SAVING, CAPITAL IMPORTS AND GROWTH:

A MACROECONOMETRIC STUDY OF INDIA

SAVING, CAPITAL IMPORTS AND GROWTH:
A MACROECONOMETRIC STUDY OF
INDIA

by

ATUL ADITYA DAR, M.A., M.A.

A Thesis
Submitted to The School of Graduate Studies
in Partial Fulfilment of the Requirements
for the Degree
Doctor of Philosophy

McMaster University

1981

DOCTOR OF PHILOSOPHY (1981) (Economics)

McMaster University
Hamilton, Ontario

TITLE: Saving, Capital Imports and Growth: A Macroeconometric Study of India

AUTHOR: Atul A. Dar, M.A. (Delhi University)
M.A. (McMaster University)

SUPERVISOR: Professor F.T. Denton

NUMBER OF PAGES: xv, 437

FOR M.K.D.

ABSTRACT

In this study, a macroeconometric model of the Indian economy is constructed and estimated for the period 1957-1976. The model is evaluated in terms of its ability to forecast major endogenous variables through historic simulation, and is then used in a set of experiments to examine the short and long period effects of changes in various important exogenous variables.

The model is growth-oriented, and focuses on the process of capital accumulation which is, amongst other things, an important determinant of growth in labour-surplus economies such as India. Supply factors play a major role in determining capital formation and output. Thus, the constraint imposed by the availability of resources - viz., saving and capital imports - is an important factor in the process of capital accumulation. Keynesian-type demand phenomena play a minor role in determining output. The forces of demand, however, are involved in determining prices which partly determine real resource supplies, which in turn, affect the rate of capital formation and hence the growth rate of output.

In order to articulate important institutional and economic characteristics of the economy, the role of

the government sector in the process of accumulation is separately and endogenously examined, the economy is disaggregated into four major sectors and the process of capital accumulation and other determinants of sectoral output are separately analysed. The sectoral rates of capital formation are determined within the context of an overall constraint on aggregate capital formation imposed by the real volume of resources - viz., saving and foreign capital.

The study also attempts to look at some additional aspects of foreign capital. Thus, one question that is examined is whether foreign resource inflows adversely affect the domestic resource mobilization effort - viz., the saving effort (of the government) for a given level and structure of taxation, prices and income, and/or the taxation effort itself. Further, a sub-model of the foodgrains sector is constructed and integrated with the rest of the system to examine specific as well as economy-wide effects of Public Law (PL 480) foodgrain aid to India. Of interest are the effects on foodgrain and agricultural output and investment, as well on output in other sectors.

To deal with the simultaneity problem the model is estimated by a two-stage procedure based on principal components. The tracking ability of the model is found to be reasonably good in respect of major endogenous variables.

There is some evidence of weak (adverse) effects of foreign resource inflows on government saving, though no such evidence is found for the tax effort. PL 480 foodgrain aid is found to be a less-than-perfect substitute for commercial foodgrain imports, thereby implying that there is some foreign exchange saving implicit in each unit of PL 480 imports.

Our simulation experiments suggest that an increase in foreign capital inflows over a short period have only temporary favourable effects on the growth rate of the economy though the time-path of national output is permanently raised. Moderate increases in foreign capital inflows sustained over a longer period, merely raise the time-path of output but have no significant effects on the rate of growth. Reduced PL 480 aid compensated by increased foreign exchange aid has favourable effects on foodgrain and agricultural output, as well as on national income. If there is no compensating increase in foreign exchange aid, but a corresponding decline in capital transfers to the government, there are economy-wide contractionary effects. In both cases, ther supply of foodgrains in the economy is adversely affected. Other simulation experiments suggest the presence of the "Please Effect" in that increased direct taxation leaves the aggregate volume of saving unchanged, while increased government spending based on money creation is largely absorbed through rising prices.

ACKNOWLEDGEMENTS

I would like to thank the members of my Supervisory Committee - Professors Frank T. Denton, James R. Williams and David W. Butterfield - for all the help and guidance they extended to me during the course of my work. I owe a special debt of gratitude to Professor Denton, who, as Chairman of the the Committee, gave freely of his time and provided many constructive comments at all stages of the study. Professor Syed Ahmad was a member of the Committee before he left for sabbatical in the early stages of the dissertation. During that time I benefitted from discussions with him. Professor Atif A. Kubursi, as well as Reza Ghaeli helped clarify certain matters and offered constructive comments. I thank them all.

I would be failing in my duty if I did not acknowledge my debt to a number of other people - to Messrs. Wanchoo, Nazrul Islam, and Mohammed Fatmi for making available some of the data used in this study, to Karen Scott without whose help the simulation experiments I conducted would not have been possible, and to Aloma Munian for undertaking the horrendous task of typing the manuscript. Most of all, I would like to thank my wife, Najma, for her continuous support and encouragement, and for bearing with fortitude what was a difficult period for her.

My entire stay here at McMaster as a graduate student was made possible by a scholarship from the University. I thank the University for its generosity.

I need hardly add that all errors of omission and commission reflect my own shortcomings and for them I alone assume full responsibility.

TABLE OF CONTENTS

TABLES AND FIGURES

FIGURES

ABBREVIATIONS

CSO	Central Statistical Organization
DES	Directorate of Economics and Statistics
DGCI	Department of Commercial Intelligence and Statistics
ICAR	Indian Council of Agricultural Research
IBRD	International Bank of Reconstruction and Development
ICSSR	Indian Council of Social Science Research
NBER	National Bureau of Economic Research
UNCTAD	United Nations Conference on Trade and Development

CHAPTER 1

A NOTE ON THE NATURE AND ORGANIZATION OF THE STUDY

In this study, we construct and estimate a growth-oriented, macro-econometric model of the Indian economy[1]. In contrast to the demand-oriented models of the Keynesian type in which demand-determined expenditure categories determine output, this model is primarily supply-oriented, and the forces of accumulation are the major determinants of output. Resource constraints are a central feature of the model, and constitute a major obstacle to capital accumulation and output.

Resource constraints and their implications for growth in less-industrialized countries have received much attention in the development literature. Saving has been traditionally considered as an important domestic resource constraint on capital accumulation and output in economies like India. In contrast to developed economies, in which fluctuations in output and employment around the full-employment growth path originate primarily from fluctuations in aggregate demand, and are hence a central problem of stabilization policy, developing economies like India suffer from considerable unemployment of a secular nature, and the central problem is one of enhancing the economy's productive capacity, which is a major determinant of output and employment. The role of saving as an important determinant of capital accumulation is explicitly treated in our model. This is in contrast to most other Indian models, in which accumulation is primarily demand-determined[2]. Further, while the saving constraint on capital accumulation is explicitly modelled at an aggregate level, it is indirectly linked to capital accumulation in different production sectors of the economy as well. We also partly allow for the possibility that, apart from additions to capital, the productivity of capital itself can also be an important factor determining output.

The supply of foreign exchange is considered to be another major resource constraint on growth in developing economies, since it is a major determinant of import capacity, which in turn, determines the ability of the country to import essential producer goods required to sustain its development drive. Foreign exchange is a scarce resource with many competing uses to which it can be put. In our model, a distinction is made between imports that normally receive top priority (such as food, fertilizer and compulsory payments such as interest on external debt), and are hence the first charge on available foreign exchange, and those imports which are also essential imports (producer goods), but which are licensed to the extent permitted by the availability of foreign exchange after netting out the foreign exchange requirements of top priority imports. The foreign exchange constraint on imported inputs and hence on output and/or investment, is common in models of developing economies, and is a feature of a number of Indian models[3]. Our approach (outlined above), however, is not only an approximation to how the foreign exchange licensing mechanism actually works at a broad level; it also enables us to link the foodgrains sector to output in other sectors of the economy via its impact on imported inputs. In fact, since the effects of commodity assistance to India are explicitly modelled (as we point out below), we have a framework that permits us to examine the direct and secondary foreign exchange effects of such assistance. Apart from imported inputs, we attempt to examine the impact of other "essential" inputs on output. Thus, we consider the effect of important infrastructural inputs, such as industrial power, and in the case of the agricultural sector, we attempt to model the effects of modern farming methods associated with the spread of the so-called "Green Revolution".

The role of foreign capital in fostering economic growth in developing nations has also received much attention in the development literature. The significance of foreign capital is argued to arise not merely from the fact that it adds to a country's investable resources in the same way an increase in saving would, but it also eases the foreign exchange constraint. Thus foreign capital can plays an important role in permitting higher rates of capital formation and growth. These potentially important aspects of foreign capital are explicitly examined in the present study. Further, some additional issues are also studied. Thus, an issue that has attracted much attention over the years, is the view that foreign capital has adverse effects on domestic saving. One avenue through which this adverse effect has been argued to operate, is a relaxation in the government's tax effort. Both these issues are examined, and an attempt is made to incorporate such effects in the relevant relationships in the model. Another aspect of foreign aid, that has attracted considerable attention is the issue of commodity aid. India received substantial foodgrains asssitance under U.S. Public Law 480 (PL 480) in the sixties and late-fifties. It has been argued that such aid has adverse effects on agricultural production and investment in recipient countries. We examine these and other effects in our model. Thus, we construct a sub-model of the foodgrains sector, which enables us to examine the effects of PL 480 aid on foodgrains and agricultural output. Further, the inter-sectoral links in the model imply a broader set of effects on agricultural investment, as well as on investment and output in other sectors of the economy, national income and prices. An interesting feature of PL 480 aid, which we incorporate in the model, is the effect of such aid on the foreign exchange situation, and hence on output via the impact on imported inputs. A distinction is drawn between PL 480 foodgrain imports (which are paid for in rupees instead of foreign exchange) and commercial imports (which are paid for in foreign exchange). To the extent the former substitute for the latter, PL 480 imports affect the supply of foreign exchange. The substitutability of PL 480 imports for commercial imports and the foreign exchange effects are both examined. Thus, the model attempts to examine a number of different aspects of foreign capital.

The government has played an ever-increasing role in forcing the pace of development in the economy, and has emerged as a major investor. This important institutional feature of the economy is explicitly examined. In most Indian models the government sector has been treated exogenously. Even though our approach to government economic activity is simplified and aggregative, government revenues, current expenditures and saving and capital formation are endogenously treated, and form a simultaneous interdependent sub-system with links to other economic magnitudes in the model.

An objective of the study is to use this model in a simulation context, first to evaluate its forecasting ability and second, to examine the short and long-run effects of changes in various exogenous variables, such as foreign capital, PL 480 aid and export earnings, amongst others. These experiments not only throw light on the dynamic properties of the model, but also enable us to evaluate the importance of factors such as foreign assistance and PL 480 aid in terms of their economy-wide effects as well as aggregate effects on the time-path of output.

Needless to say, the study benefits from the Indian models that have preceded it. At a broad level, a major underlying difference in this study is the emphasis on supply factors and resource constraints as the major determinants of output and capital accumulation, and the manner in which these have been modelled. At a specific level, some of the salient differences in our model are the following: (1) an explicit and broader examination of the role of foreign capital is attempted; (2) the saving constraint on capital formation is explicitly modelled; (3) a sub-model of the foodgrains sector is built and integrated with other parts of the model to enable an examination of the sectoral and aggregate effects of PL 480 aid; and (4) government current expenditures, saving and capital formation are inter-related and are endogenously determined through mutual interaction with other endogenous variables in the system. There are other differences, such as the level of aggregation adopted and the historical period examined. Most Indian models have been based on pre-1965 data. The present model is applied to more recent Indian history (1957-1976), and is based on the new revised national accounts data that have become available recently. We conclude this chapter with a brief outline of the organization of the study.

In Chapter 2, we elaborate the notion of resource constraints on growth with the help of a simple model that appears in various forms in the development literature. However, this model is used only with illustrative intent. Also outlined in Chapter 2 are the various aspects of the role of foreign capital that we attempt to incorporate in our model. Thus, we elaborate the sense in which foreign resources augment investable resources, and the sense in which they substitute for domestic saving. Chapter 2 concludes with a discussion of PL 480 assistance with reference to the issues which are relevant in examining its effects in the Indian context and which we attempt to incorporate in our model. Chapter 3 is intended as a background ot the model, as it highlights the institutional and economic structure of the Indian economy, as well as the broad trends in important economic magnitudes. At a number of points in the development of the model, reference is made to various empirical observations made in this chapter. Chapters 4, 5 and 6 are devoted to the construction of the model. In Chapter 4, the supply side of the model is developed and estimated, while Chapter 5 deals with the saving, taxation, and capital formation relationships. Chapter 6 is the concluding chapter in the development of the model, and in it we develop and estimate the foreign trade, price and related equations. The entire estimated model, along with the identities and definitions, is presented in an appendix to this chapter. Chapter 7 deals with two main issues. First, the forecasting ability of the model is examined in some detail through historical simulation. Second, the model is used in a set of experiments based on alternative assumptions about foreign capital inflows, PL 480 assistance, foreign exchange availability, amongst others. Chapter 8 is in the nature of a summary. In it we also indicate the limitations of the model. In the Data Appendix we list the sources of the data and discuss the methods adopted in constructing various series used in the model.

FOOTNOTES

Chapter 1

1. A number of efforts have been made to model the Indian economy - Narasimham (1956), Marwah (1964, 1972), Krishnamurty (1964), Choudhury (1963), Krishnamurty and Choudhury (1968), Agarwala (1970), and UNCTAD (1968, 1973). As is to be expected, these models differ in size and emphasis as well as in terms of the time period covered. Most of these models have been examined and evaluated in a survey paper by M. Desai (1973). There have been a number of sectoral studies as well. Examples are the Mammen (1967), Khetan (1973) and Gupta (1971). models of the monetary sector, and the Yadev (1975) and the Dutta (1964, 1965) studies of the foreign sector.

2. In the UNCTAD (1973) model, saving relationships are explicitly postulated. However, parts of the model are sketchily outlined, and the precise role of various variables (particularly in the identities) is unclear to the reader. There appear to be missing equations/definitions and the precise role of saving in the model is uncertain.

3. See, for instance, Marwah (1972), Agarwala (1970) and Krishnamurty and Choudhury (1968).

4. Examples are Krishnamurty and Choudhury (1968), Krishnamurty (1964) and UNCTAD (1973).

5. Prices in our model are determined through the forces of demand and supply, but the price response of output is small. In particular, it is largely confined to the agricultural sector. In this respect, the model has similarities with UNCTAD (1973). However, it is capital accumulation which is a major determinant of output in all sectors of the economy. In this respect,the model has some similarities with Agarwala (1970) as well. Consequently, the main effect of prices is on the <u>growth</u> of output <u>via</u> their effect on capital accumulation.

CHAPTER 2

SAVING, FOREIGN EXCHANGE, FOREIGN CAPITAL AND GROWTH: SOME BROAD ISSUES.

(2.1) INTRODUCTION.

In this chapter we elaborate upon those aspects of the role of saving, foreign exchange and foreign capital in economic development that are incorporated in a macro-econometric model of the Indian economy and then examined within a simulation context. The chapter is not intended to be a survey, but merely brings together certain ideas that have appeared in the development literature and which highlight the general framework that governs the nature and orientation of the model. In Section (2.2) we discuss the notion of saving and foreign exchange constraints on growth, while Section (2.3) highlights the role of foreign capital in economic growth. Section (2.4) deals with questions pertaining to the relationship between the domestic resource mobilization effort and the availability of foreign resources. Finally, we conclude with a discussion of issues raised by commodity aid, mainly in the context of the effects of PL 480 food aid to India.

(2.2) SAVING, FOREIGN EXCHANGE AND GROWTH.

In the development literature, the level and rate of growth of income per capita are commonly taken as indicators of the level of development and development performance respectively[1]. Despite the difficulties associated with such measures, they highlight an important aspect of economic development, and are central to much of the developments in the theories of economic growth and development. One of the major questions to which answers have been sought in the development literature, has been the causes of the existence and/or persistence of low incomes per capita in developing countries. Broadly speaking, one explanation of this phenomenon has been sought in the "vicious circles" that have been argued to exist in many developing countries[2]. In capital-oriented approaches to development, the "vicious circle" implicit in the mutually reinforcing interactions between low incomes per capita and low saving and investment rates, has received much attention, as it highlights the potentially important role saving can play in the growth process. If, for instance, the saving rate can be raised and sustained (for example, through foreign capital), these "vicious circles" may become, as Yotopoulos and Nugent put it, "virtuous circles"[3].

Thus, saving has long been considered to be an important constraint on the ability of developing countries to grow. This constraint highlights the importance of the role of capital formation in the process of growth, especially for capital scarce developing countries. Thus, for example, in two (now famous) papers, Rostow and Lewis suggested that for self-sustaining growth, developing countries must achieve amongst other things, a saving-investment rate of at least 10% of national output, the precise proportion depending upon the particular country one has in mind[4]. Kuznets' historical data on present-day industrialized countries seems to suggest that these countries had a saving-investment rate of this magnitude, in the periods corresponding to "take-off" into self-sustained growth[5].

The growth aspects of saving have been formalized in growth models of the Harrod-Domar or neo-classical variety. Among the well-known propositions that follow from the latter is that an increase in the saving rate lifts the economy from a lower to a higher steady-state time path of output. The problem of growth in developing countries can in fact, be viewed as one involving the transition from a "low" steady-state equilibrium to a "high" steady-state, the saving rate being an important means through which this can be sought. Indeed, the "low" steady-state is akin to the "low-level equilibrium trap" at which developing economies suffering from rapid population growth get "stuck", and in which the "vicious circles" alluded to above are operative[6]. Breaking out of this low steady-state characterized by low, subsistence per capita income levels consequently requires an acceleration in the rate of growth of output (i.e., non-steady state growth), and the saving rate, apart from other factors, can be expected to play an important role in this process. The attempt by numerous developing nations (starting at low levels of income per capita) to step up saving rates, and to force the pace of development marks the early stages of the transition to higher and sustained levels of income per capita.

The tendency in development circles to ascribe significant importance to saving and capital formation does not mean that other constraints have been ignored. In particular, the existence of an "absorptive capacity" constraint has been clearly recognized[7]. This constraint is a summary of a set of other constraints on economic development - viz., the social and institutional environment, endowments of managerial and technical skills and so forth. In spite of its relevance for many developing countries, its use in theoretical work, and much more so in empirical work, has been limited since it is difficult to define it precisely as also to quantify it meaningfully[8].

However, according to one source, most developing countries since World War II have grown at rates that are lower than those that the growth in their absorptive capacities would permit[9]. Presumably this has been on account of difficulties in resource mobilization and/or other factors.

Of these other factors, the one that has been argued to constitute, independently of saving, a major constraint to growth in developing countries, is the foreign exchange or import capacity constraint[10]. This constraint has received, over the last 15-20 years, much attention in the development literature, and has been formalized in the "Two-Gap"theories (henceforth TGT) of development to which H.B. Chenery and a host of other researchers have contributed[11]. The TGT theory goes beyond the traditional saving-oriented theories in that it incorporates a saving constraint as well as an import capacity constraint, either of which may, at any time, limit the rate at which a country can grow. The notion of an import capacity constraint derives from the presumption that problems of growth can stem from the real possibility that even if domestic saving can be raised, growth may be curtailed if a country cannot import the goods required to support even relatively modest industrialization programmes, due to insufficient foreign exchange earnings. That this problem may be very real, is reflected in the vigorous export promotion and/or import substitution policies followed in many developing countries, as also in the flows of foreign aid, the structure of imports, the chronic pressures on the balance of payments, import controls and so forth. These issues raise an important set of questions pertaining to the role of the external sector and foreign capital along with domestic resource mobilization, in economic development. Our aim in subsequent chapters is to quantitatively examine these issues in light of the Indian development experience since 1956.

The TGT of development which incorporates both the notions of saving and foreign exchange constraints on development, has been formulated in numerous ways[12]. The common underlying theme of the theory is that the development process in developing countries is hampered by certain structural characteristics. The development problem can be viewed as one which requires transforming predominantly agrarian economies into modern industrial ones. But typically the exports of developing economies are concentrated in those goods which face sluggish world markets and hence cannot provide the foreign exchange for imports of machinery, equipment and materials required for such a transformation. Indeed, export possibilities themselves are tied up with the success of this endeavour. Thus foreign exchange or import capacity can act as a constraint on growth. This is one strand of the TGT. The second strand of the theory is the traditional saving constraint which arises since existing low levels of income do not generate sufficient saving to finance the investment requirements of an industrialization programme. TGT argues that both constraints can exist independently of the other, though only one of them can be binding at any time. Let us examine briefly these and other implications.

From the national accounts identity, we know that *ex post*:

$$I - S = Z - X$$

where I = investment, S = savings, Z = imports, X = exports. The savings gap is defined as (I - S) and the foreign exchange gap is defined as (Z - X). Clearly, *ex post*, they are one and the same. The thrust of TGT theory, however, is that these may not be equal *ex ante* with reference to a *planned* rate of growth, so that growth is said to be constrained by the larger of the two gaps. The basis of the argument is that foreign inputs, which are not substitutable with domestic inputs, appear in the production function. Then, a targeted rate of growth in addition to implying certain investment requirements, will also imply foreign input requirements. Fixed saving propensities and export possibilities can thus lead to *ex ante* gaps such that

$$(I - S) \gtreqless (Z - X)$$

Growth is said to be constrained by foreign exchange if

$(Z - X) > (I - S)$,and by the saving gap if $(I - S) > (Z - X)$. In the absence of additional finance to fill the larger of the gaps, the targeted rate of growth cannot be achieved. In order to examine the nature and the relationship between these gaps, let us illustrate the TGT with the aid of a model. As noted earlier, TGT has been formulated in numerous ways, at varying levels of complexity, and with more or less restrictive assumptions. For our purpose the following simple model adapted mainly from McKinnon should suffice in highlighting the central aspects of the theory[13].

Assume

(2.1) $Y = \min (aKD, bKZ, cRZ)$

where Y = capacity output, KD = domestic capital, KZ = imported capital and RZ = imported raw materials; $a, b > 0$, and $c > 1$, are the input coefficients[14].

(2.2) $Z = IZ + RZ + CZ$

where Z = total imports, $IZ = dKZ/dt$ = capital good imports and CZ = consumption imports. McKinnon does not consider consumption imports in his model, though such imports can have important foreign exchange implications in countries like India where food imports have generally tended to be high[15]. Units are chosen such that a unit of Y can be transformed into a unit of KD, or through trade into a unit of RZ or KZ or CZ.

(2.3) $CD = n_o(Y - Y/c)$ where CD = domestic consumption and $(Y - Y/c)$ = <u>net</u> domestic income available for consumption or saving, or

(2.4) $CD = \{n_o(c - 1)/c\}Y = nY$, where $n = n_o(c - 1)/c$. Similarly, if consumption imports CZ are proportional to net income, we can write:

(2.5) $CZ = e_0(Y - Y/c) = \{e_o(c - 1)/c\}Y = eY$, where $e = e_o(c - 1)/c$. We can also write

(2.6)
$$S = (Y - Y/c) - CD - CZ = (Y - Y/c) - \{n_o(c-1)/c\}Y - \{e_o(c - 1)/c\}Y$$
$$= \{(1 - n_o - e_o)(c - 1)/c\}Y = sY,$$
where $s = (1 - n_o - e_o)(c - 1)/c$ and S = saving.

(2.7) $I = IZ + ID = S$

where I = total investment, ID = domestic investment.

If there are unlimited export possibilities, domestic output can be freely transformed into imports. The distinction between IZ and ID is redundant since saved output can be switched between KD and KZ. Using (2.1) through (2.7) yields

(2.8) $dY/dt = [1/(1/a + 1/b)](IZ + ID) = v(IZ + ID)$

$= vsY$ where $v = 1/(1/a + 1/b)$ = output-capital ratio.

The rate of growth of output is thus vs and the only constraint on it is the ability to save (i.e., the saving rate s).

If export possibilities are limited, and are themselves dependent upon domestic capacity, we can, following McKinnon, write

(2.9) $X = xY \qquad 0 \leq x < 1$

where X = exports.

Assuming balanced trade, we have

(2.10) $X = Z$

Suppose initially RZ = 0. Using (2.2), (2.5), (2.9) and (2.10), we get

(2.11) $xY = dKZ/dt + e_1 Y$ where, $e_1 = CZ/Y$ and $dKZ/dt = IZ$

However, from (2.1), $IZ = (dY/dt)/b$. Thus (2.11) becomes

(2.12) $xY = (1/b)(dY/dt) + e_1 Y$

$dY/dt = b(x - e_1)Y$

(2.13) $(dY/Y.dt) = b(x - e_1)$

This the rate of growth permitted by export possibilities. Thus, if $b(x - e_1) < vs$, growth is said to be foreign-exchange-constrained and all potential saving will not be realized and the actual rate of growth will be given by $b(x - e_1)$. Note also that raising saving by reducing domestic consumption will have no impact on growth. Increasing saving will raise the growth rate only if this is achieved by a reduction of consumption imports, for this directly releases foreign exchange which is the binding constraint. In some strict models of the TGT it is assumed that $e_1 = 0$, and here domestic saving will have no impact whatsoever on the growth, for there is no implied relaxation of the foreign exchange constraint. It is evident that with the foreign exchange bottleneck, while exports are at the maximum possible, saving is not, given that the actual rate of growth < vs.

Conversely, growth is constrained by saving if $b(x - e_1) > vs$, the actual growth being vs. In this situation, while saving is at its maximum, exports are not. Further, a reduction in consumption imports CZ or domestic consumption (CD) will always raise the rate of growth by easing the saving constraint[16].

Let us now introduce raw materials into the picture. (2.12) thus becomes

(2.14) $xY = (1/b)(dY/dt) + nY + (1/c)Y$, where $(1/c)Y$ = raw materials needs of capacity output.

(2.14) can be rewritten as

(2.15) $(dY/Y.dt) = b(x - (1/c) - n)$

It is clear from (2.15) that for there to be any growth at all, $x > (1/c) + n$. Note that a similar requirement arises in connection with (2.13), though the condition here is more stringent[17]. In McKinnon's model, $n = 0$, so that if $x < (1/c)$, there is nothing that the country can do. Here however, consumption imports can be banned or reduced <u>via</u> direct control. The reason for the possibility of no growth is of course, that with the kind of rigidity assumed in the production structure, if $x < (1/c)$ or $x < (1/c) + n$, exports cannot even cover raw material requirements, so that there can be no capital formation in foreign capital goods[18].

Provided $x > (1/c) + n$, it is clear that if $b(x - (1/c) - n) < vs$, the foreign exchange constraint is binding and the actual rate of growth is $b(x - 1/c) - n)$. If, on the other hand, $vs < b(e - (1/c) - n)$, we have a binding saving constraint and the actual growth rate is vs.

TGT thus highlights the importance of the import capacity of a country (in addition to saving in determining its rate of growth, and hence incorporates what is generally considered to be an important aspect of economic development. Nevertheless, the theory has been subject to criticism mainly in connection with the assumptions on which it is based[19]. However, using the standard neoclassical growth-theoretic framework, Khang and Bardhan have constructed models which highlight the importance of the import capacity (apart from saving) of a country in determining its rate of growth[20]. The distinguishing feature of these models is that production is dependent upon imported, raw material inputs not produced at home. However, the production structure is flexible,as a Cobb-Douglas production is postulated, and price considerations are brought in by making exports dependent upon relative prices. The authors show that if each factor is paid its marginal product, exports and labour grows at the constant rates e and m respectively, and the saving ratio s is constant, the steady-state growth rate of output is a weighted average of the rate of growth of labour and exports:

(2.16) $(dY/Y.dt) = wm + (1 - w)e$

where $0 < w < 1$

Per-capita output y, on the other hand, grows at the rate given by

(2.17) $(dy/y.dt) = (1 - w)(e - m)$

It follows from (2.16) that the steady-state growth output is higher, the higher is the rate of export growth e[21]. The implication is that for countries in which production is dependent upon imported inputs, the export sector can be a crucial element in determining their rates of growth.

