cent)
(1)	(2)	(3)	(4)	(5)	(6)
1. Agriculture	3.77	3.02	4.05	27.66	24.45
2. Mining & Quarrying	6.78	8.08	9.11	2.04	2.30
3. Manufacturing	7.19	7.46	8.16	21.50	23.46
4. Electricity	9.00	8.18	8.39	2.40	2.71
5. Construction	3.63	4.74	5.36	5.13	4.92
6. Transport	7.34	6.45	7.77	5.93	6.18
7. Communication	6.22	6.04	6.85	1.17	1.19
8. Services	6.50	5.99	6.60	34.16	34.79
9. Total	5.59	5.60	6.74	100.00	100.00

49. Sectoral distribution of investment in the Eighth Five Year Plan has been derived from the pattern of sectoral output. Gross investment during the Eighth Plan distributed according to broad sectors of economic activity is presented in Table 8. Agriculture, irrigation and allied sectors will account for 18.65 per cent of total investment. Mining and Manufacturing will get 28.57 per cent; Electricity, Transport and Communication will take 26.54 per cent of the total; and the remaining investment will be in the construction and services sectors. The sectoral investment in the five year period (1992-97) includes the requirements for sustaining the growth in output in the post-Plan period. A significant shift in investment is proposed in favour of agriculture and allied sectors. Investment in agriculture had been declining over years, while the need for agricultural growth is all the more for maintaining food security as well as for generating employment. This Plan intends, therefore, to tilt the allocation in favour of agriculture. Attempt has been made to maintain the relative share of infrastructure sector in order to strengthen the foundations for growth in future.

TABLE-8: SECTORAL INVESTMENT DURING THE EIGHTH PLAN
(1992-93 TO 1996-97)

(Rs Crore at 1991-92 prices)

Sector	Public	Private	Total	Share of Public Sector in Total Investment by Sectors (%)	Sectoral Distribution		
					6th Plan	7th Plan	8th Plan
(1)	(2)	(3)	(4)	(5)	(6)	(7)	8
1. Agriculture	52,000	96,800	1,48,800	34.95	15.24	11.23	18.65
2. Mining & Quarrying	28,500	11,100	39,600	71.97	6.06	6.70	4.96
3. Manufacturing	47,100	1,41,300	1,88,400	25.00	23.60	26.00	23.61
4. Electricity	92,000	10,120	1,02,120	90.09	12.07	13.65	12.80
5. Construction	3,300	17,240	20,540	16.07	2.73	1.86	2.57
6. Transport	49,200	38,710	87,910	55.97	9.42	9.93	11.02
7. Communication	25,000	1,000	26,000	96.15	1.50	2.03	3.26
8. Services	63,900	1,20,730	1,84,630	34.61	29.38	28.60	23.13
9. Total	3,61,000	4,37,000	7,98,000	45.24	100.00	100.00	100.00

Note: Sixth and Seventh Plan figures are calculated at 1980-81 prices.

50. Distribution of investment between public and private sectors at the sectoral level is based on the proposed reorientation in the relative roles of the private and public sector objectives. The broad industrial groups where private sector is expected to have a much larger share than hitherto are electricity, communication, mining and quarrying particularly oil and coal, large industries in manufacturing sector (petro-chemicals, metals, fertilisers and heavy capital goods) and the organised segment of commercial services.

51. The distribution of public sector outlay between Centre and States is determined by the respective resource generation capabilities, on the one hand, and the distribution of the developmental responsibilities between the Centre and the States, on the other. As already mentioned, the States' Own resources (Rs 1,10,485 crore) will be augmented by making available Central assistance for their Plan at a level of Rs 78,500 crore. In some of the development heads and programmes, such as, family welfare, eradication of disease/epidemics, reduction of illiteracy, poverty alleviation, etc., the Centrally sponsored schemes may continue. However, the number of such schemes will have to be kept to the minimum most essential. In some sectors such as power, roads/highways, large industries, village and small industries and science and technology, the investments made through the Central Plan over the past 10 to 15 years have been significant, giving adequate leverage to the Centre for influencing the outcome in these sectors. Further expansion of the Centre's role will be at the expense of the initiatives expected from the States and local authorities.

52. The Central Sector bears a residual responsibility for the Plan objectives to the extent that these could not be realised through the State Plans or through private sector initiatives. As the same time it needs to be admitted that the traditional accounting and supervision mechanisms for keeping watch on public sector spending have not been fully effective. A more purposive identification of beneficiaries and focussed targetting in respect of public sector expenditure is essential if the Government has to perform its role in the face of severe resource shortages. Programmes need to be evaluated by organisations other than those which administered them. Programme Evaluation Organisation in the Planning Commission, National Sample Survey Organisation and well reputed research institutions will have to be constantly involved with the task of evaluation of programmes and performance.

Employment

53. Employment implications of growth are presented in Table 9. With the planned pattern of investment and production, the employment potential will grow at about 2.6 per cent per annum. In absolute terms it implies generation of

about 8 million jobs per annum during the first couple of years of the Eighth Plan, and about 9 million jobs per year during the latter years, and more than 10 million jobs per year in the post-Eighth Plan period. These employment projections are based on projected employment elasticities, which, in turn are based on plans to increase agricultural intensity and agricultural productivity, particularly in the eastern region and the dry belts. The pattern of industrialisation and choice of technique, wherever possible without sacrificing productivity, have to be such as to increase the possibility of labour absorption in manufacturing and other sectors. Services will also have to play a major role in generating employment.

TABLE-9 : SECTORAL VALUE ADDED AND EMPLOYMENT GROWTH DURING EIGHTH PLAN (1992-97)

Sector	Sectoral Growth	Employment Elasticity			Employment Growth Using Elasticity as in (6)
		Achieved 1977-78 to 1983	Achieved 1983 to 1987-88	Target for 8th plan	
(1) (2)	(3)	(4)	(5)	(6)	(7)
1. Agriculture	3.02	0.49	0.36	0.50	1.53
2. Mining and Quarrying	8.08	0.67	0.85	0.85	6.87
3. Manufacturing	7.46	0.68	0.26	0.50	3.73
4. Construction	4.74	1.00	1.00	1.00	4.74
5. Electricity	8.18	0.74	0.48	0.50	4.09
6. Transport & Communication	6.39	0.92	0.35	0.60	3.83
7. Other Services	5.99	0.99	0.42	0.70	4.19
Total	**5.60**	**0.58**	**0.31**	**0.47**	**2.61**

Balance of Payments

54. Table 10 shows the evaluation of key BoP indicators for the period 1980-92 and the projections for the Eighth Plan (1992-97).

TABLE-10 : KEY INDICATORS OF INDIA'S BALANCE OF PAYMENTS (AS PER CENT OF G.D.P.)