On the other hand, it is clear from (2.17), the rate of growth per capita can decline. Thus, per capita output will continuously decline if $e < m$. It will rise continuously when $e > m$, and we get the standard result of a constant per capita output when $e = m$.

A none too remote possibility for important dependent developing economies is the simultaneous existence of rapid rates of population growth and low rates of export growth. This would, according to the above model, tend to keep these economies in a grip of stagnation. This is somewhat synonymous to the concept of a "low-level equilibrium trap" in which an economy suffering from rapid population growth, gets "stuck"[22].

The above models, though based on simplifying assumptions, are useful contributions in that they incorporate what Bardhan calls the "stylized facts" of development[23]. The case where per capita income, in steady-state, declines, cannot continue indefinitely. In the real world there are counteracting forces - viz., technical progress and foreign capital[24]. Either of these can reverse or arrest the adverse downward movement in per capita output.

(2.3) FOREIGN RESOURCES AS A SUPPLEMENT TO DOMESTIC RESOURCES.

The traditional view of the role of foreign resources is that they supplement domestic resources, and hence enable the achievement of higher rates of growth. This is best seen by considering the TGT model above in the context of unlimited export possibilities, so that the only constraint to higher growth rates is domestic saving. If foreign capital supplements domestic savings, (2.7) becomes $I = S + F$, where F = foreign capital, and by implication (2.8), which gives the rate of growth of output, becomes: $(dY/Y.dt) = (vs + f)$ where $f = F/Y$. Since $F > 0$, the growth rate of output is higher. Exactly similar results follow if we use a simple clōsed-economy neoclassical growth model.

In TGT, generally speaking, foreign capital does similar things, though the implications for the effect on the growth rate depend upon which constraint is binding. This follows from the dual role foreign capital plays - viz., that it provides additional investable resources and stabilizes the balance of payments as well. TGT thus embraces the traditional role of foreign capital as well.

We assume that there are no raw material imports, though the following illustration can quite easily be extended to allow for such imports without changing the essence of the anlaysis. The introduction of foreign capital inflows F, means that (2.7) and (2.10) become

(2.18) $I = IZ + ID = S + F$

(2.19) and $Z = X + F$

As a consequence, it can be easily shown that (2.8) and (2.15) become

(2.20) $(dY/Y.dt) = v(s + f)$

(2.21) $(dY/Y.dt) = b(x - e_1 + f)$

where $f = F/Y$.

The actual rate of growth is given by

$b(x - e_1 + f)$ if $b(x - e_1 + f) < v(s + f) \Leftrightarrow$ foreign exchange constraint is binding

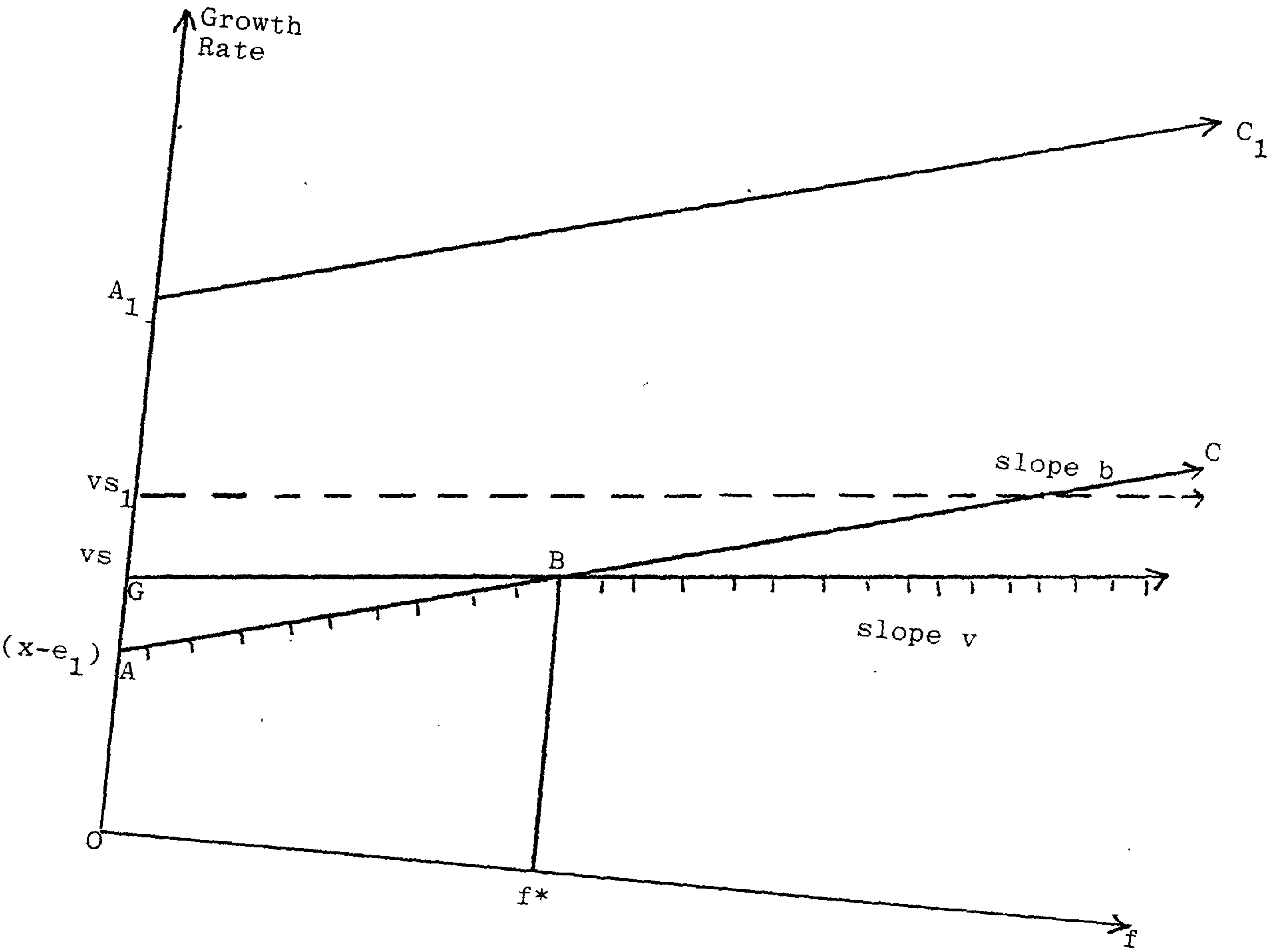
or by

$v(s + f)$ if $b(x - e_1 + f) > v(s + f) \Leftrightarrow$ saving constraint is binding

The two growth rates given by (2.20) and (2.21) can be plotted as functions of f as in Figure 2.1 below.

It is evident that (i) $b > v$ since $v = (1/(1/a+1/b))$, implying that the slope of AC > slope of GD, and (ii) for a foreign exchange constraint to exist at all, $vs > b(x - n_1)$, for otherwise AC would lie uniformly above GD (eg., A_1C_1),

FIGURE 2.1



so that the constraint on growth for any $f \geq 0$ is simply the saving constraint.

In the range Of* the foreign exchange constraint is binding while beyond f* it is the savings constraint that is binding. Starting from a position where f = 0, it is clear that the growth rate rises as f rises. An important proposition of TGT is that a given increase in foreign capital has a proportionately greater effect on the growth rate when the foreign exchange is constraint is binding than when the saving constraint is binding. This is borne out in Figure 2.1, since for any <u>given</u> increase in f, the growth rate rises by more along AB than along BD.

Other interesting implications follow. If we are operating in the range of the foreign exchange constraint (along AB), then an increase in the saving rate to s_1 which shifts GD upward for any given rate of $f (< f^*)$, will have no effect on the growth rate, whereas if we are operating in the range of the saving constraint, there is a positive impact on growth. This result, however, follows only in strict versions of TGT. In particular, we have to assume either that $e_1 = 0$, <u>or</u> if $e_1 > 0$ that the increase in the saving rate is at the expense of <u>domestic</u> consumption. In either case, an increase in the saving rate will not raise the growth rate in the range of the foreign exchange constraint. However, if the increase in s is partly or wholly due to a corresponding fall in consumption imports, then even under a foreign exchange constraint the growth rate will rise. In terms of Figure 2.1, when GD shifts upward, so does AC. The reason for this is simple. The increase in s here, due to a reduction in consumption imports, implies a relaxation in the foreign exchange constraint.

We have demonstrated how foreign resources add to domestic resources and enable the achievement of higher rates of growth, within the context of a simplified and somewhat restrictive model. However, it is meant to be largely illustrative. In the following section we discuss the view that foreign resources partly substitute for domestic resources.

(2.4) FOREIGN RESOURCES AS A SUBSTITUTE FOR DOMESTIC RESOURCES.

An issue that has attracted much attention over the past decade or so is the relationship between foreign capital and the domestic saving effort. It has been argued that foreign capital has detrimental effects on the saving effort - viz., it substitutes for domestic saving[25]. Much of the empirical work in this area seems to confirm the substitutive effect of foreign capital. In the next few pages we briefly outline the nature of the problem and tie it in with the discussion in the foregoing section, where foreign capital was viewed as a supplement to domestic resources.

Anisur Rahman has illustrated, with the help of a mathematical programming model, that foreign capital not only enables "....the recipient country to achieve a higher rate of growth than what it could have out of domestic saving pushed to its maximum.... (but that) it may also enable the recipient country to achieve the desired rate of growth with less austerity on its own part and thus to enjoy a higher level of consumption pari passu with growth at the desired rate"[26].

Foreign capital can thus be seen as inducing governments to pursue less than a maximum saving effort defined in terms of policies (e.g., taxation) directed towards resource mobilization and that which would otherwise be required to attain the targeted rate of growth[27]. It needs to be assumed, however, that there is no "physic" disutility from increased inflows of foreign capital and that the targeted rate of growth does not require the use of the entire capital inflow in addition to a maximum saving effort. As long as these conditions hold, foreign capital may be used as a substitute for domestic saving by governments unwilling to make the policy changes and adjustments that would be otherwise required to attain targeted rates of growth .

Most of the empirical approaches that study the impact of foreign capital on domestic saving cast their analyses in terms of the conventional macro-economic framework. In particular, as Rahman has suggested, for countries dependent upon foreign capital inflows, the appropriate specification of the saving function involves the foreign capital inflow as an explicit explanatory variable in addition to income[28]. Thus, many studies on the substitutive effect of foreign capital specify and estimate functions of the following kinds[29].

(2.22) $S = a_0 + a_1 Y + a_2 F$

or alternatively,

$(S/Y) = b_0 + b_1 (F/Y)$

where S = saving, Y = income, F = foreign capital inflow. A negative value for a_2 or b_1 articulates the substitutive effect of foreign capital. Most empirical studies in the area find evidence that supports the substitutive effect defined in this manner.

A pertinent question that arises is whether this substitutive effect as reflected by $a_2, b_1 < 0$ is a behavioural result or an accounting outcome. Thus, consider the familiar identity

(2.23) $Y = C + I + (X - Z)$

or

$Y - C = S = I - F$ where $F = Z - X$.

Differentiating yields

$$dS = dI - dF$$

It is evident that if an increase in the foreign capital inflow, dF, is not entirely invested, but also partly consumed - i.e., $dI < dF$ - then $dS < 0$ necessarily. If all of dF is invested, $dS = 0$. Thus, the reduction in domestic saving due to a rise in F, follows necessarily (<u>ceteris</u> <u>paribus</u>) as an accounting result if a part of F is consumed. In fact, as Newlyn argues, equation (2.22) does not describe a <u>behavioural</u> relationship at all[30]. If it is savings <u>behaviour</u> we are interested in, the relationship which describes this behaviour is

$$(2.24) \quad S^* = Y + F - C = a + bY + cF$$

where S^* = <u>total</u> saving out of <u>total</u> resources

= saving out of Y + saving out of F

c = marginal propensity to save out of F

$0 < c < 1$

This relationship correctly describes behaviour, and would (as it should) show a positive relationship between S^* and F, for as long as F is not entirely consumed, it raises total investable resources[31]. But suppose we relate saving as conventionally measured ($S = Y - C$) to F. Then the implied equation is

$$(2.25)\quad S = a + bY + cF - F$$
$$= a + bY + (c - 1)F$$

Since $c < 1$, clearly domestic savings and F are necessarily negatively related. However, equation (2.25) is not a behavioural equation. The negative relation reflects an accounting outcome - in particular, the extent to which F is consumed, and is entirely consistent with no relaxation in the taxation effort, and will, in general be associated with an increase in the total volume of saving[32].

The preceding paragraphs indicate that the foreign capital inflow in general cannot be expected to be exactly additive to domestic resources as was assumed in the preceding section, in which we illustrated the positive effects, on the growth rate, of increased capital inflows. This is what we would expect on theoretical grounds, since any given increase in the total volume of resources is likely to raise consumption as well as total saving. Thus, as long as some foreign capital is saved, there are no adverse effects on total saving since the total volume of resources going to investment must necessarily rise[33]. However, the substitutive effect of foreign capital can be interpreted differently, and this is what we examine next. The foregoing analysis can be extended in a simple manner to incorporate behavioural substitutive effects, which can be interpreted more meaningfully as implying a relaxation in the saving effort. These effects are not only intuitively plausible and implicit in the works of writers like Rahman but are, in fact, independent of the extent to which foreign capital is consumed. Thus, consider

$$(2.26) \quad C = C_Y + C_F$$

where C = total consumption

C_Y = consumption out of income

C_F = consumption out of foreign capital

We also have from earlier discussion

$$(2.27) \quad I = S^* = Y + F - C = Y + F - C_Y - C_F$$

or

$$I = S^* = Y + F - C_Y(Y) - C_F(F)$$

We have seen that, _ceteris paribus_,

$dI = dS^* = dF - \frac{\partial C_F}{\partial F} dF = dF(1 - \frac{\partial C_F}{\partial F}) > 0$ as long as the as the propensity to consume out of $F (= \frac{\partial C_F}{\partial F}) < 1$

Let us consider the case where all of F is saved - i.e., $C_F = 0$. According to the preceding discussion, in this case, the entire increase in F is invested. However, it can be argued that the increase in foreign capital can _induce_ greater consumption out of a _given_ level of income even if there is no _direct_ consumption out of F. Thus, for instance, even if consumption out of F is forbidden by the terms on which aid is forthcoming and is specifically meant for investment, domestic resources are not use-specific and can be switched between consumption and investment. For instance, the government may be induced to switch its revenues from investment to consumption if foreign capital is forthcoming to finance this investment. Of course, effects of this nature are completely independent of the extent to which F is directly consumed - they are in fact, in addition to any direct consumption out of F. Therefore, we can re-write (2.27) as

$$(2.28) \quad I = S^* = Y + F - C_Y(Y,F) - C_F(F)$$

Consider an increase in F with Y held constant.

$$(2.29) \quad dI = dS^* = dF - \frac{\partial C_Y}{\partial F} dF - \frac{\partial C_F}{\partial F} dF$$

$$= dF\left(1 - \frac{\partial C_Y}{\partial F} - \frac{\partial C_F}{\partial F}\right)$$

As long as the increase in F induces extra consumption Y(i.e., $\partial C_y/\partial F > 0$), certain interesting results follow. Firstly, independent of whether foreign resources are consumed or not, there is an adverse effect on total saving and investment. This effect is least adverse when all of F is saved, for then

$dI = dS^* = dF(1 - \partial C_y/\partial F)$, and is positive as

$$\partial C_y / \partial F < 1$$

Note that in our earlier discussion, $\partial C_y / \partial F = 0$ implied

$$dI = dS^* = dF$$

Now, however, since $C_y / \partial F > 0$,

$$dI = dS^* < dF$$

It is evident from (2.29) that this adverse effect gets progressively larger the higher the propensity to consume out of F(i.e., the higher is $\partial C_F / \partial F$). The given increase in foreign capital always raises investment and saving provided

$$(2.30) \quad (1 - \partial C_F / \partial F - \partial C_y / \partial F) > 0$$

However, it is now possible for $dI < 0$, if this condition is not satisfied, a possibility most likely when the propensity to consume out of foreign capital is high (close to unity). In the limiting case where all of F is consumed, saving and investment must necessarily decline.

The foregoing discussion thus illustrates how, <u>independent</u> of the extent ot which foreign resources are consumed, the latter can induce substitution of domestic resources towards greater consumption. Both these aspects of foreign capital can be studied by an appropriate specification of the consumption (saving) function. One natural and simple specification is the following:

(2.31) $C = a_0 + a_1(F)Y + a_2F$

where $a_1(F) = b_0 + b_1F$

This implies

(2.32) $C = a_0 + b_0Y + b_1F.Y + a_2F$

where $b_0 > 0, \quad b_1 \gtrless 0, \quad a_2 > 0$

Equation (2.32) implies that the marginal propensity to consume is not independent of the capital inflow, but varies inversely with it provided $b_1 < 0$[34]. It is in this sense that foreign capital can have adverse effects on the saving effort. In general, different types of behaviour of the marginal propensity can be accommodated through different specifications of $a_1(F)$ and/or the foreign capital variable.

Our discussion so far of the effects of foreign capital on saving/consumption is based on the *ceteris paribus* assumption, and deals only with the impact effects. Further, nothing has been said about the *composition* of foreign resource inflows. In particular, we have implicitly assumed that all capital inflows are in the form of grants. If they are in the form of loans, debt service is involved in future periods, and this can have important implications. It is clear that, irrespective of the direct and induced effects on consumption of an increase in the foreign capital inflow, as long as there is some addition to investment, there will be favourable secondary effects on saving and hence output. In general, the time-path of output would be higher than what it would otherwise be. If foreign capital inflows are in the form of loans, future interest payments will subtract from future additions to output. Consequently, the favourable effects on output of increased foreign capital must be sufficiently large if the economy is to attain a higher time-path of output. In this context, clearly the induced or direct consumption effects of increased foreign capital become important, since they determine the extent to which output will rise. If these effects are significant the commonly perceived role of foreign capital as a means to accelerated growth, could be undermined[35]. In particular, the higher the marginal propensity to consume out of foreign capital and the stronger the induced consumption effects, the smaller the favourable effects on the time-path of output. These favourable effects on the time-path of output would be further dampened, the greater the share of loans in a given foreign capital inflow and/or the stricter the terms on which laons are made.

If foreign capital inflows are not entirely in the form of grants, it would appear to be appropriate to modify the consumption function given by (2.31). In particular, we could plausibly argue that the marginal propensity to consume out of income depends not so much on the overall capital inflow F, or F as a proportion of national income, as upon the proportion of F that is in the form of grants (or alternatively in the form of loans). In other words additional foreign capital induces additional consumption out of a given level of income only if the grant element of this inflow increases. To the extent additional foreign capital is in the form of loans, the induced effects could be in the opposite direction, since in this case there would be an outflow of resources in the future in the form of debt service payments[36]. Similarly, the propensity to consume out foreign capital itself is likely to be different, depending upon the distribution of foreign capital between grants and loans. Both these features can be incorporated in (2.31) by writing

(2.33) $C = a_0 + a_1(FG/F).Y + a_2FG + A_3FL$

where FG = foreign grants, FL = foreign loans and

$a_1 = b_0 + b_1(FG/F)$

so that

(2.34) $C = a_0 + b_0Y + b_1(FG/F).Y + a_2FG + a_3FL$

This function allows for different consumption propensities out of foreign loans and grants. Further, the propensity to consume out of income is higher than what it would be in the absence of foreign capital, the higher the share of grants in any given capital inflow (provided $b_1 > 0$).

The foregoing discussion provides the basis for the consumption/saving relationships in our model developed in Chapter 5. However, we have found it useful to examine consumption/saving behaviour at a disaggregated level. In particular, we distinguish between private and government saving and model the aforementioned effects of foreign capital in connection with the latter only. The major reason for this is that the bulk of foreign capital inflows into India are made up of official loans and grants, and then main effects are most likely to operate via the government budget[37]. However, we attempt to model additional indirect effects (of foreign capital) on both private and government saving.

We have seen that the substitutive effect argument implicit in (2.22) could be interpreted as implying that a part of the foreign capital inflow is consumed, and need not require a relaxation in the tax effort. However, clearly, inflows of foreign capital can have independent effects in this direction as well. Thus, what our discussion so far has attempted is to examine how foreign capital affects consumption/saving for <u>any</u> given level and structure of taxation. However, foreign capital can independently affect the level and structure of taxation, with subsequent indirect effects on government as well as private saving. Rahman's argument of a relaxation in the taxation effort implies that the availability of foreign resources enables the government to avoid changes in the level and structure of taxes that would be required to achieve targeted rates of growth. It is obviously difficult to quantitatively measure the tax effort, especially at the aggregate level. One approach that has been used, is to measure it as the ratio of tax revenues to national income and to interpret a negative relation between the tax effort so defined and the foreign capital inflow as implying a relaxation in the tax effort[38]. Such a measure is subject to a number of limitations. First of all, it is only an imperfect proxy for the average of all rates in the economy. Consequently, it captures the effects of the structure and level of tax rates only imperfectly. Further, an improvement in the tax effort so defined cannot be interpreted as "adverse" unless the context is made clear. Thus, a relaxation in the tax effort would have adverse effects on government saving but could have favourable effects on private saving. The overall effects could be favourable. We interpret a relaxation in the tax effort as being "adverse" in the narrow sense - viz., in terms of impact effect upon government saving. Whether it is "adverse" in the broader sense - viz., from the point of view of its effects on aggregate saving and income - depends upon the nature and strengths of indirect and secondary effects. This is essentially an empirical question.

In spite of the limitations of the aforementioned measure of the tax effort, it has the advantage of being operational empirically. Further, in the context of developing economics like India in which the government is a major investor in the economy, such a measure can serve as a useful indicatior of its resource mobilization effort. Typically, one would expect that since the government plays an active and increasing role in forcing the pace of development, the development process (particularly in its early stages) is likely to be characterized by an increasing tax effort which would be reflected in a rising share of tax revenues in income. In countries like India however, there are important constraints on the tax effort, arising due to very low living standards and the existence of substantial unorganized sectors in the economy[39]. These factors limit the scope for additional taxation. But for precisely these reasong it is plausible that foreign capital, by easing resource constraints on the government could induce governments to relax their tax effort and thereby forego the need to raise additional resources through additional unpopular taxation. This issue is examined in some detail in Chapter 5.

(2.5) COMMODITY AID WITH SPECIAL REFERENCE TO THE EFFECTS OF PL 480 FOOD AID TO INDIA.

From the mid-fifties into the late sixties, many developing economies like India received substantial commodity assistance, largely through the disposal of surplus agricultural commodities by the U.S. under PL 480. India received the bulk of her commodity aid under Title I of PL 480 which required payment for the imported commodities in rupees instead of foreign exchange. Consequently, to the extent it substituted for commercial imports that would otherwise have been necessary, such aid can be said to have implied some foreign exchange saving. Since PL 480 aid to India and a number of developing countries was in fact heavy, and sustained over a number of years, it led expectedly to a debate on its effects on the economies of recipient countries[40].

An analysis of the effects of PL 480 aid on recipient economies requires a general equilibrium approach, since such aid has a number of direct and indirect mutually interacting effects. Only within the context of such an approach can we meaningfully evaluate PL 480 aid in terms of its specific, as well as overall effects. In the literature on the effects of PL 480 aid, the tendency has been to concentrate on speicfic effects, and at times explicitly or implicitly in terms of a partial equilibrium framework. Thus, one issue that has attracted attention in the Indian context is whether PL 480 aid has inflationary or deflationary effects. Since such aid increases the supply of wage-goods in the economy, one would expect it to curb inflationary pressures. However, it is argued that such aid has inflationary consequences because it leads to net monetary expansion[41]. This happens because the government pays the U.S. for PL 480 imports by borrowing from the Central Bank, but these funds come back into the system through U.S. loans and grants mainly to the government. At the same time, since the government budget is in a chronic state of deficit , receipts from the sale of PL 480 commodities are automatically disbursed in some form of expenditure, instead of being used to pay back the Central Bank. Thus, while the act of selling and spending itself does not lead to a change the money supply, net monetary expansion occurs when the U.S. makes loans or grants to the Indian government[42]. However, whatever the merits of this argument, the inflationary consequences (if any) are not an attribute of PL 480 aid itself, but instead an attribute of the manner in which the government chooses to finance PL 480 imports.

The issue that has attracted, perhaps, the most attention is that pertaining to the effects of PL 480 commodity aid on the agricultural sector. Schultz argued that PL 480 would have adverse long-run effects on agricultural production and investment by depressing the price of agricultural goods[43]. Thus, aid in the form of agricultural commodities would substitute for domestic production, though under "normal" conditions, the decline in production would be smaller than the increase in commodity aid[44]. If the decline in domestic production has a dampening effect on investment (e.g., by reducing the volume of farm saving), the time-path of agricultural output would be lower than what it would be in the absence of PL 480 aid.

The major drawback of these arguments is that they assume a partial equilibrium framework. Consequently, they are inappropriate for evaluating specific effects (e.g., on agricultural production) given that PL 480 has a set of mutually interacting economy-wide effects. Neither can they be used to make any statement about the overall effects of PL 480, since PL 480 has other effects (e.g., on non-agricultural output) which can be considered to be of no less importance. Thus, for instance, an increase in PL 480 aid could, in classical fashion, raise non-agricultural output by permitting a higher level of employment[45]. Thus, even if agricultural output declines, aggregate output could rise. In fact, an increase in the latter would increase the demand for agricultural commodities (as also other commodities) and this would have subsequent effects on agricultural production (and othr production). In general, the entire system would adjust to increased PL 480 aid. However, we cannot generalize about specific effects (e.g., on the agricultural sector) or about overall effects (on aggregate income) without specifying and experimenting with a general equilibrium framework in which, at least the major effects of PL 480 aid can be examined.

In an evaluation of PL 480 aid to India, the following aspects of such aid deserve specific consideration.

(1) The bulk of PL 480 aid to India has been in the form of foodgrains. The substitutive effect of increased PL 480 foodgrain imports on domestic production now can be expected to work in two ways. Be depressing the price of foodgrains relative to that of non-foodgrain commercial crops, such aid would lower foodgrains production and, at the same time, raise other agricultural production unless the cross-price elasticity of supply of the latter is zero[46]. With these two effects operating in opposite directions, the net effect on agricultural can be positive. If it is positive, the effects of PL 480 aid, even in a partial equilibirum context can hardly be called adverse unless specific importance is attached to composition of agricultural output.

(2) PL 480 aid can be associated with foreign exchange saving. Consequently, changes in the former

can have effects on output through changes in intermediate and capital good imports resulting from the effects on foreign exchange availabilities. PL 480 aid would, *ceteris paribus*, have no direct effect upon foreign exchange availabilities, since PL 480 foodgrains are paid for in rupees. Foreign exchange effects arise if PL 480 imports of foodgrains substitute for commercial imports. The foreign exchange saving implied by PL 480 aid is directly related to the extent to which such aid substitutes for commercial imports. Thus, a unit increase in PL 480 foodgrain imports would have a favourable (positive) effect on foreign exchange availabilities to the extent of the induced reduction in the value of commercial food-grain imports, which in turn, depend upon the degree to which the unit increase in PL 480 imports substitutes for commercial imports[47]. The foreign exchange saving implicit in this additional of PL 480 foodgrain imports can be expected to have favourable effects on output and investment.