Year/Period (1)	Exports (2)	Imports (3)	Trade Balance (4)	Net Invisibles (5)	Current Account Deficit (6)
Average (1980-85)	5.00	8.33	(-)3.33	1.90	(-)1.43
Average (1985-90)	5.21	8.33	(-)3.13	0.75	(-)2.38
Eighth Plan (1992-97) (Projections)	9.60	11.62	(-)2.02	0.42	(-)1.60

55. The significant changes in the industry and trade policies and exchange rate adjustments made during the year 1991-92, will have their implications on the functioning of Indian economy and the BoP situation during the Eighth Five Year Plan. It is imperative that during the Eighth Plan, steps are taken to correct the fundamental weaknesses in India's external situation so that the external imbalance does not cause serious disruption to the economy. It is, therefore, necessary to plan for a drastically reduced inflow of resources from outside. It is assumed that foreign savings would be 1.6 per cent of GDP in the Eighth Plan. This is a level of deficit that can be sustained by normal capital flows. This also implies high expectations about growth in exports. In absolute terms the foreign savings requirements are projected at Rs 55,000 crore. The projected balance of payments position during the Eighth Plan is given in Table 11. Steps will have to be taken to realise a healthier pattern of financing this order of current account deficit.

TABLE-11 : BALANCE OF PAYMENTS POSITION DURING THE EIGHTH FIVE YEAR PLAN (1992-97)

(Rs Crore)

Item (1)	1991-92 (2)	1996-97 (3)	Total 8th Plan (4)
Exports	44,292	83,869	3,30,153
Imports*	62,345	93,314	3,99,650
Trade Balance	(-)18,053	(-)9,445	(-)69,497
Invisibles*	3,494	2,332	14,634
Total*	(-)14,559	(-)7,113	(-)54,863

* These are normalised projections for the base year. Actuals during 1991-92 are expected to be lower than these.

56. The manner of financing of the current account deficit during the Seventh Plan was such that 29 per cent of the financing need was met by way of external assistance from multilateral and bilateral donors, 24 per cent by way of commercial borrowings, 23 per cent through non-resident deposits under Foreign Currency Non-Resident Accounts Scheme (F.C.N.R.A.) and Non-Resident External Rupee Account Scheme (NR(E)R.A.), about 13 per cent from other capital transactions and the remaining by the draw down of reserves.

TABLE-12 : FINANCING THE CURRENT ACCOUNT DEFICIT

Item	Seventh Plan (Rs Crore) at current prices	Eighth Plan (Rs Crore) at 1991-92 prices
1. Current Account Deficit including Errors and Omissions	38,866	55,000
FINANCED BY		
2. External Assistance	7,535	28,700
3. Commercial Borrowings	10,571	5,000
4. Non-Residents Deposits	9,897	3,000
5. Other Capital	5,790	21,300
6. Use of Reserves	5,074	(-) 3,000

@ Net of repayments to IMF and others
Note: The CAD at 1991-92 US $ will be 22 billion.

The Policy Framework

57. Development experience, both in our own country and outside, shows that a set of well coordinated macroeconomic policies is of utmost importance for achieving rapid growth with reasonable price stability and sustainable balance of payments. In general, the following macroeconomic policies need careful consideration during the Eighth Plan period:

a) The policy regime governing trade, technology and transborder capital flows;
b) Industrial deregulation and administered price policy;
c) Financial sector reforms, and
d) The stance of demand management as reflected in monetary and fiscal policies.

58. Recently, the Government has initiated significant policy changes in these areas of economic policy. However, the process of reforms initiated recently represents only a beginning. We have to carry it further if we want to reap the full benefits of these reforms. Therefore, sustaining the pace of economic reforms will be the major challenge during the Eighth Plan period.

59. During the Eighth Plan period, further trade policy reforms are needed to be carried out so that the economy is better integrated with the rest of the world. The key objectives of these reforms should be two-fold: (i) a further pruning of the "negative" lists of imports and exports, and (ii) a gradual reduction in both the level and dispersion of tariff rates. These trade policy reforms need to be accompanied by further delicensing of industries, a more rational policy towards unviable industrial units and a gradual decontrol of administered prices of industrial products.

60. A vibrant and competitive financial system is necessary to support the proposed trade and industrial policy reforms. Over the years, the Indian banking in the financial system has made impressive progress in extending its geographical support and functional reach. Despite this commendable progress there has been a steady erosion in the operational efficiency of the financial system. Key policy initiatives that are required for restoring the operational efficiency of financial sector are a gradual reduction in statutory liquidity requirements on banks, streamlining and better targetting of the priority sector lending by

banks,. simplification and liberalisation of the administered interest rate structure, restoration of financial autonomy of banks and development financial institutions and enforcement of stricter prudential norms and guidelines on the financial sector.

61. Over the medium term, these structural policy initiatives would ensure an efficient use of resources and hence help augment aggregate side. However, if aggregate demand continuously outstrips aggregate supply, it would be difficult to maintain a reasonable degree of price stability and a sustainable balance of payments. Therefore, these structural policy reforms will have to be accompanied by a three-pronged fiscal and monetary policy package aimed at, i) providing a better balance between aggregate demand and supply, ii) minimising the distortionary effects of the tax system and, (iii) forcing public enterprises to minimise costs and maximise efficiency.

62. Putting the fiscal house in order is a necessary prerequisite to obtain a better balance between aggregate demand and supply. Efforts have already been initiated on this by the Central Government in its last two budgets. These should be supported by similar efforts by the State Governments.

BOOK REVIEWS

D'Souza, Shalini and Arundhuti Roy Choudhury, - *Documenting Communal Violence: Its Limitations and Potentialities*, Indian Social Institute, New Delhi, 1994, Pp. 80.

Communication is regarded as the symbol and essence of life. It possesses the same diversity as life itself; it springs from an object or an event and even when the source of communication is the same, it is communicated in a broad spectrum of expressions by the communicator. Does someone, who receives the communication, receive exactly the same as communicated? Moreover, will other communicators verbalize that event in exactly the same words, manner, style, etc.?

An attempt has been made in this slender monograph to demonstrate how in the course of documenting or reporting an event, something more than factual account is transmitted in the communication. The process of interpretation, a selection process emphasising one experience over others, sets into action, mostly without the reporter's positive cognizance. It assigns a distinct import to the depiction when the event is reconstructed by him. It is his representation, his conception of the event, definitely reflecting his identity, his own standpoint, his perspective, including his bias. This import, thus naturally depends on his own perception of the event. But for a few exceptions, there is hardly anything that may be called pure, objective chronicles conveying data or information. Reports documenting episodes thus invariably signal certain messages. Furthermore, what ultimately reaches the reader, when he reads the report, is yet another form of subjective discourse, linked with the reader's comprehension. Reading a report may in this way convey a multitude of meanings for diverse readers, depending upon their own outlook, consciousness or standpoint. This understanding or knowledge that they acquire ultimately prompts them to action. What is written and what happens in a society are intimately related (p. 6). Narration of an event conveys meaning and this meaning often becomes the basis for subsequent events aligned with the first. It is generally intended for a particular response from its readers. That is why the pen is always considered mightier than the sword and every country has laws that place reasonable restrictions on the freedom of speech and expression.

The narrations analyzed by the authors in this monograph are reports about the Hindu-Muslim communal riots in East Delhi in 1992. The riots were the aftermath of the demolition of the *Babri Masjid*. The social activists, the media and the riot-affected people were the reporters who articulated the incidents in the riots for the authors. The variations in perceptions of these reporters are delineated and certain fundamental issues are raised in the light of such anomaly. The discussions are thematic rather than exhaustive and the authors have announced their having already undertaken a more detailed study 'Media and Communalism'. One surely looks forward to its conclusion.