(3) PL 480 aid is also likely to have favourable effects on government investment since, as we argued earlier, PL 480 funds in the U.S. Title Account are used to make grants and loans to the government. This could have favourable effects on public investment in all sectors of the economy[48]. Thus, even if there were any adverse effects of PL 480 aid on private agricultural investment, they could be more than offset by the increase

in government agricultural investment. Basically, PL 480 aid here is akin to a capital inflow which raises the volume of investable resources in the economy.

There have been few econometric empirical analyses of a general equilibrium nature on the effects of PL 480 aid to India. Mann examined empirically the impact of PL 480 imports of cereals on domestic production using a small econometric model of the cereals sector only[49]. He found that increased PL 480 imports have an adverse effect on cereals production, even though the total supply of cereals in the economy increases[50]. However, the model is incomplete in that it ignores accumulation, while as we argued above, PL 480 aid is likely to have favourable effects on public investment in all sectors of the economy. These effects are no less important than the production effects. However, the model can be generalized in this and other directions, and by integrating it with an economy-wide model of the economy, can enable the examination of the whole range of economy-wide effects of PL 480 aid.

Agarwala has also empirically examined the effects of PL 480 aid in his econometric model of the Indian economy[51]. However, no explicit distinction is made between PL 480 foodgrain imports and commercial foodgrain imports. The two are assumed to be exactly additive thereby ruling out any foreign-exchange effects of lower/higher PL 480 foodgrain imports. Further, while the author recognizes the fact that PL 480 can facilitate public investment in agriculture and other sectors of the economy, this important feature is not modelled[52]. PL 480 aid facilitates non-agricultural output in classical fashion, by permitting a higher volume of employment. It has no effect on the production of foodgrains nor on agricultural output in general <u>via</u> relative prices. The latter affect output only <u>via</u> their effect on private agricultural investment[53].

It is to be recognized, however, that a detailed treatment of PL 480 aid is inherently difficult within the framework of aggregate macro-econometric models like Agarwala's, or the one developed in this study. Even at the aggregate level, the absence of data on PL 480 data on a consistent, long-term basis, makes this task difficult. More significantly, however, is the fact that PL 480 aid is a single, highly disaggregated transaction and is, consequently, difficult to integrate in many respects with an aggregative model of the economy. Nevertheless, with some inevitable simplifications, the major aspects of PL 480 foodgrains aid to India, outlined in the foregoing paragraphs, are built into our model of the Indian economy, and provide a basis on which the general equilibrium effects of such aid can be examined in a simulation context.

(2.6) CONCLUSION

In this chapter, a number of specific issues pertaining to the role of saving, foreign exchange, foreign capital and commodity aid in developing economies were outlined. These issues highlight the importance of resource constraints (domestic and foreign) in determining growth in these economies. An attempt is made in this study, to quantitatively examine these issues, amongst others, within the context of a general macro-econometric model of the Indian economy that is constructed in later chapters. While these issues have been given special consideration in the study, the model has been constructed with reference to the institutional and economic features of the Indian economy. Before turning to the model, however, we discuss briefly in the next chapter, various aspects of the country's development experience since the early 1950s, and of its economic and institutional structure.

FOOTNOTES

Chapter 2

1. There are obvious difficulties with such a measure, and no single measure can ever hope to encompass the enormously diverse set of things development can be taken to mean. In general, however, we do find that countries which are at the top of the per-capita scale, also possess those attributes that are normally associated with high levels of development, while those countries which are at the bottom end of this scale possess these attributes to a far lesser degree. We can plausibly argue that, for low per-capita income countries, rising levels of income and income per-capita are an important aspect of the process of economic development.

2. See Nurkse (1953), p. 4-5.

3. Yotopoulos and Nugent (1977), p. 182

4. Rostow (1956) and Lewis (1954). This proposition derives from an interpretation of historical experience. The proposition does not,of course, imply causality, and must be interpreted as, as Rostow himself notes, a qualified necessary condition. While Lewis views the transition from a 3%-5% saving rate to a 12%-15% as a central aspect of economic development (see p. 416) Rostow is more careful, noting that the self-sustaining rate would depend upon, amongst other things, the rate of population growth. Thus, he notes that while a 5% or so saving rate might be sufficient to yield rapid per capita growth for countries with low population growth rates, a significantly higher rate would be required in cases where population growth is higher (see p. 158).

5. Kuznets (1966) pp. 248-249, Table 5.5. One exception is pre-1914 France, where there was substantial growth in output per-capita even though the saving investment rate was of the order of about 5%. See Rostow (1956), p. 158, footnote 2. The author also points out that for growth to be self-sustaining, it is not sufficient to merely raise the rate of investment additional pre-requisities in the form of some developed line of manufacturing activity, and perhaps more importantly, of a favourable political, social and institutional framework are necessary.

6. Thus, in terms of the standard neoclassical growth model, the higher the rate of growth of population,the lower the steady-state level of income per capita. In a fixed-coefficients Harrod-Domar type of model, output grows at the rate permitted by the slowest growing factor. In the event of a rapid rate of population growth, that is in excess of the growth rate of output permitted by capital accumulation, there is a cumulative addition to unemployment and a cumulative decline in output per capita. This possibility is remote in reality, but it highlights one aspect of the growth problem in developing economies suffering from rapid population growth - viz., that of enhancing productive capacity to absorb the rapid increases in the labour force and the vast backlog of unemployment.

7. See for instance, Schiavo-Campo and Singer (1970) p. 138; also UNCTAD (1968), p. 3.

8. Nevertheless, recent thinking on the subject emphasizes the considerable importance of "human capital". See for instance World Bank (1980).

9. UNCTAD (1968), p. 3.

10. The import-capacity constraint has a long tradition in Latin American economic thought. See Prebisch (1964).

11. For a representative sample see Chenery and Bruno (1962) Chenery and Strout (1966), Chenery and Adelman (1966), Chenery and Macewan (1966), McKinnon (1964), Linder (1967).

12. While Chenery and his associates develop and use the TGT in a policy-oriented programming framework, other writers - e.g., McKinnon (1964), Lal (1970), Findlay (1971) - use conventional tools of economic theory to examine the nature and implications of the theory.

13. McKinnon (1964).

14. The condition $c > 1$ requires that the value of output exceeds the value of foreign raw material inputs and is a simple version of the Hawkins-Simons condition in the Leontief fixed coefficients model. See McKinnon (1964), p. 376.

15. However, consumption imports have been allowed in other models. See for example, Chenery and Bruno (1962) or an unpublished paper by M.A.H. Katouzian titled "Foreign Exchange, Domestic Saving, and the Rate of Growth: An Extended Model" which was read at a seminar at McMaster University.

16. In the preceding paragraphs, we have solved the model for essentially two growth rates which may or may not be the same, depending upon the values of the parameters involved. The case of a foreign exchange or savings constraint on growth arises when these two rates are not equal - viz., $b(x - e_1) \gtrless vs$. However normally, the two-gap model is formulated in terms of a _targeted_ rate of growth. This does not alter the substance of the above analysis. This merely has the added implication that the targeted rate of growth (say $\hat{g}$) is constrained by _both_ a foreign exchange _and_ savings gap, (though as before only one constraint is binding) since we now have the possibilities implied by: $\hat{g} > b(x - e_1) \gtrless vs$.

17. The reason is that now exports have not only to cover consumption imports but also raw material requirements of current production for there to be any growth at all.

18. Indeed, with the kind of rigidity assumed in the production structure, the case where exports do not cover imported raw material needs, implies Y = 0 since by implication KF = 0. This is clearly an unsatisfactory aspect of the model and could be overcome by allowing for some degree of substitutability in the production function. However, since the aim here is merely to highlight the notions of savings and foreign exchange constraints, we shall subsequently continue to work with the fixed coefficients production function (2.1), assuming that even when exports do not cover raw material needs, output is positive.

19. See for instance Cohen (1966), Lal (1970, 1972), Bruton (1969) and Findlay (1971).

20. Khang (1968), Bardhan (1970), Chapter 4. The brief outline that follows is based on the latter reading.

21. The rate of growth of output can also be shown to be positively related to the price elasticity of export demand (which is constant given the form of the export function adopted). This is because w is dependent, amongst other things, on this constant elasticity of demand as well.

22. Khang (1968), in an extended discussion of his model, shows how, if population growth is endogenous (e.g., depends upon y) and export growth is exogenous, the economy could get stuck at a stable "low level equilibrium trap" even when e = m.

23. These "stylized facts" are: (1) the importance of imported inputs in production, and (2) given the nature of exports of developing countries in general, price inelastic export demand. Bardhan (1970), p. 64. Bardhan also considers the case in which domestic production depends upon imported capital goods which are different from domestic capital goods. The nature of the results is similar to those discussed above.

24. See, for instance, Khang (1968) who incorporates foreign borrowing and technical progress in his model.

25. See the survey by Mikesell and Zinser (1973) on saving behaviour in developing economies. See also Bhagwati (1978), pp. 166-174, where the empirical work in the area has been summarized.

26. Rahman (1967), p. 147.

27. See Chenery and Strout (1966), p. 686 for this definition.

28. Rahman (1967), p. 155.

29. See for instance, Rahman (1968), Areskoug (1969), Enos and Griffin (1970), Weisskopf (1972), Papanek (1973), Bhagwati and Srinivasan (1975), Chapter 16, pp. 232-235.

30. Newlyn (1973).

31. Newlyn (1973), p. 868.

32. Newlyn (1973), p. 869.

33. Of course, investment would be higher if there was no consumption out of foreign capital.

34. Bhagwati (1978), pp. 167-168, suggests a <u>saving</u> function of the form

$$S = b_0 + b_1(F).Y + b_2F$$

which is the same as (2.3) postulated above. However, this equation correctly describes behaviour only if S is measured as: (Y + F - C). The authors interpret the equation as implying that while $(1 - b_2)$ of an additional unit of F is consumed, the government also increases its domestic saving effort <u>via</u> taxation, yielding a higher marginal propensity to consume b_1 out of income. However, it is just as plausible to argue that for any given level of taxation foreign capital could induce lower saving, i.e., reduce the saving effort (out of a given level of income). This is essentially an empirical question. Further, as we argue below, foreign capital can affect the tax effort and hence saving, but it can also affect the saving effort for any given tax effort.

35. For an interesting study on the problems of external indebtedness in general and its relationship with growth see Avramovic et. al. (1964).

36. In other words, debt service involves a sacrifice in terms of consumption in future periods and this could be a disincentive to additional consumption out of income in the current period.

37. In fact, the aggregate induced consumption effects that we have been talking about probably reflect the effects of foreign capital on (a) government rather than aggregate consumption for a given level and structure of taxation, and on (b) government and private saving via its effects on the taxation effort. Consequently, our disaggregated approach appears to be a more accurate way of capturing these induced consumption effects.

38. See Landau (1969) where this definition of the tax effort is used to examine the effect of foreign capital on government tax behaviour. See also Lotz and Morss (1967).

39. In a large country like India, cost considerations and administrative difficulties impose severe constraints on the ability of the government to administer and collect taxes from the large unorganized sectors of the economy.

40. For some of the issues that have been debated see The Journal of Farm Economics, December 1960. See also Khatkate (1962, 1963), Fisher (1963), Falcon (1963), Beringer (1963). For some of the literature on India see Sen (1960), Dantwala (1957), Elridge (1970), Ch. 6., Mann (1967) and Rath and Patwardhan (1967).

41. See, for instance, Shenoy (1971), pp. 102-104.

42. Shenoy (1971), pp. 102-104. This argument assumes that PL 480 deposits in the U.S. account are not a part of the money supply. Otherwise, given the method of financing adopted, irrespective of whether

the deposits are loaned out, there will be net monetary expansion.

43. Schultz (1960).

44. The "normal" conditions alluded to simply mean that the demand and supply curves have the conventional shapes.

45. See Agarwala (1970) in which the PL 480 imports would increase the supply of wage-goods in the economy and this enables higher employment in the non-wage goods (viz., non-agricultural) sector.

46. A similar point is made by Dantwala (1957), pp. 1-25. See also Falcon (1963), pp. 323-326.

47. Only in the extreme and unlikely case in which commercial imports are independent of PL 480 imports, the latter do not lead to any foreign exchange saving. The other extreme where a unit of PL 480 imports substitute for a unit of commercial imports is also unlikely.

48. Indeed, it appears that such finance has been important in the government sector. Thus, it is estimated that PL 480 funds financed more than 10% of public developmental outlay during the Third Plan. See Streeten and Hill (1968), p. 324, as reprinted in Chen and Uppal (1971)

49. Mann (1967).

50. The depressing impact on production is, however, found to diminish over time so that the long-run effect is smaller than the short-run effect.

51. Agarwala (1970).

52. Agarwala (1970, pp. 39-41 and 148-151.

53. Agarwala (1970, p. 40.

CHAPTER 3

THE INDIAN DEVELOPMENT EXPERIENCE: A NOTE ON TRENDS AND STRUCTURE.

(3.1) INTRODUCTION.

In this chapter, we briefly outline some salient aspects of the Indian economy and of its development experience since the 1950s. This, it is hoped, will highlight not only the broad economic trends in the economy, but also some important economic and institutional features which provide the basis for the model in subsequent chapters.

India embarked on the path of planned economic development with the launching of the First Five-Year Plan in 1951. But for a three year 'Plan Holiday' during the years 1966-67 to 1968-69, successive five-year plans have defined the broad contours within which economic growth has taken place[1]. Just as the interplay of ideological and political forces led to the adoption of comprehensive planning (particularly since 1956) for promoting and sustaining economic development, it also played an important role in the strategy of development pursued, as well as in defining the role of public and private sectors in the economy.

The successive plans have typically been formulated with reference to a wide range of economic and social issues. The broad underlying theme has been rapid growth with social justice. In reality, rapid growth has been sought largely through a rapid expansion and diversification of the industrial base of the economy, import substitution, partly in consumer goods but mainly in capital goods, being a major feature of this policy. This emphasis on industry was particularly strong during the Second and Third Plans, especially in the area of "heavy" industry. Nevertheless, but for some shifts in the degree of emphasis, this industry-oriented strategy (some have called it a "capital-intensive" strategy[2]), has been a built-in feature of Indian planning over the past 25 years or so. Iron and steel, oil, heavy engineering,chemicals and fertilizer have been the main industrial areas where investment has been especially large. The shift in the pattern of investment towards industry is clearly evident in Table 3.1 below, where the pattern of gross capital formation by industry-of-use is given. The table shows a marked increase in the share of industrial and infrastructural investment after the First Plan, and a marked decline in the share of the agricultural sector.

Another important feature of economic growth

TABLE 3:1

SECTORAL GROSS CAPITAL FORMATION (BY PLAN)

(PERCENTAGE SHARES)

	1st Plan	2nd Plan	3rd Plan	4th Plan
Agriculture	26	19	16	18
Industry	19	25	28	28
Infrastructure	17	21	26	18
Other	38	35	30	36
Total	100	100	100	100

Notes: (1) Percentages have been calculated from data expressed in 1960-61 rupees for all but the Fourth Plan, the percentages for which are based on current value data.

(2) Agriculture = agriculture (proper) + forestry and fishing.

Industry = mining + manufacturing.

Infrastructure = transport and communication + electricity, gas and water supply.

Other = services.

Sources: (1) National Accounts Statistics, C.S.O., New-Delhi, January 1978 and February 1976 issues.

(2) National Accounts Statistics: Disaggregated Tables, C.S.O., New-Delhi, March 1975.

in India has been that it is taken place within a "mixed" economy framework. In particular, both the public and private sectors have been involved in this process, though ideological considerations have dictated an increasing role for the former. In fact, the public sector has been a major element in the country's development strategy based on import substitution. Thus, it has been estimated that the share of the public sector in cumulative investment stood at 40.62% for steel, 20.29% for engineering, 9.11% for chemicals, 12.22% for petroleum and 7.49% for mining and minerals in 1965-66[3]. The step-up in public sector investment, after the First Plan is clearly evident from Table 3.2, below. Thus, the table shows

TABLE 3.2

PUBLIC AND PRIVATE GROSS CAPITAL FORMATION (BY PLAN)

(PERCENTAGE SHARES)

Capital Formation	First Plan	Second Plan	Third Plan	Fourth Plan
Public	33	42	48	40
Private	67	58	52	60
Total	100	100	100	100

Notes: Percentages have been calculated from current value data.

Sources: <u>National Accounts Statistics</u>, C.S.O., New-Delhi, February 1976 and January 1978 issues.

that the share of public investment rose from 33% during the First Plan to 48% in the Fourth, but declined thereafter due to a sharp decline in the rate of capital spending by the government.

Apart from planning itself, and the substantial and sustained role of the public sector in the economy, there are some other important institutional aspects of the Indian economy. Since the beginning of the Second Plan, there have been two major institutional features of the overall economic policy framework, features which bear a close relationship to the strategy of growth and to the envisaged role of the public sector. These have been: (a) industrial licensing and target-setting, and (b) a strict regime of exchange control[4]. Industrial licensing was instituted with the objective of structuring the pattern of investment according to priorities and targets laid out in the Plans, and to prevent the concentration of monopoly power. Target-setting involved setting detailed and comprehensive targets for capacity creation, while the licensing system was the major instrument through which these targets were sought. The entire licensing system along with the practice of setting targets, were indeed comprehensive, in that they sought to determine the pattern of investment down to the product level, as well as the choice of technology in considerable detail. The system thus implied direct physical control over the volume and pattern of investment. However, this direct control was confined mainly to the organized industrial sector as the government had, understandably, diluted or no control over unorganized sectors like agriculture and small household businesses. For these reasons, amongst others, target-setting and industrial licensing were often at odds with actual developments[5]. The controls on the level and pattern of investment were most severe during the second and third Plans. There was some de-control in subsequent years, but it was not significant. Its scope was limited further by the fact that there were no significant nor lasting liberalization in the otherwise strict regime of exchange control.

The institutional arrangements surrounding India's import trade have been, along with industrial licensing, another important feature of the overall economic policy framework. While export trade has been relatively free of control (with some exceptions), import trade has been subject to strict physical controls through the policy of import licensing which has been comprehensive, has covered a wide range of commodities, and has involved direct foreign exchange licensing for practically all uses in the economy. This has been accompanied by restrictions on import specification, transferability and the principle of "indigenous availability" has been invoked in reviewing license applications, to protect domestic substitutes. The nature of the licensing system is clearly reflected in the proportion of licenses issued to private traders and that to producers. Thus, from 61% in 1951-52, the former had declined to 3% by 1970-71, the bulk of the licences issued being "Actual User" licenses for the import of raw materials and intermediates and "Capital Goods" licenses for the import machinery and equipment[6]. This is but another reflection of the attempt by the planners to channel scarce foreign exchange into uses determined by developmental priorities.

In conclusion, it may be noted, that both industrial and import licensing have gone hand-in-hand and have been the most important means through which industrialization *via* import substitution has been sought.

(3.2) TRENDS IN NATIONAL INCOME AND THE BROAD ECONOMIC STRUCTURE

The trends in national income and income per capita are highlighted in Table 3.3. While national income growth has been uneven over the Plans, it compares quite favourably with the experience of Japan in the Meiji period, during which industrialization was initiated and sustained, and hence can be viewed as characterizing the early stages of Japanese economic

TABLE 3.3.

NATIONAL INCOME AND INCOME PER CAPITA

		NATIONAL INCOME AT 1960-61 PRICES		GROWTH RATES ANNUAL %	
		TOTAL Rs billion	PER CAPITA Rs	TOTAL	PER CAPITA
	1950-51	90.9	253.1		
First Plan	1951-52	93.1	255.1		
	1952-53	96.4	259.1		
	1953-54	102.6	270.8	3.7	1.8
	1954-55	105.3	272.9		
	1955-56	108.9	277.1		
Second Plan	1956-57	115.1	286.9		
	1957-58	113.2	276.9		
	1958-59	122.3	292.6	4.0	2.0
	1959-60	124.5	292.2		
	1960-61	132.8	306.0		
Third Plan	1961-62	137.3	309.2		
	1962-63	139.9	308.2		
	1963-64	147.7	318.3	2.6	0.4
	1964-65	158.8	335.1		
	1965-66	150.8	311.0		
Annual Plans	1966-67	152.2	307.4	0.9	-1.2
	1967-68	164.6	325.4	8.2	5.9
	1968-69	169.4	327.0	2.9	0.5
Fourth Plan	1969-70	180.2	340.6		-1.7
	1970-71	191.0	353.0		6.6
	1971-72	193.0	349.0	3.6	
	1972-73	190.5	337.1		
	1973-74	201.4	349.1		
-	1974-75	201.8	343.2	0.2	
	1975-65	219.5	365.9	8.8	

Notes: (1) Figures relate to financial years.

(2) Growth rates for the post 1965-66 period have been computed by us.

Sources: (1) For the period 1950-51/1960-61, Bhagwati and Srivasan (1975), pp. 6.

(2) For the period 1961-62/1975-76, Economic Survey, Ministry of Finance, New-Delhi, 1976-77.

development[7]. More importantly, it represents a substantial acceleration over what was achieved over fifty years under colonial rule prior to 1947[8]. The sharp drop in the growth rate of national income during the Third Plan is largely on account of the adverse effects of the severe drought in its last year (1965-66). If this year is dropped from the calculation, the average annual growth rate jumps to 4.5%. Similar adverse effects are reflected in the growth rate in 1966-67, when another drought occurred. The growth rate picked up thereafter but was not sustained on a year-to-year basis during the Fourth Plan. Over the period as a whole, national income growth appears to have been respectable, a respectability that is appreciably compromised when it is observed that growth per capita has been woefully inadequate as population has grown in excess of 2% per annum.

Two broad features that are commonly associated with economic development are a rising share of the industrial sector in the labour force and in domestic product,and a decline in agriculture's share in respect of both of these[9]. India has primarily been an agrarian economy with agriculture being the predominant economic activity, and employing the bulk of the labour force. However, as Table 3.4 shows,the structure of the economy in both these respects, has not changed very much.

TABLE 3.4.

SECTORAL DISTRIBUTION OF LABOUR FORCE AND DOMESTIC PRODUCT

(PERCENT)

	1951		1961		1971	
Sector	LF	NDP	LF	NDP	LF	NDP
Agriculture	70.6	55.9	72.0	51.2	72.0	44.0
Industry	9.5	12.7	10.0	14.9	9.9	16.7
Services	19.9	31.4	18.0	33.9	18.1	39.3
Total	100.0	100.0	100.0	100.0	100.0	100.0

Notes: (1) LF stands for labour force, and NDP for net domestic product.

(2) The percentage distribution of NDP is for fiscal years 1951-42, 1960-61 and 1970-61. Percentages are based on data expressed in 1960-61 rupees.

(3) The percentage distribution of the labour force is for the stated calendar years. These figures are tentative due to changes in concepts, coverage and methodology over time.

(4) Sectoral classification is the same as in Table 3.1, except that "infrastructure" as defined in that table is included in "services" in the present table.

Sources: (1) Bhagwati and Desai (1970) for the 1951 labour force figures.

(2) National Accounts Statistics, C.S.O., New-Delhi, February 1976 and January 1978 issues.

(3) National Accounts Statistics: Disaggregated Tables, C.S.O. New-Delhi, March 1975.

The table shows a perceptible decline in agriculture's share in domestic product, a decline that has been picked up by industry and services. The distribution of the labour force on the other hand, shows hardly any change at all. Thus, there does not appear to have been any marked transformation of the broad economic structure in over 20 years of planning. In fact, it appears that agriculture, which had an adverse land-man ratio to begin with, has had to absorb much of the population increase, in a situation where its share in domestic product has been falling.

(3.3) AGRICULTURE AND INDUSTRY: TRENDS AND STRUCTURE

Agriculture

Given the sheer weight of the agricultural sector in the national economy, the behaviour of agricultural production is of crucial importance in the country's progress. Thus, agricultural growth is not only a major factor in income generation,but the sector is also an important supplier of raw materials to industry and a major source of foreign exchange. The foodgrains component of agricultural output is itself a crucial determinant of agricultural growth, and is important in other respects as well. It has been estimated that foodgrains occupy 75% of cultivated area, have a weight of 40% in total consumer expenditure, constitute 75% of average food expenditure and 54% of total expenditure of low income families[10]. Table 3.5 shows that both agricultural and foodgrains production exhibit an unmistakable upward trend. The compounded annual rate of growth for both agricultural and foodgrains output between 1953-54/1975-76 work out to around 2.4%. This compares favourably with agricultural growth rates achieved in Meiji Japan during 1880-1884 and 1915-1919, a period in which agricultural growth rates of 1.8% per annum have been considered impressive[11]. However, during this period while population grew at a rate less than 1% per annum in Japan,in India, it grew at around 2.1% per annum. Thus, agricultural and foodgrains production appear to have barely kept ahead of population growth. Further, much of the increases in production, at least till the late 1960's, have been on account of acreage extension, rather than through a reorganization of traditional production techniques which have kept Indian agricultural yields amongst the lowest in the world. However, since the mid-sixties, the gradual spread of modern farming technology, particularly in some regions (e.g., the Punjab) and in the cultivation of important crops (e.g., wheat), appears to have had some impact upon foodgrain yields[12]. Thus, from the table we note that the area under high-yielding seeds and fertilizer

TABLE 3.5.

TRENDS IN AGRICULTURE.

Crop Year (July-June)	(1) AGRICULTURAL PRODUCTION 1961-62 = 100	(2) FOODGRAINS PRODUCTION 1961-62=100	(3) AREA UNDER HYV SEEDS (m. hectares)	(4) FERTILIZER CONSUMPTION (000 tons)
1955-56	84.8	85.7		130.8
1956-57	89.5	89.5		153.7
1957-58	83.7	81.7		183.7
1958-59	96.6	97.0	19.8	223.8
1959-60	94.3	95.2		304.6
1960-61	102.7	102.1		239.9
1961-62	103.0	102.7		383.5
1962-63	101.4	99.4		477.9
1963-64	103.9	101.7	48.60	574.2
1964-65	115.0	112.0		652.6
1965-66	95.8	89.9		757.3
1966-67	95.9	91.9	1.88	1,203.0
1967-68	116.6	117.1	6.04	1,165.8
1968-69	114.8	115.7	9.20	1,674.7
1969-70	122.5	123.5	11.40	1,989.5
1970-71	131.4	133.9	15.38	2,260.0
1971-72	130.9	132.0	18.17	2,660.0
1972-73	120.4	121.2	22.09	2,770.0
1973-74	133.3	131.5	26.02	2,840.0
1974-75	128.6	124.0	27.01	2,570.0
1975-76	148.6	151.0	32.16	2,890.0

Sources:

(1) Estimates of Area and Production of Principal Crops in India, D.E.S., New-Delhi, 1974 for columns (1) and (2).

(2) Economic Survey, Ministry of Finance, New-Delhi, 1976-1979 issues for columns (1) to (4).

(3) Fertilizer Statistics, Government of India, New-Delhi, 1974-75.

consumption (two important aspects of modern farming techniques) both show dramatic increases after 1966-67. It seems likely that the jump in wheat yields after 1966-67, is due to these factors. Finally, we note that while the long-term trend in agricultural and foodgrains production is upward, there are significant short-run fluctuations around this trend. Weather conditions play an important factor explaining these. Thus, when these were particularly beneficient (e.g., in 1964-65) output rose sharply, while when they were bad (e.g., in 1965-66 and 1966-67), output declined equally sharply.

In our agricultural sub-model developed in the following chapter, we try to incorporate the short-run effects of weather conditions, as well as the secular effects of the spread of modern farming methods.

Industry

Table 3.6 highlights trends in the growth and structure of Indian industry. Even a cursory examination of the table shows that industrial output grew rapidly over the whole period (with a slowing down after the mid-sixties, largely due to a slow-down in the tempo of capital spending by the government, a sharp decline in aid flows and the general dislocation in economic activity brought on by the two severe successive droughts

TABLE 3.6

TRENDS IN INDUSTRIAL PRODUCTION (1960 = 100.0)

	Weight	1951	1956	1960	1965	1969	1974
MANUFACTURING	84.9	54.6	79.6	100.0	150.8	167.2	193.1
Food	12.1	66.9	78.7	100.0	127.2	137.0	154.6
Textiles	27.1	79.7	98.0	100.0	108.9	109.5	112.2
Chemicals	7.3	42.4	63.7	100.0	156.7	217.5	301.8
Basic Metals	7.4	46.5	76.4	100.0	186.4	209.7	215.8
Metal Products	2.5	30.7	74.6	100.0	109.6	205.1	243.1
Machinery [a]	3.4	22.2	52.2	100.0	281.8	349.1	455.0
Machinery [b]	3.1	26.3	56.5	100.0	224.9	322.4	436.1
Trans. Equip. [c]	7.8	19.6	102.8	100.0	164.5	135.4	148.7
ELECTRICITY	5.4	35.7	58.5	100.0	207.8	301.1	383.8
GENERAL[d]	100.0	54.8	78.4	100.0	152.4	172.5	193.4

Note: a non-electrical machinery; b electrical machinery; c transport equipment; d includes mining and other manufacturing.

Source: L.A. Veit (1976), p. 75.

of 1965-66 and 1966-67[13]). Indeed, over the first three Plans (1951-52 to 1965-66), the rate of growth of industrial production accelerated - the compounded annual rate of growth being 5.8% in the First Plan, 7.3% in the Second and almost 8% in the Third. After 1965-66, this rate fell to about 3.5% per annum. For the period as a whole, it is evident that the industrial sector grew far more rapidly than agriculture.

While the overall growth rate of industrial production was indeed impressive, also important was the pattern of industrial growth fostered by the adopted strategy of industrialization. Thus from Table 3.6, we see the striking difference in the growth of traditional manufacturing industries (viz., food, beverage and textiles) and of non-traditional intermediate and capital goods industries (e.g., chemicals, machinery, and equipment). Rapid growth was also experienced by infrastructural industries like electricity. High rates of growth persisted for most of the "new" industries even after 1965, though growth appears to have tapered off (considerably for some) by 1974. The transport equipment industry, in fact, shows a drastic decline after 1965, largely due to a sharp decline in governmental developmental activity[14].

The data in Table 3.6 are suggestive of significant structural shifts in Indian manufacturing towards the engineering and intermediate group of industries. While "traditional" industries (e.g., food and textiles), still have a significant weight, their growth has been slow and their relative importance has declined.

In spite of generally rapid growth experienced by the industrial sector as a whole, and by the new capital goods and intermediate goods industries in particular, Indian industry has come to be characterized, since the early 1960s,by the persistence of under-utilization of capacity, particularly in the latter group of capital and/or import-intensive industries. There is a lack of data on the extent and pattern of under-utilization. Such official data that exist are considered highly unreliable. However, we do have some estimates of the pattern under-utilization amongst major industry groups, and they should serve to provide a general idea of the nature of the problem. These estimates are given in Table 3.7.

The data indicate that under-utilization has in fact, been quite pervasive and particularly severe in metal-based industries (e.g., machinery) and intermediate good industries (e.g., chemicals). These latter industries also happen to be import-intensive. While these figures extend only up to 1964, the problem does not appear to have become less severe in more recent times. It can also be noted from the table that, for most industries, the degree of under-utilization is significantly higher

TABLE 3.7.

ESTIMATES OF UNDERUTILIZATION OF CAPACITY FOR SELECTED GROUPS OF INDUSTRIES, 1961-64.

Industry group	Underutilization (percent)				
	1961	1962	1963	1964	Average (1961-64)
Food products	9.9	9.3	24.4	16.9	15.1
	(7.5)	(6.5)	(21.6)	(15.2)	(12.7)
Tobacco products[a]	10.6	4.4	5.2	12.7	8.2
Textile products	7.0	7.9	9.1	6.3	7.6
	(6.3)	(7.3)	(8.2)	(5.8)	(6.9)
Wood and cork products[a]	35.1	27.1	16.9	16.0	23.8
Paper and Paper products[b]	11.2	10.5	7.8	11.7	10.3
Leather and leather products	59.9	57.8	54.4	56.0	57.0
	(27.6)	(24.4)	(17.9)	(21.5)	(22.8)
Rubber and rubber products	16.1	23.1	25.6	26.7	22.9
	(5.7)	(7.1)	(11.2)	(10.6)	(8.7)
Chemicals and chemical products	53.5	56.8	59.3	55.3	56.2
	(29.0)	(23.9)	(21.2)	(30.0)	(26.0)
Non-metallic - mineral products	36.2	34.7	33.0	35.3	34.8
	(22.1)	(20.7)	(19.0)	(21.4)	(20.8)
Basic metals	21.1	11.3	8.8	11.1	13.1
	(13.3)	(4.5)	(5.3)	(7.9)	(7.8)
Metal products	53.9	56.2	54.8	54.2	54.8
	(23.0)	(22.2)	(17.4)	(17.3)	(20.0)
Machinery except electrical machines	26.1	32.1	26.6	37.2	30.5
	(12.7)	(11.4)	(7.3)	(21.1)	(13.1)
Electrical machinery and appliances	39.7	43.6	45.4	41.8	42.6
	(8.3)	(11.7)	(11.7)	(10.6)	(8.1)
Transport equipment	49.3	42.2	41.8	35.7	42.4
	(22.5)	(18.2)	(16.3)	(10.7)	(16.9)

Notes: (1) This table is based on present and desirable working conditions. Figures in parentheses are for present working conditions.

(2) a. For present working conditions, these industries show overutilization.

b. The number of shifts working at present and the number considered desirable are the same for industries of this group.

Source: Bhagwati and Srinivasan (1975), p. 189.

under working conditions that are considered desirable.

(3.4) THE STRUCTURE AND GROWTH OF FOREIGN TRADE.

Merchandise Exports.

India's export performance since the early 1950s has, on the whole, been disappointing. From 1.8% in 1952, its share in world exports has secularly declined to a mere .6% by 1976[15]. Over the first decade of planning exports were virtually stagnant, an outcome, in no small measure, due to the neglect of the export sector by the planners[16]. But the emergence of severe foreign exchange difficulties during the Second Plan and the realization that export expansion was necessary to pay for the country's growing import needs, led planners to devote greater attention to exports. Thus, the Third Plan witnessed the initiation of various export promotion measures, particularly towards the "newer" export commodities. But for the drought years 1965-66 and 1966-67 during which the rupee was devalued by 57.5% against the U.S. dollar, and real exports fell, export growth was steady during and after the Third Plan, the compounded annual growth rate being around 4% during the Third Plan[17]. By 1969, real exports were back at their pre-drought level and thereafter grew at the impressive, unprecedented compounded annual rate of 7.5%[18]. However, a significant factor in this improved performance was the emergence, in 1971, of Bangladesh as a trading partner.

The pattern of Indian exports has undergone some noteworthy changes since the early 1950s. This is highlighted in Table 3.8. Traditionally, the country's exports have been dominated by a few primary goods (e.g., tea),or agro-based manufactures like jute and cotton. While these goods are still important export commodities,their importance has markedly declined. Thus, tea, jute and cotton which accounted for almost 48% of total exports in 1962-53, registered a steady decline as their combined share fell to a mere 17% by 1975-76, a decline that is almost secular in nature after 1960-61[20]. With the exception of iron ore, whose exports grew rapidly after 1960-61, most other primary exports were either stagnant or declined in terms of their shares. On the other hand, since the early 1960s, a number of "new" manufacturing exports became important, reflecting the increasing diversification of the industrial base and the step-up in export promotion measures in this direction. Thus, manufactures like engineering goods, chemicals, iron and steel, etc., all increased their shares in total

TABLE 3.8.

THE STRUCTURE OF EXPORTS (PERCENTAGE SHARES)

EXPORT CATEGORY	1952-53	1955-56	1960-61	1965-66	1970-71	1975-76
A. MANUFACTURES	45.5	42.0	45.1	48.1	52.9	50.9
Traditional						
1. Jute	22.5	19.5	21.1	22.7	12.4	6.1
2. Cotton	10.9	9.4	9.0	7.8	6.3	5.3
3. Coin	1.3	1.5	1.3	1.3	Neg	Neg
Non-Traditional						
1. Chemicals	Neg.	1.0	1.1	1.4	2.4	2.3
2. Leather	3.5	3.7	3.9	3.5	4.7	5.0
3. Iron and Steel	Neg.	Neg.	1.5	1.5	5.9	3.0
4. Engineering goods	N.A.	Neg.	1.0	2.2	8.5	10.2
5. Pearls, stones etc	Neg.	Neg.	Neg.	1.8	2.7	3.7
B. PRIMARY	55.5	58.0	54.9	51.9	47.1	49.1
1. Tea	14.1	18.1	19.1	12.8	9.5	5.8
2. Cashew Kernel	2.3	2.1	2.9	3.4	3.4	2.4
3. Oil-cakes	Neg.	1.2	2.2	4.3	3.6	2.1
4. Spices	3.5	1.6	2.6	2.9	2.5	1.0
5. Manganese	3.8	1.8	2.2	1.7	1.0	.5
6. Iron Ore	Neg.	1.0	2.7	4.9	7.6	5.3
TOTAL EXPORTS	100.0	100.0	100.0	100.0	100.0	100.0

Notes: (1) Percentages have been calculated from data in current values.
(2) N.A. = not available. Neg. = neglible (less than 1%).

Sources: (1) Basic Statistic Relation to the Indian Economy, C.S.O., New Delhi, April 1976.
(2) Economic Survey, Ministry of Finance, New-Delhi, 1974-75 and 1977-78.
(3) K.H. Thanawala (1967) for the totals A and B for the years 1952-53 and 1955-56.

exports. Engineering goods exports in particular, grew very rapidly (especially after 1965-66), their share increasing from 2.2% in 1965-66 to 10.2% in 1975-76. The combined share of the items listed as "non-traditional" manufacturing exports, increased from 7.5% in 1960-61 to 20% in 1975-76. This rapid growth of "new" manufactures however, was not sufficient to arrest the decline in India's share in world exports.

Thus, while India appears to have been successful in achieving greater diversification of its export basket, particularly in the direction of that class of manufactures which constitutes the most dynamic element in world trade, this basket is still heavily weighted in primary products, many of which do not face bright future prospects.

Merchandise Imports

As we indicated earlier, import trade has been subject to strict and direct control through the policy of import licensing. This policy has therefore, been the major force behind the evolving structure of imports. By design, it has been used to channel foreign exchange away from "non-essential" uses (i.e., consumer goods, excepting food) into producer goods[20]. Even though licensing has been comprehensive, extending to fine product classification, there does not appear to have been any clear-cut criteria on which detailed allocational decisions have been made, though they can be expected to have reflected, at the broad level, the structure of industrialization planned for. Again, at the broad level, it seems allocation procedures have involved netting out "priority" imports like food, fertilizer, oil, etc., from expected exchange availabilities in each period, the remainder being subsequently allocated between capital goods, raw materials, etc.[21].

The explicit attempt to structure the pattern of imports in the direction of capital goods and raw materials and intermediate goods, and away from consumer goods (excepting food), through licensing, is reflected in the evolving structure of imports depicted in Table 3.9.

The heavy concentration towards producer goods in the import structure is clearly evident. The share of capital goods imports rises significantly up to 1965-66 while that of raw materials and intermediate goods declines, reflecting quite accurately the nature of the industrialization strategy with its emphasis on capacity-building over a wide range of "heavy" industries[22]. After the 1965-66, these trends are reversed, reflecting the growing importance of raw materials and intermediates in response to the growth in productive capacity. The

TABLE 3.9

THE STRUCTURE OF IMPORTS (PERCENTAGE SHARES)

	1950-51	1955-56	1960-61	1965-66	1969-70	1970-71	1975-76
Raw Materials and Intermediate Goods	53.5	51.4	46.6	35.0	47.9	54.5	52.5
Capital goods	20.2	28.7	29.7	36.2	25.5	24.7	18.4
Other Imports of which	26.2	19.9	23.7	28.8	26.6	20.8	29.1
Cereals	16.0	2.6	16.2	22.9	16.5	13.0	25.5
Total Imports	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Notes: The figures after 1960-61 are not strictly comparable to those preceding 1960-61 due to differences insources and slight differences in coverage.

Sources: (1) Economic Survey, Ministry of Finance, New-Delhi, 1974-75 and 1977-78 issues for the post-1960-61 figures.

(2) Bepin Behari (1965), pp. 176-181, for the pre-1960-61 figures.

table also shows that the bulk of other imports (viz., mainly consumer goods imports) have been cereal imports. These imports actually show much fluctuation on a year-to-year basis, but over the whole period, have on average accounted for a significant proportion of overall imports.

(3.5) RESOURCE TRENDS IN THE ECONOMY.

In this section we highlight the trends in the domestic resource mobilization effort and the magnitude of foreign resources over the Plans. On the domestic front, it appears that much success has been achieved in resource mobilization. In fact, the country's saving performance appears to have been the most satisfactory aspect of the country's development performance. Thus, as is clear from Table 3.10, the country has been successful in pushing up its saving rate quite significantly.

TABLE 3.10.

AVERAGE SAVING AND INVESTMENT RATES BY PLAN.

	First Plan	Second Plan	Third Plan	1966-67/ 1968-69	Fourth Plan	1974-75/ 1975-76
Saving Rate (%)	6.7	8.2	9.6	10.5	12.1	13.6
Investment Rate (%)	7.0	11.2	12.2	13.1	12.9	14.4

Notes: The saving and investment rates are, respectively, the ratio of net domestic saving and net capital formation to net domestic product (all expressed in current prices).

Source: National Accounts Statistics, C.S.O., New-Delhi, February 1976 and January 1978 issues.

The table shows a steady upward trend in the saving rate from an average of only 6.7% during the First Plan to an average of 12.1% during the Fourth

Plan, to 13.6% during 1974-75/1976-77. Thus, over the whole period, the saving rate doubled. In fact, India's saving rate compares quite favourably with those achieved historically by present-day industrialized economies[23]. We note from the table that capital formation in the economy was financed practically by domestic saving alone over the First Plan. But thereafter, the gap between investment and saving (ex post) appears to have widened, the gap indicating the extent of external financing. We shall touch upon the role of external resources shortly.

Sectoral Saving

Table 3.11 depicts the distribution of aggregate saving by institutional sector over the five-year plans. It can be seen from the table that the household sector provides the bulk of aggregate saving in the economy, the share of the government sector is substantial. We note that the government succeeded in dramatically raising its share in total saving over the first three Plans. However, it was unable to maintain it, as its share declined thereafter from its peak of 27.2%. The corporate sector's share in saving has been small, and it is clear from the table that it has declined over the period.

TABLE 3.11

SECTORAL SAVINGS BY PLAN (PERCENTAGE SHARES)

	First Plan	Second Plan	Third Plan	1966-67/ 1968-69	Fourth Plan
Household	74.0	74.7	66.0	83.5	79.6
Corporate	7.6	6.7	6.8	2.7	5.2
Public	18.4	18.6	17.2	13.8	15.2
Total	100.0	100.0	100.0	100.0	100.0

Notes: Percentages are based on current value data.

Source: National Accounts Statistics, C.S.O., New-Delhi, February 1976 and January 1978 issues.

Government Saving and Taxation

Taxation has been an important policy instrument in the government's resource mobilization effort, as tax revenues are the major source of government saving. The government appears to have maintained a steady tax effort, as both direct taxes and indirect taxes as a proportion of national show an upward trend over the period. This is evident from Table 3.12. However, this is to be expected given the low levels they initially started from and the sharp step-up in government economic activity. The table also shows that the government saving effort has not matched the increase in its revenues, as we note a perceptible decline after 1965, in its saving rate (i.e., its saving as a proportion of its revenues).

TABLE 3.12

GOVERNMENT SAVING AND TAXATION.

	First Plan[e]	Second Plan	Third Plan	Annual Plan	Fourth Plan	1974/57/ 1975-76 Average
DTR/NNP(%)[a]	2.8	3.0	3.8	3.2	3.4	3.8
IDTR/NNP(%)[b]	6.1	7.2	9.8	10.4	11.7	13.5
TR/NNP(%)[c]	8.9	10.2	13.6	13.6	15.1	17.3
Saving Rate(%)[d]	8.4	10.5	17.8	10.4	11.3	17.3

Notes: a Direct tax revenues as a proportion of national income.

b Indirect tax revenues as a proportion of national income.

c Direct + indirect tax revenues as a proportion of national income.

d Government saving as a proportion of tax *plus* other current revenues.

e Average for 1954-55/1955-56.

All calculations are based on current value data.

Sources: As in Table 3.11, plus *Estimates of National Product*, C.S.O., Planning Commission, New-Delhi.

Foreign Resources in the Indian Economy.

External resources have been a significant factor in India's development drive, being substantial till the mid-sixties but declining quite sharply thereafter. The bulk of these resource inflows have been in the form of official capital, private capital never acquiring any real significance over the period of our study[24]. Consequently, in subsequent discussion, as in other parts of this study, we shall not make a distinction between the two.

It has been argued that while India has on average, absorbed a significant proportion of world aid flows, in relation to its size, it has been an under-aided country[25]. Thus, for instance, as Table 3.13 below shows, the net inflow of foreign capital (defined as the excess of investment over saving) per capita, or as a proportion of national income has been rather low, and has declined sharply after the Third Plan.

It may be noted that while the relatively small magnitude of foreign resources per capita or as a proportion of national income puts the role of the otherwise large capital inflows in proper perspective, the significant aspect of foreign resources, particularly till 1965 or so, is not only that they have permitted investment levels in excess of domestic savings, but that they have provided the foreign exchange for the import of capital goods, raw materials, etc. As is also evident from Table 3.13, they have been quite a significant proportion of capital formation, thereby pointing to their role in filling the overall resource gap.

TABLE 3.13

NET FOREIGN CAPITAL INFLOW.

Net Foreign Capital Inflow	First Plan	Second Plan	Third Plan	Annual Plans	Fourth Plan
as a proportion of national income (%)	.6	3.4	2.9	2.8	1.0
Per capita (Rs per head)	1.4	7.5	10.7	14.6	7.1
as a proportion of gross capital formation (%)	2.1	19.1	14.5	13.5	4.5

Notes: (1) Data on foreign capital inflow, capital formation and national income are in current values.

(2) First Plan average is for years 1954-55 and 1955-56 only.

Sources: As in Table 3.12.

Table 3.14 below highlights the trends in the magnitude and pattern of external assistance to India.

The figure indicates a sharp increase in external assistance after the First Plan, an increase that was sustained up to the Third Plan, the figures thereafter overstating the magnitude of external resource inflows in view of the devaluation of the Indian rupee in 1966. In fact, in dollar terms, the post-1966 figures indicate a decline in foreign resource inflows. Further, the "real" resource transfers implicit in these figures would be considerably lower, if they are appropriately adjusted for inflation and debt service payments. The table also

TABLE 3.14

EXTERNAL ASSISTANCE: THE PATTERN OF UTILIZATION

(Rs 10 million and per cent)

	First Plan	Second Plan	Third Plan	Annual Plans	Fourth Plan	1974-75
Loans	1,264	7,250	19,083	22,005	34,223	7,582
	(62.7)	(50.7)	(66.5)	(70.0)	(91.6)	(91.4)
Grants	702	1,606	1,062	2,258	1,596	717
	(34.8)	(11.2)	(3.7)	(7.1)	(4.3)	(8.6)
Commodity	51	5,448	8,532	7,194	1,540	--
Assistance	(2.5)	(38.1)	(29.8)	(22.9)	(4.1)	
Total	2,017	14,304	28,677	31,457	37,359	8,299
	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)

Notes: Figures in parentheses are percentage shares.

Source: Basic Statistics Relating to the Indian Economy, C.S.O., New Delhi, April 1976.

highlights some interesting trends. Thus, it is clear that the grant component of foreign aid has declined sharply following the First Plan, while the share of loans has risen considerably from 62.5% over the First Plan to the all time high average of 91.6% during the Fourth Plan. Even though loans have generally been made available at concessional rates, their terms have been stiffening since the 1960s. It has been estimated that debt service payments as a proportion of non-food aid to India have risen from 12% during the First Plan to 23% during the Third and to 68% during the Fourth.

It is also evident from Table 3.14 that commodity assistance (mainly assistance under U.S. Public Law 480 and 665), has been considerable right up to the beginning of the Fourth Plan, being particularly heavy during the Second and Third Plans. By an overwhelming margin, foodgrains have been the most important element in this assistance. Further, the bulk of commodity assistance under the U.S. aid programme to India has come under Title I of PL 480, whereby payment for commodities imported under it, has been in rupees to the extent of the f.o.b. value of such imports and 50% of the ocean freight incurred in the transportation of the commodities. However, since 1968, a portion of such assistance has had to be paid for in convertible currencies, thereby reducing the foreign exchange saving implicit in such aid.

Foodgrains - viz., wheat, rice, corn - have formed an overwhelming bulk of Title I PL 480 aid. Thus, of the total dollar market value of commodities received till 1967, foodgrains accounted for 87%, the remaining 13% being accounted for by commodities like cotton, tobacco, evaporated milk, etc.[27]. The significance of foodgrain PL 480 imports is evident from Table 3.15.

TABLE 3.15

PL 480 (TITLE I) FOODGRAINS IMPORTS IN RELATION TO PRODUCTION AND TOTAL FOODGRAINS IMPORTS

PL 480 as a percentage of	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
Production	3.2	3.5	5.2	5.0	4.8	3.0	5.2	6.6	8.4	13.6	9.5	7.6	2.7	2.4	1.3	.5
Foodgrain Imports	77.1	56.1	87.0	81.8	76.0	63.5	82.2	94.2	88.3	89.5	65.7	75.9	52.3	56.6	49.4	24.0

Notes: Figures relate to crop years ending in July.

Source: See Data Appendix.

It is evident that foodgrain imports under PL 480 have been a significant proportion of total foodgrain imports, particularly around the drought year of 1966. They were almost 14% of domestic production of foodgrains in that year but declined continuously thereafter. In fact, after 1972 such imports virtually disappeared with the expiry of the last agreement on PL 480 between the U.S. and Indian governments in 1973.

This concludes our discussion of the major trends and structural changes in the Indian economy since the inception of planning in 1951-52. We turn to the development and estimation of the econometric model in subsequent chapters.

FOOTNOTES

Chapter 3

1. These Plans correspond to the following periods in chronological order:

   First Five-Year Plan: 1951-52 to 1955-56.
   Second Five-Year Plan: 1956-57 to 1960-61.
   Third Five-Year Plan: 1961-1962 to 1965-1966.
   Fourth Five-Year Plan: 1969-70 to 1973-74.
   The Fourth Plan was to start in 1966-67, but due to severe difficulties following the 1965 war with Pakistan and two severe droughts in 1965-66 and 1966-67, it was abandoned. For three years up to 1968-69, all planning was on an annual basis.

2. See for instance, Mellor (1976).

3. Bhagwati and Desai (1970), pp. 24.

4. The next few paragraphs are based on Bhagwati and Desai (1970), Chapters 12 and 13,and Bhagwati and Srinivasan (1975) Chapter 1.

5. Thus, investments not targeted for were not necessarily ruled out. In fact, often capacity creation took place in areas not planned for.

6. See Bhagwati and Srinivasan (1975), pp. 18.

7. K.N. Raj quoted in Bhagwati and Desai (1970), pp. 65.

8. Ibid.

9. See S. Kuznets (1966), Chapter 3.

10. Mellor (1976), pp. 29

11. Bardhan (1968), pp. 6-7, as reprinted in Chen and Uppal (1971).

12. Thus, it has been calculated that if the period 1949-50 to 1964-65 is extended to 1970-71, the growth rate of wheat yields jumps from 1.3% per annum to 2.4% per annum. Bhagwati and Srinivasan (1975) pp. 49.

13. The country also fought a brief war with Pakistan in August 1965.

14. In fact, the decline in government capital spending was, in no small measure responsible for recessionary trends in the industrial sector between 1966-67 and 1968-69. However, this was a period of severe dislocations in the economy - e.g., the border war of 1965, the two severe successive droughts and the devaluation of the Indian rupee in June 1966.

15. India's share in world exports in 1952 has been taken from Bhagwati and Srinivasan (1975) p. 19, while the figure for 1976 has been calculated from International Financial Statistics, Supplement, United Nations, May 1978.

16. For a detailed analysis of export trends and policies prior to 1961, M. Singh (1964) is an excellent source. The post-1960 period has also been exhaustively dealt with in Bhagwati and Desai (1970), Bhagwati and Srinivasan (1975) and D. Nayyar (1976).

17. Computed from Yearbook International Trade Statistics, Vol. 1, United Nations, 1978, p. 494.

18. Ibid.

19. In fact, India's share in world exports of tea and jute has also declined secularly. India is still the world's largest producer of tea and jute manufactures, but in the case of tea, the country not only lost its position as the world's largest exporter in 1965, but its share declined from 46.5% in 1951 to 31.5% in 1970. In the case of jute, the decline in the country's share in world exports was even more dramatic - it fell from the all-commanding level of 92.2% in 1948-50 to 47.8% in 1970. These percentages have been obtained from M. Singh (1964), pp. 38, 58, and Nayyar (1976), pp. 37, 88.

20. In point of fact, the import content of domestic "non-essential" consumer goods industries has not been insubstantial. See Bhagwati and Desai (1970), pp. 306-308.

21. See Bhagwati and Srinivasan (1975), p. 36.

22. In particular, this was a period when a wide range of capital goods industries were set up, imported capital goods playing important role in this development.

23. See for instance, Kuznets (1966), pp. 248-249.

24. This is due to the fact that there have been strict controls on the inflow of private capital and a general lack of interest in attracting private technology.

25. Streeten and Hill (1968).

26. Computed from P. Chaudhri (1979), p. 98.

27. Computed from Bhagwati and Desai (1970), Table 10.11, p. 208.

CHAPTER 4

THE SECTORAL SUPPLY OF OUTPUT

(4.1) INTRODUCTION.

In this chapter, the first part of the model is developed and discussed along with our empirical findings. The approach adopted is to construct the relationships that comprise this part of the model on the basis of relevant theoretical, empirical and institutional considerations. Thus, in what follows in this and the next two chapters, each equation is developed from a discussion and evaluation of such considerations. Inevitably, the availability of data has dictated what could be done and what could not be done. Difficulties, or procedures devised to circumvent difficulties in this regard, have also been spelled out. We follow the practice of presenting the estimated counterpart of each theoretical equation along with various summary statistics. In many parts of the model, it was considered useful to experiment with alternative formulations. Hence, wherever necessary, the results of such experimentation are also reported.