Every sane Indian is concerned today about the frequency and extent of communal riots in urban areas and the new and increasingly horrifying forms the violence is assuming. The authors too, out of similar anxiety, seek to locate the roots of the problem by undertaking a content analysis of the three narrations about communal riots in Seelampur by social activists, media and the affected people. They have come to the conclusion that these narrations are inculcating a genre of knowledge, a mould of critical consciousness in the society that would, instead of resolving, rather aggravate the problem of communal divide.

This monograph, issued in the *Monograph Series* of the, Indian Social Institute, New Delhi, with Sebasti L. Raj as the General Editor of the series, consists of five chapters. The first one furnishes the rationale, while the last one the conclusions. The second, third and the fourth contain the kernel of the study - the content analysis of the reports on the same event by three different catalysts. Their accounts of the riots are examined in the light of the following four propositions - (i) historical memories, (ii) identity information, (iii) the role of the police, and (iv) the possible alternatives to the affected people as suggested in the reports.

Reports of the Social Activists

The social activists comprise the Delhi- based citizen's groups, the intellectual community, represented by Veena Das, the *Aids Bhedbhav Virodhi Andolan*, a joint delegation of four national groups for women who visited Bhopal,

Ahmedabad and Surat during February 16-19, 1992, *People's Union for Civil Liberties, (PUCL) People's Union for Democratic Rights, (PUDR)* and *Sampradayikta Virodhi Andolan (SVA)*. For them reacting through their reports was a social obligation, a commitment, which they owed to the society and, especially, to the victims. The objects of their documenting the riots were a) to give voice to the victim's version, an alternative noncommercial interpretation of what occurred, and b) to raise public consciousness and form alternate opinion.

(i) Historical memories - The reports observe that two events, one historical and the other, for the educated, more mythological than historical, are undeniably etched out in the collective social memory and cultural heritage of our country: 1. the partition with its shattering consequences and the creation of Pakistan, and 2. the *Ram Raj*, the ideal of social, economic and political equality to be achieved. The former legitimises the riots through reviving negative memories even when sixty per cent of Indians are born after partition and, therefore, have never lived through partition. The latter, on the contrary, attempts legitimisation through creating positive hopes for a) better economic prospects, consequent to elimination of Muslims from the competition for scarce resources, and b) for a stronger, more homogeneous Hinduised nationhood. These two events are supposed to justify the violence. Constant reference to them in the slogans of the rioters is aimed at internalisation by the masses of such justification. The social activists, therefore, stress in their reports the urgent need of creating an alternative notion of the past, the past as comprehended as a process of development. This kind of presentation of the history, the activists believe, would be a fitting reply to construction of historical memories in the way, mentioned above.

(ii) Identity information - Representations of communal riots - whether it is the Hindu version, the Muslim version, the secular version or the state (official, government) version- rely on either of the two positions. Either there exists a fundamental divide between the two communities, or alternatively, harmonious Hindu-Muslim relations have existed at the ground level in the past and continue to prevail riot after riot. As a rule the social activists have taken in their reports the second position and supported the stance that rioters and, to an extent the police, conveyed the message of conflict and separation based on the concept of a primary identity, that of religion, and that outside elements disturbed the harmony among the localities. But how the masses were mobilised to commit atrocities against the other community is not explained, nor are the class and caste dimensions, so vital for mobilisation taken into consideration in these reports. Also the concern for harmony in these reports ascribes, perhaps without any such intention, certain qualities to the two communities.

(iii) The role of the police - The police are blamed in all the reports of the social activists for the dereliction of their duty during the riots. Whatever alternatives people find out in such a situation of the failure of the state machinery, are obviously based on survival strategies. Hence they may be constructive or even destructive. The social activists, however, are unmindful of this actuality. Also the reasons for the communalisation of the police are not searched in their reports. They once again urge the state to take corrective measures.

(iv) The possible alternatives - For the social activists, the state is the harbinger of change, social, economic, total. They are optimistic that the state would find out a solution to such sectarian violence. The involvement of most of the political parties in communal politics is disregarded when they rely so blindly on state intervention.

The Media Reports

In this monograph the authors have analysed the English newspapers from December 7, 1992 to January 31, 1993. Confining the analysis to English newspapers, ignoring the regional language papers is perhaps the greatest drawback of the monograph. Moreover, the articles analysed cannot be called in the true sense media reports. Almost all of them are narrations, interpretations by sociologists, scholars, etc.; the press may not necessarily agree with the views published in their papers.

(i) Historical memories - Construction of history or deduction from history and culture along with the use of certain stereotypes in society has been undertaken by all, the secular minded included. Their diverse views, their contextualisation of present events in relation to the past are all expressed through the media. The authors notice presentation of selective historical memories. Whether it is the over-simplified version of history which asserts the Hindu tolerance of Muslim aggression, or the more comprehensive cognition of the historical complexities, both build the image of the society mainly in terms of two monolithic communities - the Hindus and the Muslims - which have the potentiality to move into the backwoods of prejudices (p. 40). Moreover, such conception of history signals the wrong message that the solution to the present communal problem has to be sought in the past.

(ii) Identity information - Like the reports of the social activists, most of the media reports have ironed out the caste, class and other complex diversities in our plural society. They have supported the belief that communal identity being the basis of conflict should be replaced by a homogeneous, national identity which is the basis of unity. In reality, the propagation of monolithic nationhood, like that of a monolithic community, equally perpetuates the inegalitarian social and economic structure. This, according to the authors, is the root of conflict in the country where diverse and multiple identities prevail. Secondly, the media have understood the nation in terms of numbers. Most of the media reports indicate that because the majority wants it, India is secular whereas the Muslims are conservative in their outlook. This portrayal of the Muslims is not much different from the one that states that they are a threat to the Hindu *rashtra*. The former perceives them, like the Hindu communal elements, as a threat to the secular fabric of the country. Lastly, there exists no such uniform identity as Hindu identity; there are multifarious forms of Hinduism, visible in different parts of the country.

(iii) The role of the police - The media projections of the police vary immensely, between the police as victims and the police as brutalised and communalised aggressors. Yet, all media reports stress the need of creating a neutral police, oriented solely to prevention of violence in society. It is stressed that the peace-keeping role belongs to the police, and therefore their use of ruthless methods for prevention of violence is endorsed. The authors of the monograph, however, express anxiety about such attitude which is likely to be interpreted as a consent to coercive state regulations, since it sidesteps the issue of change in the basic values of the existing state system.

(iv) The possible alternatives - The media too, like the social activists, attribute to the state the predominant role not only in quelling but also in preventing riots. They also point out the necessity of economic development and prosperity to counter communalism.

The Affected People's Observations

The affected common people's perception of the event -the Hindu-Muslim communal riots - has hardly found any place in the above two reports. Hence the authors collected data on their unstructured thoughts during the course of informal conversations with them or by observing their day to day dealings.

(i) Historical memories - The authors find that even the third generation of people since 1947 constantly referred to the partition experience, and that in the context of riots its recollection created strong emotions of buried pain of the loss of family members, of the witnessing of murder, rape of their women and arson, destruction of all their belongings. The rioters' slogans further freshened their memory anew. Such kindling of the partition memory instilled insecurity and uncertainty in the minds of the affected Muslims. It also accentuated the communal identities.