As is well known, the ordinary least squares (OLS) estimation method is inappropriate in a simultaneous equation context. In particular, OLS applied to each equation which has a endogenous right-hand side variable will give estimates that are biased and not even consistent. In our model of the Indian economy, the simultaneity problem afflicts a subset of equations. Thus, equations which have only predetermined variables on the right-hand side, have been estimated by OLS. Wherever possible or necessary, a correction for autocorrelation has been made. For the simultaneous block of equations, a two-stage estimation procedure has been adopted. A common difficulty with even moderately sized models in the context of estimation by two-stage least squares (2 SLS), which gives estimates that are consistent, is that the number of predetermined variables in the system can quite easily exceed the size of the sample, especially since most samples tend to be small. This means that the first stage regressions involved in 2 SLS estimation cannot be carried out. We faced this difficulty in the present model, since our sample size of 20 falls substantially short of the number of exogenous and lagged variables in the system. One way out of this difficulty is to run first stage regressions of each endogenous variable on a subset k of all predetermined variables (where $k <$ number of observations)[1]. We did not adopt this technique. Instead, following the method developed by Kloek and Mennes, we first constructed a set of principal components from all the predetermined variables in the system[2]. These components accounted for 97% of the variation in all the predetermined variables. Our two-stage estimation procedure then involved (1) regressing each endogenous variable on the set of principal components, and (2) replacing all right-hand side endogenous variables in the equations of the model by their fitted values for estimation. This procedure purges the stochastic element in the endogenous variables, so that they are no longer correlated with the disturbance terms, thereby giving consistent estimates. As with the equations which were estimated by OLS, we used the Cochrane-Orcutt iterative technique to correct for autocorrelation wherever such correction was called for. The estimation procedures adopted by us, of course, deal only with the problems raised by simultaneity and by autocorrelated disturbances. Estimation procedures exist for dealing individually with additional problems raised by lagged dependent variables, multi-collinearity, errors in variables, etc. However, there are no procedures which can be invoked when we are confronted simultaneously with all these problems. Even if such procedures existed, they would most likely raise monumental computational difficulties. Clearly, if we want our estimates to have the usual desirable properties, our estimation procedures may well be found lacking. Thus, it is well known that lagged dependent variables give rise to biased estimates in both small and large samples. In the additional presence of autocorrelated disturbances, the estimates are not even consistent. Since our model is dynamic, the presence of lagged endogenous variables is very much a part of it. We have not dealt effectively with these problems. A complicating factor in our model is that in many of the equations with lagged dependent variables, there are nonlinear constraints on the coefficients, thus requiring nonlinear estimation techniques, which however, could not be adapted to deal with additional problems.

Having briefly touched upon estimation procedures, let us take note of a few points, before we move on to the equations of the model.

In reporting our empirical results below, we follow the practice of presenting the estimated equation with the t values of estimated coefficients in parentheses. Along with the estimated equations we report the following summary statistics: the coefficient of multiple determination R^2 and its adjusted counterpart $\bar{R}^2$, and the Durbin-Watson statistic (D.W.). Further, wherever an equation has been adjusted for autocorrelation we report also the final value of the autocorrelation coefficient (ρ) used in the Cochrane-Orcutt iterative method. Unless stated otherwise, all equations with endogenous right-hand side variables have been estimated using the two-stage procedure outlined above. Finally, to distinguish between various types of variables, the following notation is adopted, using as an example, the letter X to denote a variable:

X	= real, endogenous	
XS	= nominal, endogenous	
$\bar{X}$	= real, exogenous	
$\overline{XS}$	= nominal, exogenous	
XL	= real, lagged one period	
XSL	= nominal, lagged one period	
XLi	= real lagged	i stands for lags > 2
XSLi	= nominal, lagged	(i = 2,3...k)
XR	= rate	
XI	= index, except in the case of prices, all which are indices but do not end with the letter I	

All variables are expressed in Rs 10 million, except where explicitly stated otherwise. Further, the significance of all estimated coefficients is inferred with reference to the 5% level of significance unless stated otherwise.

Having outlined our estimation procedures and the format used to report our results, we turn now to the determinants of output in agricultural, industrial, infrastructural and services sectors. The supply side is an important aspect of the model since it plays a major role in output determination in economies like India. This is in contrast to models of developed economies in which output is determined in the context of the theory of cyclical fluctuations. The theory does not appear to provide a useful framework for economies like India which typically do not experience cyclical fluctuations in economy activity, and in which output fluctuations have their main origins on the supply side. Thus, for instance, agriculture accounts for around 45% of national product and is highly susceptible to the vagaries of the weather. Because of both these reasons, short-run fluctuations in aggregate output are dominated by those in agricultural output. However, we do not deal with the supply of output question at the aggregate economy-wide level. For the reasons spelled out in Chapter 3 as well as the fact that the factors explaining output in agriculture and nonagriculture are likely to be fundamentally different, a separate treatment of agriculture is warranted. A separate treatment of the industrial or manufacturing sector is also warranted not only because the country's development drive has been based on this sector, but also because this would enable us to link it appropriately to other relationships in the overall model. The remaining sectors of the economy are split into 2 sectors, one which we call "infrastructure" and a residual sector which we call "services". The definitions of these sectors are adapted from the Indian National Accounts, and are as follows:

1. Agriculture - agriculture (proper), allied activities, forestry and fishing
2. Manufacturing - manufacturing (proper), mining and construction.
3. Infrastructure - transport and communication, electric, gas and water supply.
4. Other services - trade banking, insurance, real estate, community and personal service.

(4.2) THE AGRICULTURAL SECTOR.

The supply relationships in this sector consist of two parts. The first part involves relationships explaining the supply behaviour of the entire sector. In the context of the economy-wide model, these relationships play a role in determining income generation in the economy, and indeed, given the sheer size of the sector, are a major determinant of it. The second part of the agricultural supply model is a set of relationships describing the behaviour of foodgrains production in the economy. Food output is an important element in the country's progress, since traditionally it has barely managed to keep abreast of rapid population growth, often requiring large imports of foodgrains which have eaten into the country's scarce foreign exchange resources and displaced strategic imports of raw materials, intermediate and capital goods. On the other hand, from 1956 to the late sixties, India received food aid on a non-commerical basis from the U.S. under Public Law 480 (PL 480). The issues raised by such aid have already been touched upon in previous chapters. The supply of foodgrains in our model is linked to other relationships developed later,to examine, amongst other things, the interrelationships between PL 480 aid, food grains prices, output, the foreign exchange situation, imports and manufacturing output. In fact, PL 480 aid has, in the context of the model we developed, economy-wide effects, which we shall look at later in a simulation context. Let us turn now to the determinants of agricultural and foodgrains output.

For agricultural output as a whole, let us postulate the following standard production function:

(4.1) $YA = F(KAL, A)$[2]

where YA = net output in agriculture.

KAL = capital stock in agriculture (end of previous period)

A = area under all crops (millions of hectares).

Equation (4.1) needs to be augmented in at least 2 ways: (1) typically agricultural output is subject to wide fluctuations primarily due to random factors like the state of the weather. To capture this, we need to include in (4.1) an index reflecting the state of the weather (we call this WI). (2) Indian agriculture has traditionally been based on low-yielding methods of production. In such a situation, one would expect that the adoption of modern farming technology would have a definite impact upon output. It would be instructive to examine whether the spread of modern farming technology in India has had any dramatic impact upon output. Thus, this suggests the inclusion of variables reflecting technical progress in the sector. Let $\underline{TN}$ denote a vector of such variables. Thus, we can rewrite (4.1) as:

(4.2) $YA = G(KAL, A, WI, \underline{TN})$

Perhaps the most important TN variable is fertilizer consumption because the use of manufactured fertilizer, as opposed to manures, represents a fairly radical departure from traditional techniques of production. Fertilizer consumption *per se* is but one aspect of the spread of modern farming technology, which comes more in the form of a package, involving not only fertilizer use, but also, as crucial complements, adequate water supplies, better seeds, etc. Thus for TN we can specify variables such as (a) fertilizer consumption (b) area under irrigation, and (c) area under high-yielding seed varieties. The inclusion of these variables however, raises collinearity problems since each of the variables is highly correlated with the others. In particular, an irrgiation variable appears to be redundant since the effects of irrigation are reflected in the capital stock which includes investment expenditures on irrigation. Some early experimentation with an irrigation variable did not yield reasonable results. We thus dropped this variable and worked with (a) and (c) only, though as our results below show, the inclusion of these variables raises similar difficulties.

Our basic specification of (4.1) was as a Cobb-Douglas function:

$$(4.3) \qquad YA = a_0(KAL)^{a_1} (A)^{a_2}$$

which was modified to (4.4) to incorporate the weather and technical progress variables.

$$(4.4) \qquad YA = a_0(KAL)^{a_1}(A)^{a_2} \exp(a_3\overline{WI} + a_4\overline{FC} + a_5\overline{AHYV})$$

where

$\overline{WI}$ = ratio of actual to normal rainfall[3]

$\overline{FC}$ = fertilizer consumption (millions of tons)

$\overline{AHYV}$ = area under high-yielding seed varieties (millions of hectares)

All three variables are assumed to be exogenous. In this formulation the TN and weather variables shift the basic production function (4.3). After some initial experimentation, we found the following modification seemed to perform better:

$$(4.5) \quad YA = a_0(KAL^{a_1}(A)^{a_2}(\overline{WI})^{a_3} \exp(a_4\overline{FC} + a_5\overline{AHYV})$$

(4.5) can be rewritten as

$$(4.6) \quad YLD = a_0(KAL/A)^{a_1}(A)^{-(1-a_1-a_2)}(\overline{WI})^{a_3} \exp(a_4\overline{FC} + a_5\overline{AHYV})$$

where $YLD = YA/A$ = yield in agriculture

a_1, a_2, a_3, a_4, a_5, are all expected to be positive, while the coefficient of A can go either way since it is a measure of the returns to scale in the basic function (4.3).

We estimated various versions of (4.6) using the two stage procedure outlined above[4]. The results are reported in Table 4.1.

It is clear from an examination of the equations that we have met with little success in trying to incorporate the effects of the TN variables. While these variables have the right sign in all equations, their coefficients are statistically insignificant throughout. This finding can possibly be explained by two factors. Firstly, the spread of the "Green Revolution" involving better farming methods has largely been confined to foodgrains (and that too, to wheat) as well as to particular regions. Its effect, in the aggregate may

TABLE 4.1: AN INITIAL SET OF YLD EQUATIONS

EQUATION	INTERCEPT	$\ell n(KAL/A)$	$\ell n\ A$	$\ell n\ \overline{WI}$	$\overline{FC}$	$\overline{AHYV}$	R^2	$\bar{R}^2$	D.W.
4.6a	3.4981	.6886	-.4402	.1516	-	-	.8079	.7728	1.8539
	(1.0870)	(2.959)	(-.615)	(2.981)					(.1022)
4.6b	3.4139	.2852	-.1612	.1269	.0394	-	.8130	.7631	1.8203
	(1.026	(.386)	(-.156)	(2.343)	(.588)				(.1490)
4.6c	1.9179	-.0045	.3705	.1127	-	.0053	.8253	.7787	1.9207
	(.542)	(-.007)	(.335)	(2.239)		(1.211)			(.2085)
4.6d	2.1354	-.2770	.5428	.1013	.0289	.0052	.8274	.7658	1.9045
	(.592)	(-.319)	(.451)	(1.871)	(.413)	(1.095)			(.255)

Note: The figures in parentheses in the column for the D.W. statistic are the final values of the autocorrelation coefficient $\hat{\rho}$ used in adjusting for autocorrelation.

thus be obscured. In particular, our $\overline{AHYV}$ variable refers to foodgrains only and its impact on overall agricultural production is likely to be weak. Secondly, since the adoption of modern technology involves investment in irrigation, land improvement, etc., its effects are captured by the capital stock variable. The equations show that the inclusion of $\overline{FC}$ or $\overline{AHYV}$ or both adds somewhat to the overall explanation of the equations, but the values of R^2 adjusted for the degrees of freedom clearly show that this improvement is either absent or very small. Indeed, we find that the inclusion of these variables makes the capital coefficient negative. However, it is statistically insignificant. Only the weather index appears to be stable and significantly positive in all equations[5]. In view of the insignificance of $\overline{AHYV}$ and $\overline{FC}$, we tried to incorporate the impact of technical progress by replacing these variables with a time trend. Our estimated equation was

$$(4.7) \quad \ell n\ YLD = \underset{(1.344)}{5.51016} + \underset{(0.489)}{.2872}\ \ell n(KAL/A) \underset{(-0.706)}{-.05855}\ \ell n\ A + \underset{(2.453)}{.1257}\ \ell n\ \overline{WI} + \underset{(.769)}{.0096}\ \overline{TEE}$$

$$R^2 = .8158,\ \bar{R}^2 = .7793,\ D.W. = 1.8201,\ \hat{\rho} = .1722$$

Again, the results are unsatisfactory, as the only significant coefficient is the weather coefficient.

The evidence is in favour of equation (4.6a). Both the ℓn(KAL/A) and WI coefficients have the right sign and are significant. The non-significance of the A coefficient is borne out by other equations as well, and is not unexpected. It simply implies that the sum of output elasticities of capital and acreage is not significantly different from unity - i.e., constant returns to scale. This suggests that we can drop A from the equation. It is possible that since A, $\overline{FC}$ and $\overline{AHYV}$ are collinear variables, the inclusion of A may be obscuring the effect of the latter two. So we re-estimated the above equations, without the A variable. Our results are reported in Table 4.2.

As indicated by $\bar{R}^2$ these equations provide better fits than the earlier set of equations reported in Table 4.1. It is interesting to note that the exclusion of acreage variable lowers quite substantially the standard errors of the estimated coefficients in equation (4.8a). However, again the TN variables fail to come through, probably on account of the reasons given earlier. Replacing the TN variables by a time trend did not help at all as can be seen from the following equation:

$$(4.9) \quad \ell n\, YLD = \underset{(1.4618)}{3.18377} + \underset{(.2370)}{0.1319}\ \ell n\left(\frac{KAL}{A}\right) + \underset{(2.5138)}{0.1258}\ \ell n(\overline{WI})$$

$$+ \underset{(.7704)}{.0095}\ (\overline{TEE})$$

TABLE 4.2: A SECOND SET OF YLD EQUATIONS

EQUATION	INTERCEPT	$\ell n(\frac{KAL}{A})$	$\ell n\ \overline{WI}$	$\overline{FC}$	$\overline{AHYV}$	R^2	$\bar{R}^2$	D.W.*
4.8 a	1.5391	.5530	.1527	-	-	.8156	.7939	1.8433
	(5.442)	(8.064)	(3.220)					(.0761)
4.8b	2.9694	.1931	.1251	.0455	-	.8127	.7776	1.8218
	(1.760)	(.456)	(2.450)	(.873)				(.1479)
4.8c	3.0183	.1860	.1172	-	.0042	.8239	.7909	1.8858
	(2.656)	(.661)	(2.473)		(1.384)			(.2047)
4.8d	3.4407	.0794	.1116	.0169	.0039	.8248	.7781	1.8667
	(1.958)	(.180)	(2.230)	(.167)	(1.0190)			(.2309)

Note: *See Note, Table 4.1.

$R^2 = .8093$, $\bar{R}^2 = .7735$, D.W. = 1.8438, $\hat{\rho} = .1954$

Consequently, we accept equation (4.8a) as the equation for explaining yields in the agricultural sector as a whole. Agricultural output YA is then obtained from

(4.10) $YA = YLD.A$

For explaining foodgrains production we adopted the same format as above. In particular, we worked with the following model:

(4.11) $YF = b_0(KAL)^{b_1}(AF)^{b_2}(\overline{WI})^{b_3} \exp(b_4\overline{FC} + b_5\overline{AHYV})$

where YF = output of food grains (millions of tons)

AF = area under food grains (millions of hectares)

The other variables have already been defined. It may be noted that KAL and $\overline{FC}$ refer to total agriculture, while ideally, it could be argued, these variables should pertain to the foodgrains sector only. Data in this detail are simply not available. Besides, in the case of KAL, it would appear that there are conceptual difficulties in splitting it into that part of it used in foodgrains production and that part of it used in other agricultural production. For one thing, in the same year, a farmer may grow a foodgrain and a commercial crop, in both cases using fully his available capital stock. Another problem is that KAL includes investment in irrigation which benefits the production of all crops.

TABLE 4.3: AN INITIAL SET OF YLDF EQUATIONS

EQUATION	INTERCEPT	$\ln(\frac{KAL}{AF})$	$\ln AF$	$\ln \overline{WI}$	$\overline{FC}$	$\overline{AHYV}$	R^2	$\bar{R}^2$	D.W.*
4.12a	-1.8722	.8833	-.4596	.2242	-	-	.7768	.7350	1.9382
	(-.357)	(2.451)	(-.346)	(2.836)					-
4.12b	-3.3639	-.6945	1.1739	.1498	.1509	-	.8068	.7510	1.8959
	(-.648)	(-.719)	(.730)	(1.762)	(1.787)				(.0393)
4.12c	-12.5516	-.3994	2.9203	.1657	-	.0072	.8655	.8271	2.3657
	(-4.089)	(-1.307)	(3.479)	(2.366)		(2.985)			(-.4942)
4.12d	-4.7855	-.4238	1.2301	.1602	.0647	.0050	.8236	.7606	1.8877
	(-.895)	(-.521)	(.800)	(1.923)	(.700)	(.953)			-

Note: *See Note, Table 4.1

Nevertheless, we did try to make a simple adjustment for this. We shall discuss this later on.

We expressed (4.11) as

$$(4.12) \quad YLDF = b_0(KAL/AF)^{b_1}(AF^{-(1-b_1-b_2)})(\overline{WI})^{b_3} \exp(b_4 \overline{FC} + b_5 \overline{AHYV})$$

where YLDF = yield in the foodgrains sector.

We estimated various versions of (4.12) by our two-stage procedure, adjusting for autocorrelation wherever appropriate. Our findings are reported in Table 4.3.

An examination of Table 4.3 suggests that the TN variables do not do very well. Except in equations 4.12b and 4.12c respectively, the $\overline{FC}$ and $\overline{AHYV}$ coefficients are statistically insignificant. Their inclusion, separately or together, leads to a negative capital elasticity and an unreasonably large AF coefficient which is,however, statistically insignificant in all equations except 4.12c. In terms of fit, the inclusion of $\overline{AHYV}$, apart from giving a significant coefficient, raises the total explanatory power of the equation more than in the case of $\overline{FC}$, or both $\overline{FC}$ and $\overline{AHYV}$. However, the equation remains unreasonable in view of the negative capital elasticity and the unduly large AF coefficient. Using a time trend variable in place of $\overline{FC}$ and $\overline{AHYV}$ did not materially alter the results.

TABLE 4.4: A SECOND SET OF YLDF EQUATIONS

EQUATION	INTERCEPT	$\ln(\frac{KAL}{AF})$	$\ln \overline{WI}$	$\overline{FC}$	$\overline{AHYV}$	R^2	$\bar{R}^2$	D.W.*
4.13a	-3.6776	.7646	.2245	-	-	.7752	.7488	1.9618
	(-7.755)	(7.118)	(2.917)					
4.13b	.2640	-.1607	.1601	.1213	-	.8000	.7600	1.8448
	(.114)	(.297)	(2.023)	(1.762)				(.0976)
4.13c	-.5423	.0384	.1552	-	.0087	.8069	.7683	1.9912
	(-.336)	(-.103)	(2.140)		(2.091)			(.2151)
4.13d	.9269	-.3086	.1382	.0691	.0065	.8136	.7603	1.9868
	(.376)	(-.535)	(1.846)	(.707)	(1.116)			(.2523)

Note: *See Note, Table 4.1.

While the time variable coefficient was significant, the capital elasticity remained negative. The AF coefficient, however, was insignificant. The unduly large AF coefficient in equation 4.12c, which includes the $\overline{AHYV}$ variable, suggests that some restrictions should be placed on the coefficients *a priori*. Since in most equations the coefficient of AF is found to be insignificant, we dropped the AF variable and re-estimated the equations reported in Table 4.3. Our findings are summarized in Table 4.4.

It is clear that the inclusion of $\overline{FC}$ or both $\overline{FC}$ and $\overline{AHYV}$ does not alter the previous situation much.The inclusion of AHYV only, however, seems to improve matters somewhat. (See equation 4.13c.) The coefficient of the $\overline{AHYV}$ variable is statistically significant, and even though the capital elasticity is not significant, it has the theoretically correct sign. Again it seems to be the case that the impact of $\overline{AHYV}$ is reflected in the KAL variable, since the inclusion or exclusion of the $\overline{AHYV}$ variable dramatically affects the capital elasticity. A similar though less marked effect on the $\overline{WI}$ coefficient is also perceptible, though this coefficient is statistically significant throughout. If we view the capital elasticity in equation (4.13a) as embodying the effects of the $\overline{AHYV}$ variable, or note that its inclusion raises the explanatory power of the equation by no more than 3 percentage points or so, this equation would appear to be quite a satisfactory choice for explaining yield in foodgrains production. The implied AF elasticity in (4.13a) is approximately 0.24. This might appear to be on the low side given government expenditures on land improvement, extensions in irrigated area, etc. However, the effects of these factors are probably embodied in the capital stock variable[6].

In concluding our discussion of the supply of output in the agricultural sector, we briefly report our findings when we tried to adjust KAL in the foodgrains yield function to reflect the proportion of capital in the foodgrains sector. The simplest case is the one in which capital in the foodgrains sector (KAFL) is proportional to KAL.

(4.14) $KAFL = h.KAL$

Under this assumption no change of any consequence is warranted in the preceding equations because, by substituting the above in the basic function:

(4.15) $YF = e_0(KAFL)^{e_1}(AF)^{e_2}(\overline{WI})^{e_3}$

h is absorbed in the intercept and the estimating equation is in terms of KAL, AF, $\overline{WI}$ and the TN variables. We assume, however, that the proportion of KAL in the foodgrains sector varies positively with the share of the foodgrains sector in overall acreage. That is:

(4.16) h = c(AF/A), where h is the proportion of total capital stock employed in foodgrains production.

Equation (4.15) then becomes

$$(4.17)\quad YF = e_0\{c(AF/A) \cdot KAL\}^{e_1} (AF)^{e_2}(\overline{WI})^{e_3}$$

which can be shown to reduce to

$$(4.18)\quad YF = e^1(KAL/A)^{e_1}(AF)^{(e_1+e_2)}(\overline{WI})^{e_3}$$

where $e^1 = e_0c^{e_1}$

$$(4.19)\quad \text{or } YLDF = e^1(KAL/A)^{e_1}(AF)^{(e_1+e_2-1)}(\overline{WI})^{e_3}$$

But for A in the denominator and the absence of $\overline{AHYV}$ and $\overline{FC}$, (4.19) is exactly the same as (4.12). We estimated (4.19) with and without the TN variables, as we did in the previous equations. The general pattern of results was very much the same. In particular, the inclusion of the TN variables resulted in a negative capital elasticity and/or unreasonably large coefficients for the AF variable in a number of cases. However, these estimates were statistically insignificant. Further, rarely were the coefficients of the TN variables themselves statistically significant, and replacing these variables by a time trend did not improve matters at all. Thus, again the most reasonable results were obtained when the TN variables were not considered at all, but the results here were very similar to those obtained when the KAL variable was not adjusted in the manner described above. Thus, the estimated equation in this case was

$$(4.20)\quad \ln YLDF = \underset{(-1.449)}{-5.81019} + \underset{(2.726)}{.6856} \ln\left(\frac{KAL}{A}\right) + \underset{(.543)}{.5616} \ln AF + \underset{(3.007)}{.2203} \ln \overline{WI}$$

$R^2 = .8084$, $\bar{R}^2 = .7725$, D.W. = 2.2564

We also estimated these equations under the restriction of constant returns to scale (i.e., we dropped AF). Again we found that the most reasonable estimates are obtained when the TN variables are ignored[7]. In fact, taken individually or together, these variables were not significant. Their inclusion futher, made the capital stock coefficient insignificant. Excluding the TN variables we got the following estimated equation:

$$(4.21)\quad \ln YLDF = \underset{(-8.5148)}{-3.64028} + \underset{(7.808)}{.8095} \ln\left(\frac{KAL}{A}\right) + \underset{(3.052)}{.2188} \ln \overline{WI}$$

$R^2 = .8048$, $\bar{R}^2 = .7818$, D.W. = 2.1171

It seems that the adjustment to the capital stock variable does not lead to any significant changes. Thus, either of equations (4.13a) or (4.21) will do for explaining yield in foodgrains production. For simulation purposes we shall use (4.13a) since the AF variable (which is absent in (4.21)) is of particular interest to us.

The next step is to explain the acreage variables A and AF. The approach adopted is in the spirit of the dynamic supply response models first developed by Nerlove[8]. In such models, the basic idea is to study the response of farm output to price changes. However, since output cannot be controlled by farmers effectively, while acreage decisions reflect more accurately farmers output plans, such models use acreage variables to study this question. Thus:

$$(4.22) \quad A_i = f(P_i) \qquad f^1 < 0$$

where A_i = area under the i^{th} crop

P_i = relative price of the i^{th} crop

The usual practice is to adopt a dynamic specification of $f(P_i)$ to allow for lagged responses, which are characteristic of the agricultural sector. Noting that A_i is a proxy for planned output, (4.22) is a simple supply function. A more general approach would be to write

$$(4.23) \quad A_i = f(P_i \, , \underline{P} \, , \underline{r})$$

where $\underline{P}$ = vector of prices of other crops

$\underline{r}$ = vector of input prices

However, most studies consider only one alternative crop price, partly for computational convenience but mainly because of the lack of data for input prices.

In our aggregate model, we have distinguished between two broad crop-types, foodgrains and non-foodgrains. However, the latter play no explicit role in the model, in which our concern is mainly with the behaviour of foodgrain production and overall output in the agricultural sector. It is appropriate to assume that the price response of overall acreage A is likely to be small in India. This is because the supply of cultivable land is relatively fixed in the short-run, and in the long-run, extensions in acreage occur due to capital expenditures by the government on land reclamation, improvement, etc. On the other hand, one would expect the acreage under individual crops to be sensitive to relative prices. In particular, we argue that there are acreage switches between foodgrains and non-foodgrains based on changes in the price of the former relative to that of the latter[9].

Thus, we would expect the major effect of price changes to be reflected in acreage switches, with a small effect on overall acreage. One approach would be to assume

$$(4.24) \quad AF = g\left(\frac{PF}{PNF}\right) \qquad g^{1} > 0$$

(4.25) $ANF = h(\frac{PF}{PNF}) \qquad h^1 < 0$

(4.26) $A = AF + ANF$

where PF = index of foodgrain prices

PNF = index of non-foodgrain agricultural prices

ANF = acreage under non-food crops

On our above arguments one would expect almost offsetting responses to a relative price change so that overall acreage would show only a small change.

Equations (4.24) and (4.25) can be specified in standard cobweb fashion by arguing that current acreage decisions are based on last period's prices only. Alternatively, we could argue that

(4.27) $\hat{AF} = d_0 + d_1 PFR^* \qquad d_1 > 0$

(4.28) $\hat{ANF} = e_0 + e_1 PFR^* \qquad e_1 < 0$

where PFR = (PF/PNF), ^ stands for "planned" and * stands for "expected".

We assume however, that whatever acreage is planned is in fact realized, so that $\hat{AF}$ can be replaced by AF. If PFR^* is defined as a weighted geometric average of past prices - i.e.,

(4.29) $PFR^* = \sum_{i=0}^{+\infty} q^i(1 - q) PFR_{t-i-1} \qquad 0 < q < 1$

Equations (4.27) and (4.28) become

$$(4.30)\quad AF = d_0(1-q) + d_1(1-q)(PFRL) + q(AFL)$$

$$(4.31)\quad ANF = e_0(1-q) + e_1(1-q)(PFRL) + q(ANFL)$$

However, since typically farmers plant and harvest more than one crop in a given crop year, it seems that current acreage decisions would depend also on current prices. This can be incorporated into the equations by rewriting:

$$(4.32)\quad AF = d_0 + d_1(PFR) + d_2 \sum q^i(1-q)\ PFR_{t-i-1}$$

$$(4.33)\quad ANF = e_0 + e_1(PFR) + e_2 \sum q^i(1-q))PFR_{t-i-1}$$

where $d_1, d_2 > 0; \quad e_1, e_2 < 0$

Manipulation reduces these equations to

$$(4.34)\quad AF = d_0(1-q) + d_1(PFR) + \{d_2(1-q)-d_1q\}(PFRL)+q(AFL)$$

$$(4.35)\quad ANF = e_0(1-q)+e_1(PFR)+\{e_2(1-q)-e_1q\}(PFRL)+q(ANFL)$$

We estimated equations (4.30), (4.31), and (4.34) and (4.35). The results are reported in Table 4.5. It seems that the former set of equations provides the best estimates, and is at least as good in terms of fit as the latter set. Thus in equations (4.30) and (4.31) the relative price coefficients have the expected sign and are statistically significant (though barely so, in the AF equation). On the other

TABLE 4.5: THE ACREAGE EQUATIONS

EQUATION	DEPENDENT VARIABLE	INTERCEPT	PFR	PFRL	AFL	ANFL	R^2	$\bar{R}^2$	D.W.*
4.34	AF	1.8109	1.1042	7.5270	.9061	-	.6968	.6362	2.2055
		(.147)	(.140)	(1.212)	(9.980)				(-.7017)
4.30	AF	2.5573	-	8.1012	.9057	-	.6964	.6585	2.2149
		(.220)	(1.40)	(1.780)	(10.283)				(.6990)
4.35	ANF	12.8109	-	-11.1047	-	.8450	.8496	.8195	2.2056
		(2.466)		(-3.646)		(6.251)			(.2022)
4.31	ANF	12.7783	5.5924	-9.4789	-	.9609	.8343	.8136	2.1939
		(2.892)	(1.335)	(-3.431)		(8.513)			(.0503)

Note: * See Note, Table 4.1.

hand, in equation (4.34) the coefficient of the current relative price variable has the right sign but is not statistically significant. In fact, by dropping this variable (i.e., estimating (4.30)) we find that the fit improves since $\bar{R}^2$ rises. In equation (4.35) the current relative price variable has the wrong sign, but is statistically insignificant. If we drop this variable (i.e., we estimate (4.31)) we find the fit is hardly changed while the remaining coefficients have the right sign and are statistically significant.

Thus, it seems equations (4.30) and (4.31) perform reasonably well. The presence of only price variables in these equations, can be argued to give too much leverage to prices in explaining acreage changes, in the short as well as long-run. In particular, one would expect that some proportion of changes in AF and ANF is independent of prices, and is accounted for by government outlays on land reclamation, etc. Further, it was felt that the acreage equations should also incorporate the effects of the weather. In particular, we would expect that in years when weather conditions were particularly adverse, damage to cultivable land would result in a sharp decline in cropped area. The data do seem to confirm this, particularly in the excessive drought years 1965 and 1966. We consider these modifications shortly. The magnitude of the price effects involved in equations (4.30) and (4.31) can be seen from the short and long-run relative price elasticities (evaluated at the sample means) given below

	Short Run	Long Run
AF	.08	.83
ANF	-.27	-7.00

Thus, foodgrains show an inelastic acreage response in both the short and long-run, though the long-run elasticity is significantly higher than the very low short-run elasticity[10]. Non-foodgrains, on the other hand, show a much higher acreage (cross) price elasticity in both the short and long-run. This is to be expected since any given acreage switch from foodgrains to non-foodgrains represents a substantially higher percentage of existing acreage under non-foodgrains than under foodgrains, given that the share in overall acreage of the former is considerably lower than that of the latter. A long-run elasticity of -7 in the case of non-foodgrains appears to be too high. On the other hand, the inelastic short-run elasticities for both crop types as well as the inealstic long-run elasticity in the case of foodgrains, are to be expected in the Indian context.

We tried to incorporate the acreage effects of non-price factors, like those mentioned above, by re-estimating equations (4.30) and (4.31) with a time trend. This did not succeed in the case of the AF equation (4.30), as the adjustment parameter turned out to be negative.

On the other hand, it seemed to work well in the ANF equation (4.31). We also tried to incorporate the effects of bad weather conditions with the help of a dummy variable which was unity in the years in which weather conditions were particularly adverse and zero in all other years. Its coefficient was found to be insignificant in ANF equation, but had the correct sign in the AF equation and was highly significant. However, the adjustment parameter in the AF equation was highly insignificant, so we dropped it. The equations for AF and ANF that gave the best results and were consequently adopted are reported below.

(4.36) $AF = 118.514 + 10.7052\ PFRL - 4.6823\ \overline{DUM}$

$(23.083) \quad (3.741) \quad (-12.827)$

$R^2 = .9507, \quad \bar{R}^2 = .9445,\ D.W. = 2.2243,\ \hat{\rho} = .9306$

DUM = 1 in years 1957-58, 1967-66, 1966-67, 1972-73, 1974-75.

0 = in all other years.

The equation performs reasonably well and the coefficients of PFRL and the dummy variable both have the correct sign and are statistically significant. The acreage elasticity with respect to relative price is .11, thereby implying an inelastic price response of acreage.

This is quite plausible. Consider next, the ANF equation

$$(4.37)\quad ANF = \underset{(3.312)}{24.7821} - \underset{(-2.959)}{8.1503}\ PFRL + \underset{(2.541)}{.5792}\ ANFL + \underset{(1.839)}{.1707}\ TEE$$

$$R^2 = .8645,\ \bar{R}^2 = .8374,\ D.W. = 1.9711,\ \hat{\rho} = .1012$$

We note that compared to its value in equation (4.31), the adjustment parameter drops dramatically in value, but is still statistically significant, as are the coefficients of all other variables. The short-run price elasticity works out to -.24 which is close to the earlier result. However, since $\hat{q}$ falls from .96 to .58 and the PFRL coefficient itself registers some decline, the long-run elasticity drops dramatically from -7.0 to -.56. Thus, while this adjustment to the ANF equation appears not to alter the magnitude of short-run price responses it has appreciably different implciations for the long-run effects. In the AF equation, on the other hand, there is no longer any difference between short and long-run responses.

Thus, for the purposes of this study and specifically for simulation purposes, we considered the implications of the following alternative sets of equations for determining acreage behaviour:

Scheme 1.

AF and ANF are explained by the following equations:

(4.38) $AF = 118.514 + 10.7052\ PFRL - 4.6823\ \overline{DUM}$

(4.39) $ANF = 24.7821 - 8.1503\ PFRL + .5792\ ANFL + .1707\ TEE$

Overall average A is then determined from

(4.40) $A = AF + ANF$

Scheme 2.

AF is explained by equation (4.38) but overall acreage A is assumed to be exogenous. In this case (4.40) determines ANF.

From a simulation point of view Scheme 2 is more appropriate since,given the basic scarcity of land in the country, there are limits to acreage extension, except through land reclamation, etc. In a simulation context it is possible to get solutions for overall acreage that would be not feasible given these basic constraints. However, in our experiments, the results from both schemes were found to be rather similar. This concludes our discussion of output determination in the agricultural sector[12].

(4.3) THE INDUSTRIAL SECTOR.

In this section we deal with the determinants of output in the industrial sector. This sector has been an important element in the country's development drive as the government has sought actively to expand and diversify the industrial base of the economy. In this context it would perhaps be more useful to take a disaggregated approach which would enable us to examine the growth of the sector in terms of its evolving structure. However, because of the lack of data and the intended scope of our study, we take an aggregate view of the sector, so that the question of structure is not considered directly.

In econometric models for developed market economies, a distinction is commonly made between capacity output and actual output when dealing with the determination of output in the non-agricultural sectors of the economy. Capacity output is normally measured either by linear interpolation between output or output-capital ratio peaks, or by estimating a production function

(4.41) $Y = g(K, L)$

where Y = output, K = capital, L = labour, and then obtaining a measure for capacity output Y^C from

(4.42) $Y^c = \hat{g}(K, L^f)$

where ^ stands for "estimated" and L^f = full employment labour force[13]. A somewhat more elaborate approach involves allowing for labour and capital-augmenting technical progress[14]. Capacity utilization is thus determined as the ratio of actual to capacity output.

The above framework highlights the short-run, demand-oriented nature of the capacity utilization issue and is suitable for models of developed market economies, where the problem is one of short-run departures of output from the long-run path of full employment output, and one that lies in the domain of the theory of cyclical fluctuations. There are some important differences in the nature and causes of capacity under-utilization in countries like India, differences that can have implications for the manner in which one might approach the issue, as well as for how one might choose to deal with it. Thus, the theory of cyclical fluctuations, which emphasizes the role of short-run demand factors, is not particularly relevant in a context in which the country does not experience cyclical fluctuations. Nor is it very meaningful to relate capacity output to a fully employed labour force, fluctuations in which lead to fluctuations in the utilization rate, in a situation in which there is vast, secular unemployment, the volume of which is not sensitive to short-run demand changes. In fact, it would be more appropriate to argue that employment is primarily output determined (and hence dependent upon the growth in productive capacity, amongst other things).

There are two important aspects of the capacity utilization problem in India:

(1) A tendency for under-utilized capacity to persist over the long-run, mainly in the "new" capital and import-intensive industries. This does not contradict the view that saving and capital formation are important constraints on growth, because in a country like India, a substantial proportion of saving must be made simply to maintain already low per capita income levels. The persistence of under-utilization in areas of the manufacturing sector reflects planning errors[15], the nature of industrial growth fostered directly by the government according to developmental priorities, and the general economic policy framework adopted in pursuance of these objectives. There appears to have been an imbalance between the growth and structure of consumer and capital goods industries on the one hand, and the growth of basic industries and the evolving structure of demand, on the other. In addition, foreign exchange availabilities have not developed satisfactorily relative to the needs thus created. Further, and perhaps most importantly, the direct licensing of

capacity creation and of import trade that has dominated the economic policy framework has been argued to have distorted incentives and led to an inefficient use of scarce resources by encouraging their flow into areas where excess capacity has been known to exist[16]. Thus apart from the rate of capital formation and saving, favourable developments in respect of these factors are likely to have favourable short and long-term effects on the growth of output in the economy.

(2) Short-run variations in the degree of capacity utilization tend to emanate mainly from the supply side. On the domestic front, serious effects on utilization come from fluctuations in the supply of industrial power, through interruptions in transportation, from strikes, lock-outs, etc.[17] In fact, deficiencies in the growth of the first two of these factors have had important long-run effects as well. On the external front, the availability of foreign exchange (after netting out necessary imports of food) has important effects on utilization *via* its impact upon imports of raw materials and intermediate goods.

There are difficulties in trying to incorporate both these sets of factors at the macro level,particularly since there exists no precisely formulated theory of the phenomenon[18]. In addition, given the nature of the capacity-utilization problem, there are severe difficulties in measuring capacity output. We adopt the following procedure for explaining industrial output.

We started with the assumption that labour is not a limiting factor of production, an assumption with some relevance in the context of widespread, secular unemployment, and one that has often been used in Indian models[19]. Instead, productive capacity, can be argued to be the major determinant of output. Thus, consider the following fixed-coefficients production function:

(4.43) $YM = \min (c\ KML,\ b\ LM) \qquad c, b > 0$

where YM = industrial output

KML = capital stock in the industrial sector (end of previous period)

LM = labour input

Under the assumption that labour is not a limiting factor of production, output is given by

(4.44) $YM = c\ (KML)$

Our approach is to generalize (4.44) to allow for a non-constant output-capital ratio c, at least in the short run. Equation (4.44) can be viewed as determining capacity output, where c is some unknown capacity-output capital ratio which, in our framework, varies over time due to a variety of (yet) unspecified factors. On the other hand, the relationship between realized output and capital stock is given by

(4.45) YM = d(KML) where d, the realized productivity of capital, is $\leq$ c

The two most obvious (and important) factors determining the realized productivity of capital are the utilization rate (UR) of the capital stock and the (non-constant) capacity output-capital ratio.

Thus we can write

(4.46) $d = \phi(UR(\underline{x}),\ c\ (\underline{y}))$

where $\underline{x}$ is a vector of variables that determine the utilization rate, and $\underline{y}$ is a vector of variables affecting the capacity output-capital ratio. Substituting in (4.45), we can write

(4.47) $YM = \phi(UR(\underline{x}),\ c\ (\underline{y})KML$, or

(4.48) $YMKR = \phi(UR(\underline{x}),\ c(\underline{y}))$, where YMKR = YM/KML

Equation (4.48) can be rewritten as

(4.49) $YMKR = \Psi(\underline{x},\underline{y}) = \Psi'(\underline{z})$ where $\underline{z} = \underline{x},\ \underline{y}$

One advantage of being able to express equation (4.46) in this way is that it enables us to circumvent the difficulties associated with measuring capacity output. We assume, for simplicity, that $\Psi'(\underline{z})$ is linear:

(4.50) $YMKR = a_0 + \underline{a}_1(\underline{z}')$

where $\underline{a}^1$ is a vector of coefficents of appropriate dimension while z' is the transpose of the row vector $\underline{z}$.

To make equation (4.50) operational, we need to specify the variables in vector z. Some of the variables which are likely to be important elements in the z vector have already been discussed in connection with the nature and causes of under-utilization. Of these, we consider as being the most important the supply of industrial power and imports of raw materials and intermediate goods, variables for which sufficiently long time-series data are available to us. To the extent that these constitute bottlenecks which hinder the achievement of higher rates of capacity utilization, an increase in either or both can be expected, ceteris paribus, to raise output and hence the output-capital ratio. Other variables which are also likely to be important are those reflecting the effects of structural shifts within the industrial sector, the efficiency (or the lack of it) of the economic policy framework, technical change, etc. By their very nature such variables are hard to quantity. At the aggregate level of our study, we considered two variables to capture these effects. The first was a simple time trend, but such a variable is too imprecise. Structural shifts within the industrial sector reflect fundamental changes in the pattern of investment and hence the pattern of growth,and hence are likely to have important effects on the capital output-ratio. To capture the effects of the evolving structure of industrial growth, we took the ratio of "non-traditional" manufacturing output to total output[20]. The thrust of planning in India has been to rapidly develop "non-traditional" manufacturing industries particularly of the "heavy" capital-intensive type, a factor which is reflected in the shifting pattern of investments. While these structural shifts have undoubtedly affected the overall productivity of capital, on a priori grounds we cannot predict the direction of these effects on the basis of the chosen variable. Thus these shifts, by merely changing the mix of output-capital ratios within the industrial sector, could have positive or negative effects upon the overall output-capital ratio, depending upon the realized productivity of capital in the "non-traditional" industries relative to the realized productivity in other industries[21].

However, since capacity under-utilization has been pervasive and high mainly within the "non-traditional" group, the effects of an increasing share of these industries on the output-capital ratio, may well be negative[22]. On the other hand,the growth in the relative share of these industries can also be viewed as reflecting the process of import substitution in the economy[23]. Ceteris paribus, this could be expected to have a positive impact upon the output-capital ratio to the extent that it fosters higher capacity utilization previously constrained by the import capacity of the country.

There are other factors as well that are likely to have important effects upon the behaviour of the output-capital ratio. Thus, the economic policy framework and the manner in which it has been administered have been argued to have had significant effects on the efficiency and productivity of investments[24]. However, it is very difficult to quantify a variable to incorporate these effects. Another potentially important factor is technical progress which can be expected to have a positive impact upon the output-capital ratio. Again, it is difficult to incorporate technical progress in a relatively straightforward fashion, other than representing it by a time trend variable. However, in this context we can consider the import-intensity of investment as reflecting technical change. Thus, up to the late 1960s, a significant proportion of capital formation in the economy (and specifically, in the industrial sector) was based on imported capital goods. To the extent that such goods embody more productive technology ("technical progress"), a rise in the share of imported capital goods in capital formation can be expected to have a positive impact on the productivity of capital (_ceteris paribus_)[25]. Moreover, it is likely that the effects of the import-intensity of capital formation are not confined to one period but are distributed over a number of periods[26].

On the basis of the foregoing discussion, we can write equation (4.50) as

$$(4.51) \quad YMKR = a_0 + a_1(ZRK) + a_2(INPOWK) + a_3(YNYML) + b_1(ZCINL) + b_2(ZCINL2) + \ldots + b_k(ZCINLk)$$

Where $ZRK = \frac{ZRAW}{KML}$, $INPOWK = \frac{INPOW}{KML}$,

$YNYML = \frac{YNIML}{YML}$, $ZCINL = \frac{ZCAPL}{NFITL}$

and where ZRAW = imports of raw materials and intermediate goods.

INPOW = availability of industrial power (in millions of kilo-watt hours)

YNTML = output of "non-traditional manufacturing" industries (lagged one period)[27].

ZCAPL = imports of capital goods (lagged one period).

NFITL = net fixed capital formation in the economy (lagged one period).

Applying the Koyck transformation, equation (4.51) can easily be shown to reduce to

$$(4.52) \quad YMKR = a_0(1-q) + a_1(ZRK) - a_1q(ZRKL) + a_2(INPOWK) - a_2q(INPOWKL) + a_3(YNYML) - a_3q(YNYML2) + b_1(1 - q)(ZCINL) + q(YMKRL).$$

We estimated equation (4.52) with different definitions of the import-intensity of the capital formation variable. Ideally, this variable should be the ratio of capital goods imported by the industrial sector to capital formation in this sector. However, data for capital goods imports by sector of use are simply not available. Thus, as an approximation we considered the ratio of total capital good imports to net fixed capital formation in the industrial sector. This approximation may in fact be quite reasonable since a major proportion of imported capital goods over the period has gone to the industrial sector[28]. We also experimented with three other definitions of this variable. These were:

(1) the ratio of imported capital goods to capital formation in the industrial and infrastructure sector.

(2) the ratio of imported capital goods to capital formation in nonagriculture as a whole.

(3) the ratio of imported capital goods to total capital formation in the economy.

Our results are reported in Table 4.6

It can be observed that in terms of fit, the D.W. statistic, the significance of coefficients, etc., all four definitions of the import-intensity variable give very similar results. On these counts, definition A gives the best results, though the differences are

TABLE 4.6: THE YMKR EQUATIONS

Definition of Import Intensity	$\hat{a}_0$	$\hat{a}_1$	$\hat{a}_2$	$\hat{a}_3$	$\hat{b}_1$	$\hat{q}$	R^2	$\bar{R}^2$	D.W.
A	-.7784	.8478	.9481	1.1497	.4009	.8776	.9702	.9496	1.7655
	(-2.536)	(2.650)	(2.515)	(2.585)	(4.155)	(20.347)			
B	-.8264	1.0452	1.1055	.9724	.8333	.8884	.9636	.9506	1.6066
	(-2.340)	(2.882)	(2.666)	(1.937)	(3.142)	(16.049)			
C	-.7326	1.1608	1.0683	.8791	1.2070	.8717	.9628	.9495	1.6683
	(-2.059)	(2.895)	(2.568)	(1.649)	(3.423)	(11.889)			
D	-.6732	1.1859	1.0402	.7892	1.4103	.8617	.9633	.9502	1.7158
	(1.883)	(2.951)	(2.539)	(1.433)	(3.682)	(10.874)			

Note: A = ZCAPL/NFIML

B = ZCAPL/(NFIML + NFINFL)

C = ZCAPL/(NFITL - NFIAL)

D = ZCAPL/NFITL

very small. It can be seen from the table that the coefficient of YNYML, a_3, is not significant with either definitions C or D of import-intensity, and barely so with definition B. However, it is statistically significant with definition A. This latter finding implies that an increase in the share of "non-traditional" industries in total output has a favourable effect on the output-capital ratio. This could be due to favourable effects on the utilization rate *via* import substitution (to the extent that various shortages of imported materials have led to under-utilization) or the possibility that in spite of the fact that this increase implies a shift toward more capital-intensive industries, these industries are relatively more productive (per unit of capital) even under conditions of under-utilized capacity[29]. It seems that even though these industries show higher average rates of under-utilization, the implied negative impact on the overall output-capital ratio, of an increase in the share of these industries, is not supported by any of our results[30].

The results reported in Table 4.6 indicate that imported raw materials and intermediate goods, as well as the supply of industrial power, have significant favourable effects upon the output-capital ratio, a finding that is to be expected on *a priori* grounds. The same is true for imported capital goods, which have significant short as well as long run-effects, thus pointing (indirectly) to their higher relative productivity[31].

As an illustrative example, consider the elasticity of output with respect to each of ZRAW, INPOW and ZCAP, evaluated at the sample means of all variables. The elasticities are reported in Table 4.7.

TABLE 4.7: ESTIMATED OUTPUT ELASTICITIES

Definition of Import Intensity	$\hat{\eta}_{ZRAW}$	$\hat{\eta}_{INPOW}$	$\hat{\eta}_{ZCAP}$	
			Short Run	Long Run
A	.1466	.7248	.0604	.4934
B	.1807	.8451	.0676	.6056
C	.2007	.8167	.0783	.6104
D	.2051	.7952	.0771	.5574

Notes: $\hat{\eta}_{ZRAW}$, $\hat{\eta}_{INPOW}$ and $\hat{\eta}_{ZCAP}$ are the output elasticities with respect to raw material imports, industrial power and the imported capital goods, respectively.

The table shows that the elasticity of output with respect to industrial power is the largest in magnitude, while the short-run output elasticity with respect to imported capital goods is the lowest[32]. The long-run elasticity with respect to the latter, however, is considerably higher. It may also be noted that most of the elasticities are in fact quite similar, irrespective of the definition of ZCIN adopted. Any of these equations can be chosen for explaining the output-capital ratio over the period under consideration. Equation D would fit neatly with the import side of the model. However, we used only equation A in our simulation experiments due to time considerations.

(4.4) THE INFRASTRUCTURE AND "OTHER SERVICES" SECTOR.

Output in these sectors is assumed to be determined in simple, straightforward fashion. Thus, once again, under the assumption that labour is not a limiting factor of production in these sectors, we can write:

$$(4.53) \quad YINF = c_0 + c_1(KINFL)$$

$$(4.54) \quad YSV = d_0 + d_1(KSVL)$$

where YINF and YSV are respectively output in the infrastructure and services sectors, while KINFL and KSVL are their respective (end-of-previous-period) stocks of capital.

Our estimates for these equations are

$$(4.55) \quad YINF = \underset{(-.092)}{-6.087} + \underset{(16.970)}{.1197} \ (KINFL)$$

$$R^2 = .9919,\ \bar{R}^2 = .9914,\ \text{D.W.} = 1.0645,\ \hat{\rho} = .6490$$

$$(4.56)\quad YSV = .705.104 + .2725(KSVL)$$
$$\qquad\qquad (1.019) \qquad (7.809)$$

$$R^2 = .9947,\ \bar{R}^2 = .9944,\ \text{D.W.} = 1.6344,\ \hat{\rho} = .8879$$

Thus, both equations fit well and the capital coefficient is highly significant in both cases. Some autocorrelation seems to persist (particularly in equation (4.55)) even though we corrected for first-order autocorrelation. However, for our purposes these equations are satisfactory and require no further discussion.

This concludes our discussion of the determination of sectoral outputs and hence of net domestic product. In the next chapter we look at saving, taxation and capital formation.

FOOTNOTES

Chapter 4

1. Klein (1974), pp. 184.

2. Kloek and Mennes (1960), pp. 45-61.

3. For details on how this index was constructed see the Data Appendix.

4. Of course, for estimation purposes we make the theoretical functions stochastic by introducing disturbance terms. In case of nonlinear (in variables) equations like (4.3) the error term is introduced multiplicatively.

5. Other Indian models have also successfully incorporated an index of weather conditions in explaining agricultural output. See Agarwala (1970), and UNCTAD (1973).

6. The estimated capital elasticity is .76, which is high, and is likely to incorporate the impact of TN type variables. On the other hand, it is possible that in a land-scarce economy like India, acreage extensions would also involve bringing under cultivation, marginal, less fertile lands which would tend, *ceteris paribus*, to have adverse effects on the productivity of land.

7. TN type variables have not been considered in a number of models onIndia - e.g., Agarwala (1970) and UNCTAD (1973). Krishnamurty (1964) tried to incorporate a fertilizer variable with little success, as has been the case in the present study. On the other hand, Krishnamurty (196) and Krishnamurty and Choudhury (1968) were successful in incorporating an irrigation variable in explaining agricultural output. However, they do not have a capital input in their equations, and it is probably the presence of this variable in our equations that prevents us from successfully incorporating independent effects of the TN variables. The use of the $\overline{AHYV}$ variable, which on its own does reasonably well in some of our equations, is new but its absence in other Indian models is to be expected since the spread of high-yielding seed varieties is mainly a post mid-sixties phenomenon,

while most of these models are estimated from pre-1965 data.

8. Nerlove (1958). Nerlove's pioneering work has, in fact, inspired numerous micro and macro-empirical studies of agricultural supply response.

9. There is evidence of such switching between individual crops or crop-types in India. See Bhagwati and Chakravarty (1969), pp. 38-40, for a survey of major studies in the 1960s. On the other hand, as these authors point out, constraints on acreage response arise from technological constraints on the ability to shift land (p. 40). Evidence for switching between foodgrains and other crops in India (at the aggregate level) is found in the Indian model by UNCTAD (1973) as well.

10. In the UNCTAD (1973) model, the short-run acreage elasticity is estimated to be .21, which is much higher than our estimate. On the other hand, their estimated long-run elasticity of .8 is very much in agreement with ours.

11. Evaluated at the sample mean, the share of non-foodgrains in total acreage is .25.

12. At this stage, we point out certain modifications that were necessitated by the nature of the available data. National accounts data (as well as our model as a whole) are on a fiscal year (April-March) basis, while much of agricultural data are on a crop year basis (July-June). Wherever possible, we have tried to appropriately adjust series to achieve consistency in various equations. In some cases, such adjustments were found not to make a difference to the results, while in others they were not feasible. Thus, in all the equations discussed thus far, all the variables except capital stock KAL, and output YA, in the agricultural sector are on a crop year basis, or have been so adjusted. The fiscal year variables just mentioned were not adjusted because of the overall yield equation (4.6), some of the adjustments tried hardly changed the results.

The nature of these and other subsequent adjustments are discussed in the Data Appendix.

13. See Artus (1977), pp. 1-35, for a survey of the methods commonly employed.

14. Ibid., pp. 10; Choudhury et. al. (1972), Ch. 2.

15. Such errors are inevitable in a system where economic development is planned. Thus, for example, errors in demand estimation can lead to a situation where the evolving structure of demand is at odds with the structure of capacity created. The effects of these errors are of course, compounded by faulty planning, inefficiencies in the implementation of plans and the economic policy framework adopted. Unfortunately, the Indian experience with planning is replete with such examples. See for instance, Bhagwati and Desai (1970), especially Parts VI and VII. See also Bhagwati and Srinivasan (1975).

16. Ibid., p. 188. The authors argue that under the system of import licensing, licences for for the import of intermediate goods and raw materials were linked to installed capacity, so that often the only way, a producer wanting to expand utilization of existing capacity could secure these imports was to create more capacity. Additionally, various policies followed ensured profitability even in under-utilized industries (e.g., through barriers to entry in numerous protected industries).

17. Ibid., p. 188.

18. See, however, Winston (1971) for a micro-study of Pakistani manufacturing.

19. See for instance, Marwah (1972), and UNCTAD (1973).

20. In this study, "non-traditional" industries are defined to exclude food, beverage and textile industries, which were the major manufacturing industries in the 1950's, but whose relative importance has declined since then with the rapid development of capital goods, intermediate goods and durable consumer goods industries. See Chapter 3, pp.71-73. While "non-traditional" industries so defined include some "traditional" industries as well (e.g., leather and leather manufactures), the share of the latter is small.