(ii) Identity information - The authors notice that even if the masses are fundamentally secular in nature, violence does leave an impact on the consciousness of those who are involved or threatened. It shapes and alters their perceptions and aspirations. Therefore it is but natural that an

inclusive identity of a colony maintaining harmony till riots reformulates itself into an exclusive religious identity after riots. Each religious group is suspicious of the other and the colony no longer has the same atmosphere again. Such exclusively religious identities transform into communal ones because of rumours, need for self defence and sentiments of honour. Sometimes even passive people with low communal consciousness come to accept the new reformulation. For the identities are not static in nature. Secondly, not only the riots but unfortunately the relief measures too underscore a demarcation between the two communities on communal lines. After the 1992 riots, relief was provided not on the economic basis of the victim's need. On the contrary, communal organisations and even some political parties organised aid to the victims on communal lines. At least that is the understanding of the affected people, which helped to harden the exclusive identity of communal overtone.

(iii) The role of the police - The people affected in the East Delhi riots of 1992 have lost their trust and confidence in the police, for they see these riots as an organised violence, a vicious police operation, carried out with the help of local goons with a view to unleashing terror on a minority community (p. 60). In spite of such strong conviction about the role of the police among the Hindus as well as the Muslims, yet surprisingly they could be pitted against each other on communal lines and did not show solidarity in the crisis incited by outside elements. They were utilised as instruments in the communal frenzy. Secondly, though the affected people accuse the police for the atrocities that were committed against them, yet they do not relate this bungle by the police with the state machinery, with *Sarkar*, nor question the prevailing state structure. The existing economic, social and cultural exploitation of the masses by the dominant groups is offered by the authors as the possible explanation to this contradiction (p. 66).

(iv) The possible alternatives -The affected people have survived the experience of violence and are trying to weave it with their day to day existence. Somehow they have coped with the situation. However, there are signs of suspicion and distrust amongst them. The alternative they have found should cause more apprehension for any non-communal Indian. Neighbourhoods in the riot-prone areas are tending to become exclusively Muslim or Hindu in character. This would help the crystallisation of stronger identities based on religion.

In conclusion, the authors evaluate the three narrations. The social activists' version of the event (the Hindu-Muslim communal riots in East Delhi, in 1992) succeeds in reducing it to a temporary failure of law and order machinery. Its tangible causes are local goons, communal character of the police and support of the communal parties. There is no attempt in these reports to explore the other forces at work, nor to suggest some people-oriented measures to prevent its recurrence. Such a version may lead to reification and standardisation of the happening (Pp. 31-32).

As regards the media, the authors observe that the media represent various strands, democratic, Marxist, populist, fundamentalist, etc. Still they generally favour the stability of existing institutions, values and the system. Information or facts are for them a commodity to be circulated in society. If it is to be sold at a profit, it must satisfy the buyers who belong primarily to the educated middle class, (the authors refer here exclusively to English newspapers). The power of the media is hence based on the knowledge of the middle class. This knowledge is the cultural capital of the media. So they strive for reinforcing, consolidating the dominant social consciousness of this class rather than searching for new answers (p. 51).

Regarding the affected people's observations, the authors are optimistic that in the long run, 'the multiple and contradictory feelings (would) provide a space in society for pluralism, which can be channelised to evolve a strong civil society' (p. 67). The last chapter in the monograph discusses what measures are essential to achieve this. The authors stress the need for studying the problem of communalism as it exists today and creating new dynamic identities. For example, history of violence or of partition should not be suppressed by the secular minded people and left to distorted interpretation by the communal forces. Secondly, the permanently hostile monolithic communal identities are nurtured by

projecting that all Hindus or Muslims have identical sets of interest. This is not true. People belong to secular identities too, such as class, profession, language, region, etc. They have to safeguard their interests as workers, peasants, women, residents of a particular locality, and so on. ' ... identities are constituted by the micro-processes of everyday life and help to induct people into a culture and social relationship which leads to various groupings in society' (p. 73). A space for legitimate assertion of such contextualised, dynamic, plural and diffused identities has to be created to counter separatist sentiments. In other words there should be decentralisation of power, especially decision-making power, so that groups have a sense of participation. Thirdly, high social and geographic mobility is thrust on people on account of economic compulsions. Consequently, their roots or moorings are lost, the only source of group activities and of identity is religion; hence it is necessary to create other secular, social affiliations. However, like the social activists, the authors object to conformity for the sake of national identity, which, they also believe, is virtually that of the dominant castes and classes of the majority community. Lastly, they suggest that alternatives emphasising collective action, such as *Mohalla* Peace Committees, should be encouraged to take up the peace-keeping role of the police.

If content analysis of this monograph is attempted on similar lines as the authors have undertaken here, what message would be signalled to the readers? What are the limitations and potentialities of this monograph? Barring a few fresh insights into the problem of communalism in India, the authors have hardly contributed contentwise anything new. The monograph offers a good recapitulation of the reading material available on the event, supplemented with the first-hand experiences of the riot-affected people. Yet the presentation is unique. It broaches many aspects of not only communalism or violence but of communication, consciousness, imparting of knowledge, and even of pluralism and decentralisation. Of course, in-depth analysis of any aspect cannot be provided in so few pages. Again, perhaps the intelligentsia's perception of the event, including the present monograph, is too distanced from the ground reality. That is why the authors fail to understand how the poor people could be pitted against each other. The regional language newspapers may exaggerate, sensationalise, even publish biased reports but there is a grain of truth in their tales of brutalisation, of the lure of money triggering people off to murder, rape, and unheard of atrocities, of settling scores in generations old feuds. An analysis of the psyche of the affected people who read these newspapers, is likely to be vacuous in basics.

The Anthropological Survey of India has surveyed the people of India based on 776 variables, the first pan-Indian ethnographic study of all the communities of India*. It records that only about 285 variables are identical, conforming to what may be described as the Indian identity. This finding substantiates the authors' proposition for a plural, diffused, dynamic Indian identity.

* Singh, K.S., (Ed.), *People of India*, in 11 volumes, *National Series*, Anthropological Survey of India and Oxford University Press, Delhi. Two volumes have been brought out in 1993 and other volumes are still in press.

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Gulati, Leela, *In the Absence of Their Men: The Impact of Male Migration on Women*, 1993, Sage Publications, New Delhi; Pp. 174; Price: Rs 200/-.

'In the Absence of their Men' by Leela Gulati is a study of the women from two neighbouring villages in Kerala when their men migrate to West Asia. The two villages are on the rim of Trivandrum city as described by the author. A total of 50 migrants from 37 households were identified and surveyed and then a smaller number of households were taken up for an in-depth study. These latter were purposively chosen to cover the different aspects of the migration process as well as differing characteristics of the migrants or of the women left behind.

The book mainly contains stories of ten women whose husbands or *sons* are away in West Asia. The interest in this subject accrues from the fact that migration to West Asia is now supposed to

be Kerala state's biggest industry. The author sees the life around her changing fast, male-dominated families becoming female-dominated, with their men migrating and the author is probably afraid that economists sitting before computers might end up with a single number on income or investment but may not know what effect it has on people. I am sure it is the variety of data presented by several authors on migration in the Appendix 1 which really give a sound base for the ten pictures of women presented in the earlier pages. The pictures describe the family living that often changes the status of women who are exposed to the outside world including economic world in the absence of their men.