21. Thus, while "non-traditional" industries have definitely been relatively more capital-intensive than other industries, we do not have any precise information on the productivity of capital (i.e., the output-capital ratio) in the two groups of industries.

22. This effect operates, ceteris paribus, through an increase in the average overall utilization rate in the manufacturing sector.

23. The Indian import-substitution strategy has been directed towards both capital and intermediate goods industries, with special emphasis on the former. Both are important components of the "non-traditional" manufacturing group of industries.

24. See Bhagwati and Srinivasan (1975).

25. Some writers have argued that this aspect of imported capital goods constitutes the major benefit of trade for developing countries. See for instance Agarwala (1970), pp. 31-34.

26. This is because we can view the productivity of the existing capital stock as reflecting past compositional shifts between imported (higher-productivity) and domestic (lower-productivity) capital goods.

27. The ratio of "non-traditional" manufacturing output to total industrial output is introduced with a one-period lag because this variable reflects the effects of structural shifts which take place gradually and whose impact is likely to be delayed. Further, in defining the import-intensity of investment, the appropriate procedure would have been to consider only investment in machinery and equipment in the denominator. However, the separation of capital formation into (a) capital formation in machinery and equipment and (b) construction, while desirable, was not considered feasible in the present study because of data limitations.

28. This is primarily because the strategy of development has been biased in favour of the industrial sector.

29. It could also be that this variable captures some of the favourable effects of the import-intensity of investment, especially since "non-traditional" manufacturing industries, which have been the major element in industrial growth have accounted for a major share of the more productive imported capital goods.

30. It is also possible that an increase in the share of these industries is due to increased capacity utilization, so that the overall effect on the industrial utilization rate (and hence the output-capital ratio) is favourable.

31. The favourable impact of producer goods imports on output is also found in other Indian models. See for instance, Krishnamurty and Choudhury (1968), and UNCTAD (1973). These studies, however, do not consider important infrastructure-related inputs such as power (which we have explicitly considered) and transport, etc., (which we have not).

32. The short-run elasticity is a current-period elasticity. This is also the interpretation for the elasticities with respect to ZRAW and INPOW.

CHAPTER 5

SAVING, CAPITAL FORMATION AND TAXATION

In this chapter we develop and estimate equations for saving, aggregate and sectoral capital formation in the economy, as well as for the tax and other government sector variables. In Section 5.1 we first look at private saving behaviour. Following that, two alternative approaches to government saving are explored. In one approach an independent government saving function is postulated and estimated, while in the other, government consumption behaviour is examined and its saving is residually determined. Section 5.2 looks at the tax variables in the model. An issue that is examined and tested here is the relationship between the taxation effort and foreign capital inflows. In Section 5.3, we develop and estimate the capital formation relationships at the sectoral as well as aggregate level within a framework that has overall resource constraints built into it.

(5.1) SAVING BEHAVIOUR.

In this study, government saving is given explicit and separate treatment. This is warranted by the fact that the government has played an increasing role in development activity in the country, emerging as a major investor. (See Chapter 3, Sections 3.3 and 3.4). To articulate this important aspect of Indian economic development, it is necessary to specify a set of government sector variables which would enable us to link government resource availability to government capital formation. Saving, along with extra-revenue government resources, builds this link in our model[1].

Private Saving.

We tried a number of alternative formulations of the private saving function. We first considered a standard Keynesian saving function.

(5.1) $SP = a_0 + a_1 NDY$

$a_0 < 0, \quad 0 < a_1 < 1$

where SP = private saving (net).

NDY = real disposable private income.

= $(P.NY + \overline{NDRS} - DTS - ORS - LRS)/P$, where.

NY = national income.

$\overline{NDRS}$ = interest payments on public debt.

DTS = direct tax revenues.

LRS = land revenue.

ORS = other government revenues.

P = national income deflator.

Our estimated equation is

$$(5.2) \quad SP = -1675.34 + .2080\ NDY$$
$$\qquad\qquad (-9.481) \qquad (18.690)$$

$$R^2 = .9657, \quad \bar{R}^2 = .9637, \ DW = 1.9530, \ \hat{\rho} = .1652$$

This simple model appears to fit the data rather well and the Durbin-Watson statistic indicates that autocorrelation does not appear to be a problem. The marginal propensity to save is approximately .21, implying a consumption propensity of about .8, which is high but to be expected in an economy like India.

We next introduce some dynamic considerations into the picture. Thus, we adopted the following simple version of Friedman's "permanent" income model[2].

$$(5.3) \quad SP = a_0 + a_1 NDY^P + a_2 NDY^T$$

where NDY^P = "permanent" or expected real disposable income

NDY^T = "transitory" real disposable income

and

$$NDY = NDY^P + NDY^T$$

This model simply postulates that saving responses are different depending upon whether an income change is "permanent" or "transitory". Equation (5.3) is actually a weaker version of the strict Friedman hypothesis where a_2 - the MPS out of "transitory" income - is unity. However, this formulation allows us to test for this and, by including an intercept, for the proportionality of the long-run saving function.

In order to estimate (5.3) we have to make NDY^P AND NDY^T operational concepts. We define NDY^P as a geometric weighted average of past and current incomes.

$$(5.4) \quad NDY^P = \sum_{i=0}^{\infty} q^i(1-q)Y_{t-i} \text{ where } \sum q^i(1-q) = 1$$

Substituting this into (5.3) and noting that

$$NDY^T = NDY - NDY^P$$

we can reduce equation (5.3) to the following dynamic equation

$$(5.5) \quad SP = a_0(1-q) + \{a_1(1-q) + a_2q\}NDY - a_2qNDYL + qSPL$$

The long-run MPS is a_1, while the short-run MPS is $a_1(a - q) + a_2q^3$.

We estimated this equation by non-linear least squares in order to obtain standard errors, t-ratios, etc., for each individual coefficient. Our results are:

$\hat{a}_0$	$\hat{a}_1$	$\hat{a}_2$	$\hat{q}$
-1598.93	.2035	.2237	.2797
(-6.735)	(12.695)	(.843)	(1.688)

$R^2 = .9595$, $\bar{R}^2 = .9519$, DW = 1.9030

It can be seen that the estimated long-run MPS,

$\hat{a}_1$, is .2035, which is almost the same as the estimate obtained in the simple Keynesian function, and is highly significant[4]. There is virtually no support for the Friedman hypothesis that $a_2 = 1$. In fact, a_2 is not significantly different from zero even though it is greater than the propensity out of "permanent" income. The short-run MPS out of measured income, $\hat{a}_1(1-\hat{q}) + \hat{a}_2\hat{q}$, is .2092, which is very close to the long-run propensity and is lower than the "transitory" income propensity of .2237. Gupta's study on sectoral saving in India reaches the same conclusions for urban saving, though his results for the rural sector lend partial support to the Friedman hypothesis[5]. We may also note that $\hat{a}_0$ is statistically significant, thereby lending support to a non-proportional saving function.

In a study on saving behaviour in a number of developing countries, Williamson found that the "permanent" income model was inapplicable to Indian household saving - the coefficients of both types of income were found to be negative and insignificant[6]. Gupta re-examined the model with additional data and reached the opposite conclusion[7]. In particular, he found positive and significant marginal saving propensities out of both types of income. It is interesting to note that Gupta found the saving propensities out of the two types of income to be the same, which is in agreement with our findings[8]. However, his estimate of .145 is low compared to our estimate of .21. Apart from differences in data and sample period, this difference is probably explained partly by the fact that his estimates are based on OLS while ours are not.

Our findings lend only partial support to Williamson's claim that the "permanent income" model is not applicable to India. While his estimates of the saving propensities were negative and insignificant, ours are both positive. The saving propensity out of "permanent" income is highly significant, but that of transitory income is not. Thus, even the weaker version of the model in which $a_2 > a_1$ is not supported by our findings. This might suggest that private saving depends only upon "permanent" income. However, the adjustment parameter $\hat{q}$ is not significant at the 5% level, thus lending support to the simple Keynesian model.

There is some evidence in India that an aggregate saving (household) function which ignores the effects of the distribution of income is a mis-specification. In particular, some studies indicate that rural households save less,at the margin,than do their urban counterparts[9]. A distribution variable cannot be appropriately introduced in the context of our model. However, we did attempt to incorporate such a variable in the private saving function. We assumed that rural income is equivalent to income originating in the agricultural sector and urban income is equivalent to income originating from all remaining sectors in the economy. We then specified and estimated a private saving function with these two types of incomes as regressands, but found no significant differences in the propensity to save.

We tried to incorporate income distribution in our "permanent" income model as well. Strictly speaking, this should be done by introducing "permanent" and "transitory" income variables for both agricultural and non-agricultural income. However, this procedure would lead to computational difficulties with a multitude of lags and right-hand-side variables. Thus, we took the simpler approach of introducing a distribution variable defined as the ratio of agricultural income YA to non-agricultural income (NY - YA). If the MPS out of the latter is higher than the MPS out of the former, we would expect this ratio to be negatively related to saving. We thus postulated the following equation

$$SP = a_0 DIST + a_1 NDY^P + a_2 NDY^T \qquad (5.6)$$

where DIST = YA/(NY - YA)

When the incomes of agriculture and non-agriculture are equal, this function becomes (5.5) above. In other words, equation (5.5) can be viewed as the relevant saving function when income distribution is not changing, or when sectoral incomes are equal. The function shifts up and down in the short-run due to fluctuations in (primarily agricultural) output, while in the long-run it shows a steady upward drift as the relative share of the agricultural sector declines.

Defining NDY^P as before, equation (5.6) can be shown to reduce to

$$(5.7) \quad SP = a_0 DIST - a_0 q DISTL + \{a_1(1-q) + a_2 q\} NDY - a_2 \lambda NDYL + qSPL$$

We estimated this equation by nonlinear methods. Our results are reported below.

$\hat{a}_0$	$\hat{a}_1$	$\hat{a}_2$	$\hat{q}$
-1045.45	.1536	.3368	.4433
(-4.449)	(12.392)	(1.802)	(2.478)

$R^2 = .9530$, $\bar{R}^2 = .9442$, D.W. $= 1.9400$

As can be observed, the model performs rather well. All coefficients are statistically significantly and have the correct signs. While the estimate of the "transitory" income coefficient a_2 is significantly different from unity, it has the right sign, is statistically significant, and, as theory suggests, is greater than the "permanent" income coefficient (i.e., the long-run saving propensity) of .154.Though the latter estimate is lower than our earlier estimates, it is in remarkable agreement with Gupta's estimate reported earlier. The short-run MPS (out of measured income), $[\hat{a}_1(1-\hat{q}) + \hat{a}_2\hat{q}]$, is .235, which is quite close to the estimates of the <u>long-run</u> MPS obtained from previous equations.

Thus, we find that a modification of the "permanent" income model, along the lines discussed above, appears to give quite reasonable results. In terms of statistical performance there is not much to choose between this model and the simple Keynesian model. The "permanent" income model would appear to be more general since it successfully incorporates (although roughly) commonly held notions about distributional effects, as well as dynamic behaviour. However, it does not allow for long-run constancy of the saving ratio. We shall use equation (5.7) in our simulation experiments.

<u>Government Saving</u>

Consider first the definition of the public sector adopted. In India, the government sector, or more appropriately, the public sector consists of: (1)government administration; (2) departmental enterprises; (3) non-departmental enterprises - viz., financial and non-financial companies and statutory corporations.

For the purposes of this model, we look at the saving of (1) and (2) combined and assume that the saving of non-departmental enterprises is exogenous. This latter saving typically forms a small proportion of public saving. No serious consequences can be expected from this asumption. Thus, we can write

$$(5.8) \quad SG = SG1 + \overline{SG2S}/P$$

where SG = aggregate real government saving.

SG1 = real saving of government administration and departmental enterprises.

$\overline{SG2S}$ = nominal saving of nondepartmental enterprises (assumed exogenous)

The excess of government current revenues over its current expenditures in the government budget, constitutes government saving. Budgetary policy is an important channel through which the government has attempted to mobilize reasources for its development drive. Consequently, both the mobilization drive (e.g., taxation policy, etc.) and its saving effort play an important role in determining government investment. We look at both these issues.

Government saving SG1 can either be determined residually from government revenues, or alternatively, an independent saving function can be postulated and estimated. In the former case, we would then have to specify an equation for government consumption, while in the latter case, government consumption would emerge as a residual. An issue that we are interested in examining is the relationship between the government's resource mobilization effort (e.g., saving) and foreign capital inflows. In particular, do foreign capital inflows lead to adverse effects on the government saving effort? In principle, this issue can be examined either in terms of a government saving function, or alternatively, its consumption function.

In the first case, we could postulate a government saving function as

(5.9) $SG1 = F(GRN, FK)$

where GRN = government current revenues
FK = foreign capital inflow

Various specifications of FK can be considered. The simplest case is

(5.10) $SG1 = a_0 + a_1 GRN + a_2 FK$

This form implies that for any given level of GRN, an increase in FK either lowers or raises the average saving rate depending upon the sign of a_2. Thus, if a_2 is negative, an increase in the foreign capital inflow leads to a fall in the saving ratio for a given level of GRN.

Equation (5.10) can be extended by examining whether the inflow of foreign resources has adverse effects on government saving at the margin as well.

Thus, (5.10) can be rewritten as

$$SG1 = a_0 + a_1(FK)GRN + a_2FK$$

$$= a_0 + (b_1 + b_2FK)GRN + a_2FK$$

(5.11) $SG1 = a_0 + b_1GRN + b_2(FK)GRN) + a_2FK$

In the absence of FK, b_1 is the marginal propensity to save (MPS). When FK $\neq$ 0, the MPS is given by $b_1 + b_2FK$.

If $b_1 > 0$ and $b_2 < 0$, foreign resources have a negative effect on how much of an additional unit of revenue the government saves. If $b_2 < 0$, the MPS is lower the higher the level of FK. Based on the modified equation (5.11), the impact of foreign capital is given by

$$\frac{\partial SG1}{\partial FK} = a_2 + b_2GRN$$

In the event that both a_2 and b_2 are negative, foreign cpaital has a larger negative impact upon saving than implied by (5.10)[10].

The estimated counterparts of equations (5.10) and (5.11) are given in Table 5.1.

Looking at the results for equation (5.10) first, we find that the coefficient of FK is positive but highly insignificant, thus indicating the absence of any adverse effects upon government saving. The

TABLE 5.1: A SET OF SG1 EQUATIONS.

Equation	Intercept	GRN	FK	(FK)(GRN)	R^2	$\bar{R}^2$	D.W.
5.10	-392.905	.2773	.1126	-	.8171	.7927	1.4408
	(-1.357)	(3.458)	(.569)				
5.11	-560.734	.3223	1.2457	-.2457	.8342	.7987	1.5103
	(-1.997)	(4.001)	(1.746)	(-1.693)			

Note: The figures in parentheses in the column for the D.W. statistic are the final estimates of the first-order autocorrelation coefficient used in correcting for autocorrelation.

marginal saving propensity is .27 and is highly significant.

Consider next the results of equation (5.11). The coefficient $\hat{b}_2$ is negative implying adverse effects on government saving at the margin, while since $\hat{a}_2$ is positive, the effects on the saving rate are positive. This, the estimate of marginal propensity to save MPS, given by $\hat{b}_1 + \hat{b}_2FK$, is (.3223 - .0004FK). Further,

$\frac{\partial MPS}{\partial FK} = -.0004 < 0$, thereby implying that the MPS is adversely affected by an increase in the capital inflow. In addition,

$$\frac{\partial SG1}{\partial FK} = \hat{a}_2 + \hat{b}_2 GRN = .28 \text{ at the mean of GRN.}$$

The MPS, evaluated at the mean of FK is .19 and is lower than that implied by (5.10). Further, evaluated at the mean of GRN, while foreign capital has adverse effects on the MPS, the overall effects are favourable due to a more than offsetting favourable effect on the saving rate (since $\hat{a}_2 > 0$). However, the magnitude of this overall effect (.28) is on the high side since it implies that an additional unit of FK raises government saving alone, by about .3 units. The coefficients of FK and (FK)(GRN) are both statistically insignificant at the 5% level. Thus, the results of equations (5.10) and (5.11) are not indicative of any significant effects of foreign capital (adverse or otherwise) on government saving.

We next introduced some dynamic considerations. In the first instance, we replaced FK in equation (5.11) by expected capital inflow FK^e. It can be argued that the government is not likely to relax its saving effort for any given level of current revenue if an increase in the foreign resource inflow is viewed as being temporary, but is more likely to do so if this increase is viewed as a real improvement in the country's long-run resource position. On the other hand, this increase could presumably have favourable effects if it is viewed as implying increased/continued dependence upon foreign resources, in a situation where "self-sufficiency" has been an oft-expressed (though elusive) objective[11].

We define FK^e as before, as

$$(5.12)\quad FK^e = \sum_{i=0}^{\infty} q^i(1 - q)FK_{t-i}, \qquad 0 < q < 1$$

With this modification, it can easily be shown that equation (5.11) becomes

$$(5.13)\quad SG_1 = a_0(1-q) + a_2(1-q)FK + b_1GRN - b_1qGRNL$$
$$+ b_2(1-q)(FK)(GRN) + qSG1L$$

If FK had adverse effects all around, a_2 and b_2 would be negative. Equation (5.13) is dynamic, and hence we have to distinguish between short and long-run effects. The short-run responses can be evaluated directly from equation (5.13) by taking the appropriate partial derivatives. The long-run effects require knowledge of the long-run function, which in this case is equivalent to equation (5.11). Because of the non-linear constraints across parameters, we estimated equation (5.13) using non-linear methods. Our results are

$\hat{a}_0$	$\hat{a}_2$	$\hat{b}_1$	$\hat{b}_2$	$\hat{q}$
-851.47	2.1210	.3935	-.0007	.4574
(-2.562)	(2.705)	(4.476)	(-2.849)	(2.675)

$R^2 = .8746, \quad \bar{R}^2 = .84116, \quad D.W. = 1.6939$

The equation fits quite well and all coefficients appear to be statistically significant at the 5% level. These findings can be interpreted with the help of the following calculations.

<u>Short Run</u>

$$MPS = \hat{b}_1 + \hat{b}_2(1 - \hat{q})FK$$

$= .27$ at the mean of FK

$$\frac{\partial SG1}{\partial FK} = \hat{a}_2(1 - \hat{q}) + \hat{b}_2(1 - q)GRN$$

$= .26$ at the mean of GRN

<u>Long Run</u>

$$MPS = b_1 + b_2\ FK$$

$= .17$ at the mean of FK

$$\frac{\partial SG1}{\partial FK} = \hat{a}_2 + \hat{b}_2 GRN$$

$= .48$ at the mean of GRN

It may be noted that the long and short-run MPS'S are no longer independent of FK. Evaluated at the mean of GRN, they are .17 and .27 respectively. These values compare quite favourably with the estimtes from previous equations. Further, calculations show that while FK has a negative effect on the MPS (in the long and short run) the overall effect of an increase in FK is positive. This implies that foreign capital has favourable effects on government saving. However, while such effects are plausible, their magnitude is too high. We experimented with a number of other dynamic formulations of the government saving function by bringing in expectations about FK and GRN, and distinguishing between "permanent" and "transitory" government revenues and foreign capital inflows. Apart from the fact that these considerations led to complicated estimating equations with nonlinear constraints across parameters (which had to be estimated by nonlinear methods), the effects of foreign capital on saving turned out to be too large to be plausible, and/or statistically insignificant.

There are some additional unsatisfactory features associated with the kind of saving functions we have been dealing with. In Chapter 2 we indicated that the relationship between consumption/saving and foreign capital has two major aspects: (1) foreign capital adds to domestic resources, and consequently adds to both consumption and saving, and (2) foreign capital may adversely affect the volume of saving at the margin (i.e., the marginal propensity to save). In the kind of government saving equations we have been dealing with, only the type of effect listed in (2) has been incorporated. Thus, consider the following saving function on which the foregoing saving functions have been based:

(5.14) $SG1 = a_0 + a_1(FK)GRN + a_2FK$

$a_1(FK)$ incorporates the type of effect listed in (2). However, a_2 cannot be interpreted as the proportion of foreign resources (at the margin) that is saved. For one thing, the estimate of a_2 in various versions of equation (5.14) that were tried, was found to exceed unity. Secondly, FK refers to the total capital inflow, and thus is likely to include private inflows of foreign capital. The most significant point, however,is that since government saving is measured as the surplus of government revenues over its current expenditures, it does not include that portion of foreign resources that is saved. Consequently, equation (5.14) is not appropriate for studying the type of effect listed in (1) above. To quantify this effect, we should estimate a consumption function directly and derive government saving as the residual. In this connection, it should also be noted that foreign resources are not the only extra-revenue source from which consumption takes place. To the extent we are dealing with consumption out of extra-revenue sources we should consider <u>all</u> other extra-revenue sources - viz., domestic borrowing. While ideally, a distinction should be made between foreign extra-revenue sources and domestic extra-revenue sources, lack of the requisite data forces us to lump all extra-revenue resources together.

As a starting point we postulate consumption function:

(5.15) $CG1 = a_0 + a_1 GRN + a_2(\overline{XRS}/P)$

where $CG1 = GRN - SG1$[12]

and $\overline{XRS}$ = extra revenue resources

$\overline{XRS}$ is the sum of foreign capital transfers to the government, foreign and domestic borrowing[13]. Since we have data for foreign capital transfers $\overline{KTRS}$, we can allow for different consumption propensities out of the transfer and borrowing (domestic and foreign) components of $\overline{XRS}$, by rewriting (5.15) as

(5.16) $CG1 = a_0+a_1 GRN+a_2(\overline{KTRS}/P)+a_3\{(\overline{XRS}-KTRS)/P\}$

Induced effects of foreign capital on government consumption out of its revenues can be incorporated by making a_1 a function of the foreign capital inflow. We experimented with a number of alternative specifications of the foreign capital inflow. Some of these are

(5.17) $a_1 = b_0 + b_1(FK/NY)$

(5.18) $a_1 = b_0 + b_1(\overline{KTRS}/\overline{XRS})$

(5.19) $a_1 = b_0 + b_1(\overline{KTRS}/\overline{FKS})$

In each of these equations, foreign resources are introduced in different ways. Further, in each case, it is recognized that the absolute volume of foreign resources <u>per se</u> is not likely to affect the propensity to consume. In equation (5.17), the marginal propenisty to consume is assumed to depend upon the total (real) capital inflow as a proportion of national income. In equations (5.18) and (5.19) we allow for the possibility that an increase in foreign resources induces extra consumption out of additional revenues only if the increase is in the form of capital transfers instead of loans. The reason for this could be that while transfers involve no future obligations, loans would have to be serviced, and would consequently subtract from resources in future periods. Consequently, there may be no inducement to switch a given volume of revenues from saving to consumption when there is an increase in the loan component of foreign capital inflows. In fact, equation (5.19) implies effects in the opposite direction.

In equation (5.18) capital transfers are taken as a proportion of overall extra-revenue resources of the government, while in equation (5.19) they are exprssed as a proposition of the overall capital inflow. Substitution of (5.17), (5.18) and (5.19) into (5.16), yields the following equations:

$$(5.20)\quad CG1 = a_0+b_0GRN+b_1\left(\frac{FK}{NY}\right)GRN+a_2(\overline{KTRS}/P)+a_3\{(\overline{XRS}-KTRS)/P\}$$

$$(5.21)\quad CG1 = a_0 + b_0 GRN + b_1\left(\frac{\overline{KTRS}}{\overline{XRS}}\right).GRN + a_2(\overline{KTRS}/P) + a_3\{(\overline{XRS} - \overline{KTRS})/P\}$$

$$(5.22)\quad CG1 = a_0 + b_0 GRN + b_1\left(\frac{\overline{KTRS}}{\overline{FKS}}\right).GRN + a_2(\overline{KTRS}/P) + a_3\{(\overline{XRS} - \overline{KTRS})/P\}$$

Since in each of these equations we are considering consumption from all possible sources (i.e., revenue and extra-revenue sources), we ought to impose the restriction that $a_0 = 0$. We estimated these equations with and without this restriction and found that a_0 was in fact, highly insignificant. Consequently, we re-estimated the equations with $a_0 = 0$, and obtained

$$(5.23)\quad CG1 = \underset{(13.145)}{.7293}GRN - \underset{(.049)}{.0570}\left(\frac{FK}{NY}\right)GRN + \underset{(1.239)}{.1723}\left(\frac{\overline{KTRS}}{P}\right) + \underset{(2.109)}{.3840}\{(\overline{XRS} - \overline{KTRS})/P\}$$

$$R^2 = .9822,\ \bar{R}^2 = .9786,\ D.W. = 1.4814,\ \hat{\rho} = .7186$$

$$(5.24)\quad CG1 = \underset{(13.606)}{.7389}GRN + \underset{(.977)}{.1502}\left(\frac{\overline{KTRS}}{\overline{XRS}}\right).GRN - \underset{(-.442)}{.1630}\left(\frac{\overline{KTRS}}{P}\right) + .3369\{(\overline{XRS} - \overline{KTRS})/P\}$$

$$R^2 = .9833,\ \bar{R}^2 = .9797,\ D.W. = 1.5168,\ \hat{\rho} = .7040$$

$$(5.25)\quad CG1 = \underset{(15.192)}{.7789}GRN + \underset{(2.150)}{.0199}\left(\frac{\overline{KTRS}}{\overline{FKS}}\right).GRN - \underset{(-.740)}{.1447}\left(\frac{\overline{KTRS}}{P}\right) + .2879\{(\overline{XRS} - \overline{KTRS})/P\}$$

$R^2 = .9860$, $\bar{R}^2 = .9830$, D.W. = 1.5801, $\hat{\rho} = .5745$

We note that the coefficient of the real capital transfers variable is negative. However, it is highly insignificant in all equations. In equation (5.23) the marginal propensity to consume (MPC) is positively related to the total real foreign capital inflow (expressed as a proportion of national income). However, the coefficient of this variable, b_1, is statistically insginificant. The MPC is positively related to foreign capital transfers as a proportion of extra revenue resources as well, though once again, the coefficient is statistically insignificant. In equation (5.25) on the other hand, foreign capital transfers expressed as a proportion of the total foreign capital inflow have a positive and statistically significant impact upon the MPC. Thus, while all equations indicate that foreign resources induce additional consumption out of an additional unit of revenues, this effect is statistically significant only in equation (5.25). In respect of the other variables, all the equations are quite similar[14]. Thus, b_0, which is the MPC in the absence of foreign resources, is positive as expected, and statistically significant in each equation. The propensity to consume out of borrowed extra-revenue resources also has the expected sign and is on the borderline of statistical significance at the 5% level in both equations. Only the coefficient of the capital transfers variable has the incorrect sign in all equations, but it is highly insignificant. We re-estimated the equations after dropping this variable. This did not alter equations (5.23) and (5.24) much. In fact, the effect of foreign resources on the MPC (i.e., the coefficient b_1) continued to be statistically insignificant. However, in equation (5.25) all the coefficients were highly significant as can be observed from the estimated equation reported immediately below.

$$(5.26) \quad CG1 = \underset{(18.478)}{.7538\ GRN} + \underset{(2.397)}{.01451}\left(\frac{\overline{KTRS}}{\overline{FKS}}\right).GRN + \underset{(2.600)}{.3572}\{(\overline{XRS} - \overline{KTRS})/P\}$$

$$R^2 = .9855,\ \bar{R}^2 = .9836,\ D.W. = 1.1.5915,\ \hat{\rho} = .6310$$

We adopt equation (5.26) for explaining government consumption. The equation incorporates the two major aspects of foreign capital alluded to earlier - viz., that an increase in foreign capital is partly consumed and it induces additional consumption out of a given level of revenues. In equation (5.26), an increase in foreign capital raises consumption provided capital transfers do not rise by the same amount, but it induces additional consumption out of a given level of revenues only if it is associated with an increase in the share of capital transfers in the overall capital inflow. It is clear, however, that these two effects are not independent of each other. In fact, they are simultaneous. Thus, an increase in $\overline{KTRS}$, holding the total capital inflow $\overline{FKS}$ constant, raises $\overline{XRS}$ by the same amount. Consequently, there is no direct increase in consumption. But it raises the share of $\overline{KTRS}$ in $\overline{FKS}$ thereby inducing additional consumption out of a given level of revenue. In general, however, since these two effects on consumption are not independent, they cannot be separately analysed. In any case, the inducement effects are small in magnitude.