The effect of migration of men on family begins far before the migrant leaves. Getting the passport battling with bureaucracy, establishing contacts necessary for work permits, the agents to be contacted, their costs, their cheating, all have to be gone through at costs certainly not easily bearable. These involve borrowing from a variety of sources mostly nearby as well as remote relatives and friends. To help this migration wives, mothers, sisters sell their ornaments, mortgage their pieces of land. One thing that strikes is that in this bearing of costs it is mostly on trust that the monetary help comes by and is returned in due time besides gifts of various kinds. One wonders how the kith and kin is ready to help the migrant even in poverty. Not only is the help in money terms but also later to the left-back women for their protection and in their dealings with the world.

The women left behind need support for protection and also in taking on responsibilities of the household for which they never have an opportunity in the presence of their men. But once left alone they certainly get wiser, the more the responsibilities they take on. These responsibilities include not only taking decisions on education and health of the children but often the management of large sums of money, repayment of loans, release of jewellery from mortgage, investment on house repairs or renovation not needing too much supervision. Exposure to big amounts of money poses new challenges that they have never faced before. After paying off the loans improving housing has a high priority in the expenditure.

Women who have been illiterate or have forgotten reading or writing now go to banks and open their accounts. a place having 12 bank accounts in 1979 had 3,617 accounts in 1984. The women visiting banks or needing communication with the husbands feel the dire need of education and want their children including daughters to take education and that too good education which they think is obtained in English medium. Muslim girls did not go to school after twelve years of age in some families but now even mosques have made arrangements for adult female literacy. When women themselves cannot write they communicate with their husbands through their children discussing the disposal of money, possible investments, their social life, movies they see or the news they hear on the radios. All, including women, are now interested in the international news and especially their impact on West Asia. Even Muslim women allow their photographs to be taken for identification in the banks.

Women and their migrant husbands now distinguish between various health facilities available and want to choose the better ones for women as well as their children in spite of their higher costs. Often even the suggestion for sterilization comes from the migrant husband. But the practice of giving heavy dowry for girls' marriages still continues.

There is certainly a loneliness in the lives of separated couples. But there is no feeling of insecurity. Often the husbands visit their families every two years and there too the houses are crowded with friends and relatives. But the women never complain. Not only that, even in their communications in letters they take great care to see that they do not complain against the near relatives of the husbands. Even in rare cases where the migrant sends the money to the mother and not to his wife and even when the expenditure pattern of the household changes, wives do not complain.

In short there is so much change in the living style of women including their mobility, much better communication with husbands away than it would have been possible with them being close by, that the separation of the couples is bearable

due to material gains. Even Muslim women dare go out without covering their heads. They have learnt to use a variety of gadgetry in the houses. The only worry is the uncertainty of the jobs of migrants in West Asia, which constantly lurks at the back of the women's minds since all their dreams will vanish with the loss of job for the migrants. These migrants invest 15 to 30 thousand rupees to get the work permits which can be returned only if they keep the job for a few years.

The reader feels satisfied with the data presented in the Appendix 1 available from various authors. The number of migrants to West Asia from Kerala and India, the internal migration and the international migration and that especially to West Asia their skills and level of education are all highlighted in this appendix. Work status of the migrants before migration, their remittances received in Kerala as a percentage of total received in India, percentage of total income of migrant households, level of improvement in the standard of living of the migrant households, all give a sound base for the pictures of ten women described in the book. Savings of the migrant and non-migrant households, their expenditures on food and other items, bring out how migration has improved the economy of the country and the state and also of individual households.

The book is of great value in the study of migration to West Asia.

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Joshi B.H., *An Analytical Approach to Problems of Indian Agriculture: A Theoretical and System Approach*, B.R. Publishing Corporation, (Division of D.K. Publishers Distributors (P) Ltd.), New Delhi, 1992, Price Rs 995/-, Pp. ix+495.

The literature relating to issues in Indian agriculture is vast indeed. A lacuna of such literature is that it is not well integrated with theoretical underpinnings of these issues as well as a sound database.

The book under review makes a departure from this convention. It tries to fill the data gap in Indian agricultural analysis with theoretical interpretation of the issues. On the basis of commonality of the issues discussed, the fourteen chapters of the book can broadly be divided into four sections. Section one (two chapters) analyses the nature and structure of Indian agriculture and the evolution of Indian agrarian system with a historical account of famines, famine policies and famine relief measures adopted by the Mughal and British rulers in India. Section two (five chapters) deals with the optimum use of critical inputs for augmenting agricultural production and productivity. Section three (six chapters) examines the impact of the new agricultural strategy on agricultural development along with the contributory role played by measures such as land reforms, financing institutions, marketing, pricing, land revenue and taxation policies. The last section is a chapter on agriculture through five year plans, dealing with the achievements as well as shortcomings of Indian agriculture during the planning era.

Despite commercialisation of agriculture, the production process in India is still traditional in nature, due to the uneconomic holding size, making economies of large scale production non-viable. The dis-economies of small scale cultivation have been experienced in terms of wastage of labour, land and capital and decline in production and productivity. The land tenure systems that were existing in pre-independent India did not help in the process of agricultural development of the country.

The author underscores the importance of rational behaviour of the farmer in terms of optimum resource use, especially the use of land. He unfolds the intensity based and quality based arguments (given by Krishna Bharadwaj and Chakravarty, respectively) of the *land size and productivity debate*. Due to low level of technological development and high population density, labour intensity and productivity are found to be very low in India. The problems of bonded labour, found in many states, is a cause for concern.

The author discusses the theoretical issues in technological change in agriculture, with graphical illustrations (Pp. 281-82). In India, technological change has not resulted in adoption of a new production function with changed proportion

of inputs, and efficiency in production. The green revolution has failed in most of the Indian states due to low risk responsiveness of the farmers, lack of capital formation, non-adoption of high yielding varieties (HYVs) supplemented with both capital and labour instruments, etc.

The whole process of land reforms in India has been regarded as an organic outcome of alliance and conflicts between land owners, tenants, cultivators and agricultural labourers on the one hand and the ruling party, bureaucrats and the judiciary on the other, each fighting for their respective interests. Agricultural credit has been classified as dynamic credit and static credit and it is found that in India, credit is of a static nature. As a result credit does not help the farmer to repay the borrowed sum in the stipulated time, rather, it gets accumulated over time. The big farmer bias of most of the institutional agencies accentuated the growth of private/ informal agencies in India.

The importance of pricing and marketing of agricultural products has been examined. In line with Owens and Shaw [1972, Pp. 1971-72], he treats agricultural development more as a human problem than a technical one as it led to the problem of unequal access (differential access) to the market, making the large farmers beneficiaries of the green revolution. The disproportionate growth of agricultural and industrial prices made the terms of trade unfavourable towards agriculture in India. Also, the agricultural price policy of the post Independence era had failed to protect the interests of the rural and urban poor, small and marginal farmers and agricultural labourers.

The role of land revenue as a source of income of the states has declined over the years. It declined from 80 per cent of the states' income in the early years of planning to 10 per cent at present. The author's argument for levying the agricultural income tax is based on the reasoning that the higher investment in the rural sector, enhanced the income level of the farm population which is not corresponded by saving and investment. This has its own limitation, for, the income flowing to the rural sector is not steady. He criticises the recommendations of various agricultural tax commissions on the ground that they did not consider the topographical differences across the states and the resultant variations in output levels.

The author examines the theoretical aspects of planning for agricultural development in India. He examines the progress of Indian agriculture under the plans and the use of different plan models. He admits that the planning exercise in India has created awareness among the central and state governments and the Planning Commission to reckon with some of the factors at play in the agricultural economy of the country (p. 475). He is sceptical about the clarity in our planning in terms of defining social objectives, like removal of poverty, reduction of uneven distribution of income and wealth, maximum utilisation of human resources, etc.

On the whole, the book is an addition to the very limited literature on theoretical and analytical approach to the problems of Indian agriculture. It provides a sound and vast time series data base (for India, and the states) along with graphical as well as mathematical interpretations. For example, data on land use and cropping pattern (Pp. 32-83), production of principal crops (Pp. 98-100) irrigated area by principal crops (Pp. 170-72), cropwise area under HYV seeds (Pp. 288-92), public outlay and expenditure on agriculture and allied programmes during the fourth plan to the seventh plan period (Pp. 447-78), etc., are useful for future research on these lines. A limitation of the book is that much of the recent literature on issues related to Indian agriculture has not been examined by the author.

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ANNOTATED INDEX OF BOOKS AND ARTICLES IN INDIA

EDITOR'S NOTE

These abstracts are prepared by the author of each book/article sent to us voluntarily in response to our invitation through the Economic and Political Weekly. These cover publications after 1st January 1986. Only abstracts of books/articles so received are published. The index, therefore, is not exhaustive and complete.

The limit of 250 words and 100 words for abstracts of books and articles, respectively, is strictly enforced. Only a minimum amount of copy editing is done in order to bring the abstracts within the prescribed limits. The readers should approach the author of the abstract, not this Journal, for any clarifications.

BOOKS

1994

Tilak, Jandhyala, B. G., *Education for Development in Asia*, Sage Publications, New Delhi, 1994.

The study examines the growth of education in the Asian region during the last 2-3 decades, including investment in education, and analyses the contribution of education to development. It presents a broad overview of the past trends, current situation, and future prospects on the role of education in development - economic, social and political. Reviewing the experiences of several Asian countries in the recent period, the study reflects on some pleasant and some not so pleasant questions in this context on education development relationships. In the process a variety of hypotheses are examined. Specifically it examines some of the well established theses on the role of education, provides more insights into some other aspects, questions some presumptions that are based on no strong evidence, and, on the whole, reaffirms faith in education in fostering development. By analyzing the contribution of education to economic, social, health, demographic, political and various other facets of development, this study stresses the need for rational methods of investment in education.

1993

Tilak, Jandhyala, B. G., *External and Internal Resource Mobilization for Education for All.* Discussion Paper, Education for All Summit of Nine High Population Countries, New Delhi, December 1993.

Since the Jomtien Conference on Education for All in 1990, national governments and international organisations began taking serious interest in providing universal elementary education. In this context, the problems of resources is being felt seriously. The paper discusses a few selected important issues relating to financing of basic education in developing countries in general, and in nine high population countries in particular. It provides economic rationale for financing primary education, describes a few stylized facts on the pattern of public expenditure on primary education, including (i) growth in expenditure on education, (ii) education as a national priority, (iii) priority given to primary education, (iv) absence of physical capital formation in human capital sector, (v) neglect of teaching learning

material, (vi) declining expenditure per student, (vii) sources of funds for education, and (viii) external assistance for education. Secondly, the paper presents a crude estimate of finances required for EFA by 2000 AD, and thirdly, it discusses critically a large number of policy issues relating to mobilization of domestic and external resources for education for all.

ARTICLES

1994

Tilak, Jandhyala, B.G., 'The Pests are Here to Stay: The Capitation Fee in Disguise', *Economic and Political Weekly*, 29, (7), February 12 1994.

The February 1993 Judgement of the Supreme Court raises some important issues relating to capitation fee colleges in India, besides practically allowing charging of high fees to the order of more than Rs 1 lakh per student per year, contrary to the earlier judgements. This short article discusses critically some of the issues raised and solutions suggested by the Supreme Court. Contrasting the present proposed system with that in developed market economies, the paper highlights the anomalies in the proposed system in India.

1993

Tilak, Jandhyala, B.G., 'East Asia', in E.M. King and M.A. Hill (Eds.), *Women's Education in the Developing Countries: Barriers, Benefits, and Policies*, John Hopkins University Press for the World Bank, Baltimore, 1993.

With the help of a variety of indicators on educational development, based on most recent statistics, the paper presents (a) a long discussion on the development of education for women in the East Asian region, (b) an account of the contribution of women's education to development in terms of rates of return, and (c) an analytical discussion on the factors that contribute to the fast growth of education among women in some countries, and the social, cultural and economic, including labour market, factors that stand as formidable barriers in development. From the experience of the East Asian countries, a few important lessons are also drawn for the benefit of other countries that are struggling to achieve gender equality in educational development.

Tilak, Jandhyala, B.G., 'International Trends in Costs and Financing of Higher Education: Some Tentative Comparisons between Developed and Developing Countries', *Higher Education Review*, Vol. 25, no. 3, Summer 1993.

This paper presents an outline and comment on certain major international trends in costs and financing of higher education in a comparative framework, between the developing and the advanced countries. A few major features are identified, as a set of postulates, and available evidence is briefly examined on each of them. It also presents a discussion on a few major emerging policy issues on costs and financing of higher education.

1992

Tilak, Jandhyala, B.G., 'Education and Structural Adjustment', *Prospects* (UNESCO) Vol. 22, No. 4, 84: 1992. (Reprinted as 'Prospects of Investment in Social Development during the Phase of Internationally Funded Structural Adjustment', in *Journal of Higher Education* 16, (4), Monsoon 1993)

International financial institutions like the World Bank and the International Monetary Fund have been giving 'structural adjustment loans' and loans for economic stabilization for a long time. The World Bank started disbursement of such loans in 1980, and it is reported that as many as 80 countries have taken such loans so far, and have undergone or have been undergoing the process of structural adjustment. Second generation structural adjustment loans are now being designed by the World Bank and by governments of various countries. The adjustment programmes have been found to have mixed effects on the national economies - both on social and economic sectors. The adverse effects are believed to be particularly damaging on human development sectors like education. A review of the decade and odd years of experience will be very useful for the countries that are 'potential candidates' for such loans on the one hand, and the World Bank and the International Monetary Fund on the other. India has just become an 'adjusting' economy. What are the lessons India can learn from international experience? The paper is an attempt in this direction.

The Journal will publish in each issue Annotated Bibliography of Books and Articles on Indian Economy, Polity and Society, published after January 1, 1986. Authors are requested to send their entries with full details of publication and annotation not exceeding 250 words for books and not exceeding 100 words for articles. Use separate sheet for each entry.

BOOKS RECEIVED

Currently, a large number of books are being published on Indian economic, political and social problems and developments. We give below a list of books we have received with a request for a review. For want of editorial resources, it is not possible to review all of them though many deserve a critical review. Interested readers are requested to write to the editor indicating which of the following books he would like to review or write a full review article on. We shall be glad to do the needful. Readers are also welcome to review books recently published, but not appearing in the following list. As the contributors to this Journal are aware, all contributions published here are adequately remunerated.

Chawla, Janet - *Child-Bearing and Culture: Women Centered Revisioning of the Traditional Midwife: The Dai as a Ritual Practitioner*, Indian Social Institute, New Delhi, 1994.

The research in this monograph pertains not only to the *Dai*, the traditional Indian midwife, but with the cultural representation of the natural physiological capacities of the female body-pregnancy, childbirth and breast-feeding. The author is convinced that (i) women's perinatal physiological and emotional needs are similar across cultures; (ii) Indian women are still ashamed of their sexuality and regard themselves as untouchables, polluting others when they menstruate or give birth; (iii) even the western medical model of birth regards childbirth as a kind of 'illness' when it is actually, assert the feminists and natural childbirth advocates, a time of 'wellness'; and caste, gender and attitudes to childbirth, both Indian and occidental, ancient and contemporary, have colluded to devalue the *Dai*. Sociologically she is viewed within a casteist framework as a 'polluted' sweeper, whereas medically, she is perceived as a substandard obstetrician. Yet she occupies an important place in the cultural world of the majority of Indian women. Finally, the author recommends that training programmes for the *Dai* should be conducted by those who are sensitized with the cultural context of the *Dai*.

D'Souza, Shalini and Roy Choudhury, Arundhuti - *Documenting Communal Violence: Its Limitations and Potentialities*, Indian Social Institute, New Delhi, 1994.

This is a monograph, issued in the *Monograph Series* of the, Indian Social Institute, New Delhi, with Sebasti L. Raj as the General Editor of the series. It is based on the authors' interaction with the riot-affected people of East Delhi. The Hindu-Muslim communal riots in Delhi, in 1992, took place as the aftermath of the demolition of the *Babri Masjid*. The reports analyzed by the authors here are by the social activists, the media and the riot affected people. The authors delineate on the variations in perceptions of reporters as well as of the readers of these reports. The discussions in this monograph are thematic rather than exhaustive.

Government of India, New Delhi, - *External and Internal Resource Mobilization for Education for All*, (i) Discussion Paper, by Jandhyala B.G. Tilak; and (ii) Theme Papers: Panel Two, by Jandhyala B.G. Tilak and R. V. Vaidyanatha Ayyar, Education for All Summit, Nine High Population Countries, New Delhi, (India) December 1993.

These two documents were specially prepared for the Education for All 2000 AD (EFA) summit of the nine countries with high population and low literacy level. Their contents are the same, except that the second one contains a four-page section of issues for discussion at the summit by R.V. V. Ayyar. Tilak's discussion paper deals with such topics as the rationale for investment in primary education, certain facts regarding public expenditure on primary education, financial implications of implementing programmes for EFA and policy issues relating to domestic and external resources. The twelve tables and equal number of figures/graphs provide the latest available statistical information on the relevant topics. There is the usual executive summary, for quick

reference, and an appropriate selective bibliography, The issues for discussion by Ayyar are categorised into two areas: mobilisation of resources and utilisation of resources.

Joshi, Shashi and Josh, Bhagwan - *Struggle for Hegemony in India: 1920-47*, Vol III: 1941-47, Sage Publications, New Delhi, 1994.

This pioneering study, comprising three volumes, discusses Gramsci's theories in a new framework- in the context of India's struggle for Independence. So far the fight for Independence has been conceptualised as 'a dual contest' between the Congress party on the one hand and the Raj on the other; others are hardly taken into account. The role of the left, i.e., the Communist Party of India, in the freedom struggle, and its interaction with others and with social and political reality are analysed in these volumes. The Congress Party and the left movement are, according to the authors, two components of the same totality, each moving in to occupy the space left vacant by the other. Thus there are three major players in the triangular struggle for hegemony. Accordingly, the history of state policies, history of the national movement and history of the left are treated in this inquiry, not as three separate histories but as three strands of a single history. Moreover, the authors have chosen the left Communists) as the protagonists in this study, since the existing historiography has revolved round the *Raj* and nationalism/the Indian National Congress. It is thus, in the words of the authors themselves, an attempt 'to organically combine the perspective of 'history from below' with 'history from above' ... (which) sharpens our understanding of historical events and processes' of the years 1920-47. Strategies and methods adopted by the rival actors in the drama of 'transfer of power' in India are explored here in terms of Gramsci's theories, his insights into the specificity of state structure. The revelations, without doubt, break new paths in the history of our struggle for Independence; a new paradigm has been constructed, that views the Independence struggle as a protracted struggle to build 'national hegemony' 'state within a state'. All the three contenders - the Colonial State, the National Movement and the Left -participated in the struggle. The first two volumes of the study focus on the *political project* of establishing hegemony, while this third one concentrates on the *social-cultural project* of integrating a hegemonic view of the Indian society as the basis for Indian nationhood.

Kohli, Rajan - *Structural Change in Indian Industries*, Capital Foundation Society, New Delhi, 1994.

An attempt has been made in this book to analyse the structural change in Indian industries, based on available data from various sources. It is concerned with productivity growth in terms of value added, capital, labour, capital productivity, labour productivity and capital intensity. Inter-industrial differences in growth performance as well as salient features of industrial growth at state level, in Madhya Pradesh and West Bengal, are examined. Differences in foreign exchange expenditure to output in three categories of firms-private limited, public limited and a large public limited in engineering and chemical industries are expounded.

Kux. Dennis - *Estranged Democracies: India and the United States 1941-1991*, Sage Publications, New Delhi, 1994.

This is a comprehensive and detailed study focussed on the diplomatic interaction between India and the US. Political relations between them have never been very close. The author traces the reasons for it. Other facets of the Indo-US bilateral relationship- economic assistance, trade and commerce, cultural exchanges, etc. - are explored, primarily in the context of political and security ties. The study is arranged chronologically, each chapter devoted to a particular US President, from Roosevelt to Bush. It is based on primary material, such as official records and

document collections, personal interviews with over fifty key personnel, memoirs, secondary documentation and scholarly research. In the words of the author, 'the narrative ... tries to let the story largely tell itself without much attempt at theorizing'. He also admits that in spite of his best efforts to present both the American and the Indian perspective of the story, his understanding of the American diplomacy towards India is obviously greater than his ability to expound the Indian viewpoint, firstly because he was a US diplomat for over thirty years, and secondly because the declassified US official records were far more accessible than their Indian equivalents. He regrets that little has been made available after 1948 in India, although she is supposedly following a thirty year rule for releasing government documents.

Malhotra, R.N. - *Report of the Committee on Reforms in the Insurance Sector*, Chairman: R.N. Malhotra, Ministry of Finance, Government of India, New Delhi, January 1994.

The Committee on Reforms in the Insurance Sector was set up by the Government of India in April 1993 to (a) examine the structure of the insurance industry as evolved within the existing framework, to assess its strengths and weaknesses in terms of the objective of creating an efficient and viable insurance industry providing a wide reach of insurance services and a variety of insurance products with a high quality of service to the public and serving as an instrument for mobilisation of financial resources for development; (b) make recommendations for changes in the structure of the insurance industry as well as the general framework of policy, as may be appropriate for the pursuit of the above objectives keeping in mind the structural changes currently underway in other parts of the financial system and in the economy; (c) make specific suggestions regarding LIC and GIC, which would help to improve the functioning of these organisations in the changing economic environment; and (d) review the present structure of regulation and supervision of the insurance sector and to make recommendations for strengthening and modernising the regulatory system in tune with the changing requirements.

The Committee submitted its report in January 1994. Some of the salient recommendations made by the Committee include:

(i) the restructuring of the Life Insurance Corporation- the zonal offices should be made *de-facto* head offices for all operational purposes. The central office should basically concentrate on (a) policy formulation, review and evaluation; (b) product development, pricing and actuarial valuation, (c) investments, (d) personnel policies, (e) systems development, and (f) accounts of the Corporation.

(ii) as a wholly state-owned organisation, LIC's operational flexibility and its ability to respond to changing conditions is constrained. It is necessary to convert LIC into a company to be registered under the Companies Act to carry on the business of the LIC. For this purpose, the Government may take such legislative and other measures as may be considered appropriate, including the repeal of the LIC Act.

(iii) the LIC has, at present, a capital of Rs 5 crore, contributed entirely by the Central Government. This amount is not adequate for a life insurer of the size of the LIC. The capital should be raised to Rs 200 crore, with the government holding 50 per cent thereof and the remainder being held by the public at large, including company employees for whom a suitable proportion may be reserved.

(iv) the GIC should cease to be the holding company of the four subsidiary companies and these should, therefore, function as independent companies on their own. GIC should, in future, function exclusively as a reinsurance company and as the Indian reinsurer under the insurance Act.

(v) the GIC's share capital should be raised from the present Rs 107.50 crore to Rs 200 crore, 50 per cent of which should be held by the Government and the remainder being held by the public at large, including employees of the GIC for whom a suitable proportion may be reserved. This should have the effect of making the GIC a

board-run company.

(vi) the private sector should be allowed to enter insurance business. No single company should be allowed to transact both, life and general insurance business. The number of new entrants should be controlled.

(vii) the minimum paid-up capital for a new entrant should be Rs 100 crore. However, a lower capital requirement may be prescribed for state level cooperative institutions taking up life insurance business.

The Committee has called for major legislative changes in view of the recommendations made by it.

Mathew, P.D.- *Freedom of Religion In India*, Indian Social Institute, New Delhi, 1994.

This booklet is brought out in the *Legal Education Series*, meant for lay persons. It is in question-answer form and the author acquaints the readers with the constitutional provisions for religious freedom in India and their interpretation by the Supreme Court in some landmark judgments. The various aspects covered are right to profess, practice and propagate religion, conversion, ex-communication, state intervention in religious matters for bringing about social reform, freedom to establish, manage, maintain religious institutions, religious instruction and offences relating to religion punishable under the Indian Penal Code.

Mathew, P.D.- *The Indian Evidence Act: Simplified*, Indian Social Institute, New Delhi, 1994.

Law of evidence is crucial for the outcome of any litigation since it is the evidence, oral evidence through witnesses or documentary evidence, presented in the court in support of one's legal claims, that decides the case. The present book deals with the basic principles of the Indian Evidence Act, 1872, in question-answer form. The complex legal concepts, such as *Res Judicata*, burden of proof, estoppel, etc., as well as intricate rules of evidence and elaborate court procedures like various modes of proving documents of all kinds, examining and cross-examining witnesses, admission and rejection of evidence, etc., are succinctly explained in simple language. The purpose of this publication is to educate the common man about the important provisions of the law of evidence and make him aware how disastrous it would be to destroy any vital piece of evidence.

Omvedt, Gail - *Dalits and the Democratic Revolution: Dr. Ambedkar and the Dalit Movement in Colonial India*, Sage Publications, New Delhi, 1994.

This book provides an insightful account of (i) the origin and development of the caste system; (ii) Dalit movement from its beginning in the nineteenth century upto 1956, the demise of Dr. Ambedkar, the most famous Dalit leader; (iii) Ambedkarism, i.e., Dr. Ambedkar's thoughts, which form the dominant ideology of the Dalit movement for liberation; (iv) the interaction of the Dalit movement with the two struggles - the freedom struggle, particularly with Gandhi and Gandhism and the 'class' struggles of workers and peasants, with their ideology of Marxism. The analysis is based on original research material drawn from the three states of Andhra Pradesh, Karnataka and Maharashtra. Its unique methodological framework, which takes into account the realities of caste, class and gender, is a modified historical materialism.

Patel, I.G. - *Report of the Committee to Review the Work of IGIDR*, Chairman: I.G. Patel, Reserve Bank of India, Bombay, January 1994.

The report reviews the activities of the Indira Gandhi Institute of Development Research since its inception five years ago. Activities in academic and research areas, their quality, scope and relevance are examined, particularly from the perspective of the objectives mentioned in its charter. A profile of the IGIDR precedes the evaluation of its organisational structure and its activities-research, teaching and institution building. The recommendations made in the report include: a)

a discussion of the weaknesses and strengths of the Institute, and b) counsel for solving the problems in the human relations issues.

Seth, Vijay K. and Seth, Ashok - *Dynamics of Labour Absorption in Industry*, Deep and Deep Publications, New Delhi, 1994.

This study in development economics focuses on employment implications of industrialisation in developing economies. It seeks answers to the following questions: whether industrialisation can be a solution to the problem of unemployment in a developing economy; what changes have taken place so far in the realm of labour absorption in the Indian industries as a result of industrialisation within the framework of planning and market regulations; what is the impact of the labour market regulation on labour absorption in India - whether it reduces the potential of labour absorption; and whether liberalised economy and regulated labour market can coexist. Many trade unionists and leftist parties are, at present, a great deal concerned with the last question. The authors also analyse the theory and different estimation techniques of labour demand function, the degree of substitution and the responsiveness of factor demand to changes in factor price. One chapter is devoted to the inter-industry differences in labour absorption.

Swamy, Dalip S. -*The Political Economy of Industrialisation: From Self-reliance to Globalisation*, Sage Publications, New Delhi, 1994.

The study traces the path of Indian industrialisation from Independence to 1990. The growth model of self-reliance, optimal employment, social justice and prosperity for all was adopted by Indian planners in the fifties. It failed for various reasons which are critically analysed by the author. The forty years period is divided into three phases: (i) industrial growth with regulation (1950-65), (ii) industrial slow-down (1965-74), and (iii) industrial revival without regulation (1974-90). The changing role of the planning process, the performance of the public sector and the contribution of foreign capital in each of these phases are discussed. The author comes to the conclusion that the main constraint on development being external factors, it would not be possible to develop a people-oriented growth model, without tackling the effects of globalisation on the national economy. The monograph provides an excellent perspective in which to evaluate the current policy initiatives.

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विकास का समाजशास्त्र

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