(5.2) GOVERNMENT TAXATION AND RELATED RELATIONSHIPS.

In this section we develop and estimate equations for the components of public revenues defined as GRN in the previous section. Of particular interest are the taxation variables since we wish to examine the effects of foreign capital inflows on the government's tax effort. Since taxation affects both private and public saving (generally in opposite directions), this will enable us to explore the links between foreign capital, public, private, and hence, overall saving.

As indicated in Chapter 2, the taxation effort cannot be defined in a precise manner. The approach adopted here, as stated in Chapter 2, is to measure the tax effort as the ratio of tax revenues to national income, which can be viewed as an "average" tax rate. Given the level of aggregation adopted in this study, we can define the tax effort in two ways: (1) the ratio of direct tax revenues to national income, which can be viewed as the "average" direct tax rate, and (2) the ratio of indirect tax revenues to national income, which can be viewed as the "average" indirect tax rate. In other words:

$$ADTR = \frac{DT}{NY} \quad \text{and} \quad AITR = \frac{IDT}{NY}$$

where DT = real direct tax revenues

IDT = real indirect tax revenues

One factor that is likely to be important in determining the tax effort of the government, in the Indian context, is the (low) level of income per capita. The level of income per capita can be taken as a measure of the standard of living which provides the limits to additional direct and indirect taxation. Indeed, the low level of income per capita constrains not only the ability of the government to resort to additional taxation, but also the ability of the population at large to pay[15]. In a situation of this sort, it is plausible that the availability of foreign resources induces the government to relax its tax effort. On the other hand, if the resource demands of the country's development drive are high and/or the government attaches significant weight to the goal of "self sufficiency" foreign resources may lead to no relaxation in the tax effort[16]. In other words, the tendency for the government to relax its tax effort in the wake of increased foreign resources may well be offset if the latter are viewed as perpetuating the "resource gap" and hence, the country's dependence on foreign resources. In order to study the effects of foreign resources, we introduced in our equations for the tax effort, in addition to the national income per capita variable, the total net capital inflow expressed as a proportion of national income. Consequently, our tax effort equations are

$$(5.27)\quad ADTR = a_0 + a_1(FK/NY) + a_2(NY/\bar{N})$$

$$(5.28)\quad AITR = b_0 + b_1(FK/NY) + b_2(NY/\bar{N})$$

a_1 and b_1 are expected to be positive, while negative values for a_2 and b_2 imply adverse effects on the taxation effort[17]. The estimated equations are

$$(5.29)\quad ADTR = \underset{(.108)}{.0026} + \underset{(1.412)}{.0010}\,(NY/\bar{N}) - \underset{(-1.261)}{.1298}(FK/NY)$$

$$R^2 = .7349,\ \bar{R}^2 = .7018,\quad D.W. = 1.5090,\ \hat{\rho} = .6800$$

$$(5.30)\quad AITR = \underset{(-3.301)}{-.1930} + \underset{(5.615)}{.0091}\,(NY/\bar{N}) + \underset{(.341)}{.10826}\,(FK/NY)$$

$$R^2 = .8862,\ \bar{R}^2 = .8720,\quad D.W. = 2.1235$$

While foreign capital appears to have an adverse effect on the tax effort in equation (5.29) this effect is statistically insignificant. In equation (5.30) on the other hand, foreign capital has just the opposite effect, though once again, this effect is highly insignificant. Thus, in both cases, foreign capital does not have a significant impact (adverse or otherwise) on the tax effort. The per capita income variable has the right sign in both equations, but is statistically insignificant in the ADTR equation. In fact, the ADTR equation fits the data only moderately well as compared to the AITR equation.

We considered a number of modifications of these equations, but these did not markedly alter the nature of the results. Thus, one modification considered, involved disaggregating the variable (FK/NY) in equations (5.29) and (5.30) as follows:

$$(5.31)\quad ADTR = a_0 + a_1(NY/\overline{N}) + a_2(\overline{KTRS}/P.NY) + a_3\{(\overline{FKS} - \overline{KTRS})/P.NY\}$$

$$(5.32)\quad AITR = b_0 + b.(NY/\overline{N}) + b_2(\overline{KTRS}/P.NY) + b_3\{(\overline{FKS} - \overline{KTRS})/P.NY\}$$

In these equations, a distinction is made between foreign capital transfers and the remaining components (viz., loans) of the foreign capital inflow, on the grounds that if increased foreign resources are associated with a relaxation in the tax effort, this is more likely to be so in response to an increase in the capital transfer component, while an increase in the non-capital transfer loan component may have no such effects, and may indeed have positive effects on the tax effort. The estimated counterparts of equations (5.31) and (5.32) are

$$(5.33)\quad ADTR = \underset{(-2.357)}{-.0544} + \underset{(3.884)}{.0025}\,(NY/\bar{N}) + \underset{(.794)}{.1344}(\overline{KTRS}/P.NY) + \underset{(1.499)}{.1876}\{(\overline{FKS} - \overline{KTRS})/P\ NY\}$$

$$R^2 = .6689,\ \bar{R}^2 = .6068,\ D.W. = 1.3457$$

$$(5.34)\quad AITR = \underset{(-3.222)}{-.1929} + \underset{(5.492)}{.00907}(NY/\bar{N}) - \underset{(-.062)}{.0272}(\overline{KTRS}/P\ NY) + \underset{(.309)}{.1003}\{(\overline{FKS} - \overline{KTRS})/P.NY\}$$

$$R^2 = .8877,\ \bar{R}^2 = .8666,\ D.W. = 1.9366$$

The results once again show that foreign resources do not have statistically significant effects on the tax effort. Only the coefficient of the per capita income variable is statistically significant in both equations. Thus, the distinction between transfer and loan component of foreign resources does not lead to any significant change in the results as compared to the earlier equations. In equations (5.33) and (5.34) both the transfer and non-transfer components of foreign capital can have adverse effects on the tax effort. Another possible case is highlighted by the following set of equations:

(5.35) $ADTR = a_0 + a_1(NY/\overline{N}) + a_2(\overline{KTRS}/\overline{FKS})$

(5.36) $AITR = b_0 + b_1(NY/\overline{N}) + b_2(\overline{KTRS}/\overline{FKS})$

These equations imply that an increase in foreign capital would have adverse effects on the tax effort (assuming a_2 and b_2 are negative) only if it increases the share of transfers in the total capital inflow. This implies that if the foreign capital inflow increase is in the form of loans (i.e., the share of transfers declines), the effects on the tax effort would be favourable. This type of behaviour is possible to the extent that foreign loans are not viewed as improving the country's resource position in the long-run since in future periods, a part of future resources (saving) would have to be sacrificed to make interest payments on these loans. It is thus possible for this future aspect of increased laons in the current period to be reflected in an intensification of the tax effort. It is,of course, also possible that the impact of this future aspect of increased loans on the current tax effort is completely offset by another future consideration - viz., that the loans enable a higher level of income and thus saving in future periods. Equations (5.35) and (5.36) do not allow for this. The estimated counterparts of these equations are:

$$(5.37)\quad ADTR = \underset{(-.828)}{-.0122} + \underset{(2.959)}{.00132}(NY/\bar{N}) - \underset{(-2.083)}{.0009}(\overline{KTRS}/\overline{FKS})$$

$$R^2 = .7752,\ \bar{R}^2 = .7471,\ D.W. = 1.6365,\ \hat{\rho} = .6090$$

$$(5.38)\quad AITR = \underset{(-7.295)}{-.1738} + \underset{(11.570)}{.00854}\ (NY/\bar{N}) - \underset{(-.678)}{.0011}(\overline{KTRS}/\overline{FKS})$$

$$R^2 = .8885,\ \bar{R}^2 = .8754,\ D.W. = 1.8787$$

The results are broadly similar to those obtained from earlier equations. The one significant difference is that foreign capital transfers have a statistically significant adverse effect on the "average" direct tax rate, all other variables remaining constant. However, this effect is very small even for large, implausible changes in the share of capital transfers in the total capital inflow. On the other hand, the adverse effect on the "average" indirect tax rate is highly insignificant.

In conclusion we may note that our results indicate that foreign capital does not have, in general, statistically significant effects on the tax effort. In the one case in which a negative, statistically significant effect is indicated, its magnitude is very small. We also considered some extensions of equations (5.27), (5.28), (5.35) and (5.36). In particular, we considered the case in which the tax effort is assumed to depend not as much upon short-run fluctuations in the capital inflow (as defined in each of these equations) as upon some long-run expectation of it. In addition, it is also likely that the tax effort is not sensitive to short-run fluctuations in income per capita, but is geared to long-term trends in it. The long-run expectation of foreign capital inflows, in each of these equations, was defined as a geometric weighted average of current and past capital inflows, while for simplicity, a two-year average was taken as an approximation of trend income per capita. Once again, our finding was that the effects of foreign capital were very small in magnitude and/or highly insignificant (statistically). Consequently, we decided to treat the two "average" tax rates as exogenous variables. No serious consequences can be expected from this simplication. In fact, it enables us to examine, in a simulation context, the interesting question of the relationship between tax rate changes and aggregate saving. Thus, for instance, an increase in the direct tax rate is likely to foster government saving but affect private saving adversely. The question of what happens to aggregate saving is an interesting and important one, and can be examined in a simulation context.

The remaining components of current government sector variables that are explained here are: (a) land revenue - LRS and, (b) other government revenues - ORS.

LRS and ORS are both explained in terms of the following simple linear functions:

(5.39) $LRS = a_0 + a_1(PAD \cdot YA)$

(5.40) $ORS = b_0 + b_1(P \cdot NY)$

where YA = agricultural output

NY = national income

PAD = deflator for agricultural income

P = national income deflator

The estimated equations are

(5.41) $$\underset{}{LRS} = \underset{(1.450)}{53.134} + \underset{(2.313)}{.0043}\,(PAD.YA)$$

$$R^2 = .6414,\ \bar{R}^2 = .6203,\ D.W. = 1.2058,\ \hat{\rho} = .7531$$

(5.42) $$ORS = \underset{(1.956)}{126.213} + \underset{(7.981)}{.0153}(P.NY)$$

$$R^2 = .8991,\ \bar{R}^2 = .8932,\ D.W. = 1.7118,\ \hat{\rho} = .3800$$

The ORS equation fits quite well (expectedly), though the fit of the LRS equation is quite average. The latter equation also appears to suffer from auto-correlation, a first order correction for which appears not to have helped. Nevertheless, these equations appear to be reasonable and we adopt them in our model. We turn now to the determinants of aggregate and sectoral capital formation in the economy.

(5.3) Aggregate and Sectoral Capital Formation.

Empirical studies of investment behaviour in the Indian economy have been relatively few. Some writers have successfully estimated investment functions (for the whole economy or for institutional sectors) mainly in the context of economy-wide macroeconometric models. However, investment functions for production sectors in such models have been rare[18]. The main reason for this has been the general absence of time series data for sectoral capital formation. With the recent release of official estimates of sectoral capital formation since 1950-51, this gap has been (partially) filled. Apart from the constraints raised by data availabilities, there are other no less significant, difficulties in developing an appropriate framework for studying investment behaviour. These arise because, as we noted in Chapter 3, there are direct government controls on investment, particularly in the organized sectors of the economy. This makes the application of theories of investment developed for industrialized economies, inappropriate. Clearly the incorporation of the fundamental characteristics of the institutional environment within which capacity creation takes place, becomes necessary.

Resource constraints are a fundamental feature of the present model. Consequently, saving and investment ought not to be independent of each other. We have already developed the saving side of the model. In particular, we postulated and estimated an independent private saving function, while government saving is determined residually from its revenues. If investment is determined independently of the volume of saving in the economy, the latter plays no particular role in the model and the notion of a saving constraint on investment is negated. Specifically, the saving investment-identity determines something else, and changes in saving have no direct implications for the level of investment in the economy[19]. But if the volume of investment in the economy is partly constrained by the volume of saving, this constraint should be explicitly taken into account.

At an aggregate level, this constraint is automatically implied by the condition that the realized volume of investment must be equal to the volume of saving plus the net foreign capital inflow. In our model, saving is disaggregated by private and government sector, but investment is disaggregated not only by private and government sector but also by production sector. Our task in this model is not only to determine private and government investment in a manner consistent with the constraint imposed by the volume of saving and the foreign capital inflow, but also to ensure that sectoral investment is determined in a manner consistent with the overall volume of investment so determined.

<u>Private, Government and Aggregate Capital Formation</u>.

Let us start with the saving-investment identity

$$P.SG1 + \overline{SG2S} + P.SP + \overline{FKS} \equiv PINV.NFIT + PVD.INV$$

where PINV = fixed capital formation deflator

NFIT = aggregate net fixed capital formation

PVD = inventory investment deflator

INV = inventory investment

The other variables have already been defined. This identity is used in the model to determine aggregate investment NFIT. The identity can thus be rewritten as

(5.43) $$NFIT = (P.SG1 + \overline{SG2S} + P.SP + \overline{FKS} - PVD.INV)/PINV$$

We can also write

(5.44) $$NFIT = NFIG + NFIP$$

where NFIG = net fixed government investment

NFIP = net fixed private investment

Government investment is determined from the condition that government investment expenditures must be equal to government sector saving plus all extra-revenue resources (viz., foreign capital transfers + foreign borrowing + domestic borrowing). In nominal terms this condition can be written as

$$(5.45)\quad PINV.NFIG + \overline{INVGS} = P.SG1 + \overline{SG2S} + \overline{XRS}$$

where $\overline{INVGS}$ = government inventory investment, which is assumed to be exogenous.

$\overline{XRS}$ = extra-revenue resources.

It may be recalled that $\overline{XRS}$ was used in connection with the government consumption equation in the previous section.

Since (5.45) determines government fixed investment, we can rewrite it as

$$(5.46)\quad NFIG = (P.SG1 + \overline{SG2S} + \overline{XRS} - \overline{INVGS})/PINV$$

To summarize, it can be seen that aggregate fixed investment in the economy is determined by identity (5.43), while the government component of aggregate fixed investment is determined by (5.46). Private fixed investment is consequently determined as a residual by (5.44).

Sectoral Capital Formation

In developing the structure that determines sectoral capital formation we have to ensure that the sectoral rates of investment taken together satisfy the constraint on overall investment, as determined above. Or, to put it another way, we need a scheme which allocates aggregate capital formation among the four sectors of the economy. In an economy in which the government directly controls and monitors the level and structure of capital formation through the policy of industrial licensing, this sectoral allocation would seem to be determined in a mechanical fashion rather than on the basis of sectoral investment functions. However, there appears to be some important exceptions. While undoubtedly there have been strict and direct controls on the levels and pattern of investment, these controls are effective primarily in the organized sectors of the economy. However, they have little impact upon the fairly substantial unorganized sectors like agriculture. Thus, it would be appropriate to develop and estimate an investment function at least for the agricultural sector.

It is clear from the discussion of the preceding section that investment in one of the four sectors has to be determined residually. This follows from the fact that, since the level of aggregate investment is determined by (5.43), investment can be determined independently in only <u>three</u> sectors of the economy. Since an independent investment function is postulated for agriculture, investment in one of the remaining sectors - industry, infrastructure or services - has to be determined residually. In our model, infrastructural investment is determined in this manner.

(5.47) NFINF = NFIT - NFIA - NFIM - NFISV

where NFINF = fixed investment in infrastructure
NFIA = fixed investment in agriculture
NFIM = fixed investment in the industrial sector
NFISV = fixed investment in the services sector

Since an independent investment function is developed for agriculture, and infrastructural investment is residually determined, we need equations to explain investment in the industrial and services sectors. We are constrained by data availability to look only at aggregate sectoral investment, even though it would be more useful to look separately at public and private investment in each sector. The approach adopted in developing investment equations for the agricultural, industrial and services sectors is to postulate private investment functions, and then to derive aggregate sectoral investment functions on the basis of simplifying assumptions[20]. While the agricultural investment function is developed independently of the constraint imposed by the overall availability of resources and/or controls, the latter features are incorporated in developing the investment equations for the industrial and services sectors.

Capital Formation in the Industrial and Services Sector

Profits can quite reasonably be considered to be a major determinant of planned private investment in the non-agricultural sectors of the economy not only because they are an indicator of profitability, but also because they are the major source of (internal) finance[21]. Internal financing is likely to be important because of the proliferation of household businesses, which traditionally tend to be self-financing and more generally because of the general lack of access to capital markets which are underdeveloped and imperfect, and in which, there has been a lack of tradition in the provision of venture capital. Thus, we postulate, for the industrial sector,

$$(5.48) \quad \hat{NFIMP} = d\ PROF^e$$

where $\hat{NFIMP}$ = planned private (fixed) investment in the industrial sector

$PROF^e$ = expected profits

The profit variable is a measure of both the availability of finance, and of profitability. We assume that because of government controls on private investment, only some fraction c of planned investment is realized[22]. Thus,

$$(5.49) \quad NFIMP = c\ \hat{NFIMP}$$

The fraction c is not likely to be constant, but is likely to vary with the intensity or strictness of government controls. Unfortunately, we lack the data to construct a precise measure of the intensity of controls (c). One approach would be to take the realized volume of private investment as a proportion of aggregate investment in the economy as a proxy for c[23]. Alternatively, c can be defined as a function of the volume of private investment expressed as a proportion of aggregate investment. That is,

$$c = f\left(\frac{NFIP}{NFIT}\right), \text{where NFIT = aggregate investment.}$$

Actually NFIP should be measured net of private agricultural investment since government controls have little impact on the latter. However, we do not have data for private agricultural investment to accomplish this. We can write

$$(5.50) \quad c = b(NFIP/NFIT)^{24}$$

It follows that

$$NFIPM = b\left(\frac{NFIP}{NFIT}\right)NFIMP$$

$$= b\left(\frac{NFIP}{NFIT}\right)(d\ PROF^{e})$$

or

$$(5.51) \quad NFIPM = b.d\ PROF^{e}(NFIP/NFIT)$$

We have to reduce $PROF^e$ to an observable variable, as well to convert this equation into one which explains total investment in the industrial sector. We assume that

$$(5.52) \quad NFIGM = k_0 + k_1 NFIG$$

That is, government investment in the industrial sector (NFIGM) is a simple linear function of aggregate government investment. Noting that

$$(5.53) \quad NFIPM = NFIM - NFIGM$$

where NFIM = aggregate fixed investment in the industrial sector

We can rewrite equation (5.51) as

$$(5.54) \quad NFIM = k_0 + d.b\ PROF^e\left(\frac{NFIP}{NFIT}\right) + k_1 NFIG$$

If we assume that expectations about profits are adaptive

$$PROF^e - PROFL^e = m(PROF - PROFL^e) \quad 0 < m < 1$$

it can be shown that (5.54) reduces to

$$(5.55) \quad NFIM = k_0(1-q)+db(1-q).PROF\left(\frac{NFIP}{NFIT}\right)+k_1 NFIG-k_1 qNFIGL + qNFIML$$

where $q = (1 - m)$

Since profits are generally highly correlated with output, we can replace PROF by sectoral output YM and rewrite (5.55) as

$$(5.56)\quad NFIM = k_0(1-q) + e(1-q)YM(\frac{NFIP}{NFIT}) + k_1 NFIG - k_1 qNFIGL + qNFIML$$

where $e = d.b$

We also considered the case where $k_0 = 0$, which implies that government investment in industry is proportional to aggregate government investment. We estimated equation (5.56) with and without $k_0 = 0$ by nonlinear methods due to the nonlinear constraints on parameters. However, in the case $k_0 \neq 0$, there was a failure to converge even after 150 iterations. The case in which $k_0 = 0$, on the other hand, gave reasonable results, and these are reported below:

$\hat{e}$	$\hat{k}_1$	$\hat{q}$
.2111	.2688	.0458
(3.259)	(2.675)	(.1882)

$R^2 = .6966$, $\bar{R}^2 = .6609$, D.W. = 1.5636

We note that both the overall saving constraint and overall government investment are significant in terms of their effect upon overall investment in the industrial sector. It may further be observed that the long-run and short-run effects are of the same order of magnitude since $\hat{q}$ is only .05 and, in fact, not significantly different from zero. Thus, lagged adjustment does not appear to be relevant in the present context. With the restriction $q = 0$, equation (5.56) becomes

(5.57) $NFIM = k_0 + eYM(\frac{NFIP}{NFIT}) + k_1 NFIG$

We estimated this equation and found that the intercept term k_0 is, in fact, not statistically significant. The results are broadly similar to, though somewhat better than, those obtained for the dynamic equation (5.56). The results for equation (5.57), estimated with and without the intercept are as follows:

(5.58) $$NFIM = \underset{(-.684)}{-114.435} + \underset{(3.397)}{.2368}\ YM.(NFIP/NFIT) + \underset{(1.913)}{.3232}\ NFIG$$

$$R^2 = .7303,\ \bar{R}^2 = .6966,\ D.W. = 1.9166,\ \hat{\rho} = .2181$$

(5.59) $$NFIM = \underset{(3.380)}{.2328}\ YM(NFIP/NFIT) + \underset{(2.147)}{.2312}\ NFIG$$

$$R^2 = .7230,\ \bar{R}^2 = .7141,\ D.W. = 1.8482,\ \hat{\rho} = .2434$$

It appears that without or with the intercept, equation (5.57) performs quite well. The intercept is not statistically significant, but the coefficient of government investment as well as that of the variable incorporating the constraint imposed by overall private investment, are statistically significant. Note though, that while the deletion of the intercept hardly changes the latter coefficient, a decline in the former coefficient (as well as in its standard error) is noticeable. Equation (5.58) is used in the simulation experiments reported in Chapter 7[25].

We now move on to investment in the services sector. The investment equations developed here are, in essence, the same as those developed above. Thus, in equation (5.56) we can replace YM by output in the services sector as a proxy for profits. However, national income (NY) would appear to be a more appropriate variable in this context. This is because there is much household investment in residential property in this sector, and this is likely to depend upon the income of the population at large. Consequently, national income can serve as a proxy for household income as well as profits in the services sector. Ideally, net disposable income should be used, but since a similar measure cannot be defined for the industrial sector, we decided to use national income for consistency. Otherwise, a change in direct tax rates would affect services investment but not industrial investment. Thus, replacing YM by national income (NY) in equation (5.56), we get

$$(5.60)\quad NFISV = k_0(1-q)+e(1-q)NY\left(\frac{NFIP}{NFIT}\right)+k_1NFIG-k_1qNFIGL + qNFISVL$$

As in the case of the NFIM equation, we estimated equation (5.60) with and without the intercept term, using nonlinear least squares. Our results are reported in Table 5.2.

TABLE 5.2: A SET OF EQUATIONS FOR NFISV

$\hat{k}_0$	$\hat{e}$	$\hat{k}_1$	$\hat{q}$	R^2	$\bar{R}^2$	D.W.
-285.325	.1033	.3795	.3020	.7986	.7608	1.8196
(-1.284)	(1.386)	(1.981)	(.742)			
-	.0598	.1742	.1313	.7616	.7336	2.0473
	(3.870)	(1.616)	(.505)			

It can be seen that the deletion of the intercept (which statistically insignificant) results in dramatic changes in parameter estimates. Thus the coefficient of NFIG drops from .38 to .17. But it is not statistically significant in the equation without the intercept. Furthermore, it appears that the lagged effects are not important as $\hat{q}$ is not statistically significant in both equations. Consequently, we re-estimated (5.60) with and without the intercept under the restriction q = 0. Our results are

$$(5.61)\quad \underset{}{NFISV} = \underset{(-1.758)}{-194.506} + \underset{(5.262)}{.0681}\ NY(NFIP/NFIT) + \underset{(2.526)}{.2911}\ NFIG$$

$$R^2 = .7942,\quad \bar{R}^2 = .7700,\quad D.W. = 1.9172$$

$$(5.62) \quad NFISV = .0573\ NY(NFIP/NFIT) + .1883\ NFIG$$
$$(3.905) \qquad\qquad (1.865)$$

$$R^2 = .7528,\ \bar{R}^2 = .7383,\ D.W. = 2.0681,\ \hat{P} = .1464$$

In both equations, all the coefficients are statistically significant. The estimated coefficient of the government investment variable NFIG is once again much lower in the equation without the intercept. In fact, the estimate of .18 is unreasonably low. The estimated coefficient of the NY(NFIP/NFIT), on the other hand, is statistically significant and very much the same in both equations. In view of the fact that equation (5.61) fits quite well and the relatively more plausible estimate of .29 of the government investment coefficient, we adopt this equation for explaining investment in the services sector.

We turn now to capital formation in the agricultural sector.

Capital Formation in the Agricultural Sector.

In explaining capital formation in this chapter, we tried approaches which, in fact, are quite similar in interpretation and lead to similar estimating equations. In the first approach we adopt the procedure used by Agarwala[26]. Here, it is assumed that private agricultural investment is mainly self-financed so that the saving function of this sector is in fact its investment function as well. In the second approach, the investment function is not explicitly tied to the sector's saving function. Instead we argue that private investment is determined primarily by the ability of rural households to generate a marketable surplus. In both approaches, private investment equations were converted into aggregate investment functions for the sector, since, as we noted earlier, we do not have data for private and public investment on a sectoral basis.

In the first approach, the assumption that private agricultural investment is self-financing has some validity,at least for the period under consideration. Much of the farming population has little access to organized financial markets. Funds for investment, for a typical farming household, come from present or past saving or are obtained from relatives and most often, from dominant rural social groups like village money lenders, landlords, etc., whose lending operations are themselves dependent on agricultural incomes[27]. For the sector as a whole, therefore, private investment tends to self financing.

Following Agarwala, we can develop the private investment function for the agricultural sector on the basis of its saving function[28]. The simplest case is where the saving function is of the Keynesian type:

(5.63) $SAP = a_0 + a_1 YAD$

SAP = net private saving in the agricultural sector in terms of agricultural goods prices.

YAD = (YA·PAD - LRS)/PAD

= disposable income in the agricultural sector

PAD = deflator for agricutlural income

The other variables have already been defined. On our assumptions

(5.64) $(PINVT.NPIA)/PAD = SAP = a_0 + a_1 YAD$

where NPIA = real net private investment in terms of investment goods prices

PINVT = deflator for net investment (fixed plus inventory)

The left-hand side thus expresses net investment in terms of agricultural goods prices. We can rewrite (5.64) as

(5.65) $NPIA = SAP \cdot PADVT = a_0 PADPVT + a_1 (YAD) \cdot (PADPVT)$

where $PADPVT = \frac{PAD}{PINVT}$ and $YADPV = (PAD \cdot YAD)/PINVT$

Agarwala successfully estimated an investment function of this type. In order to make this equation operational for our purposes, some modifications are necessary. In the first place, NPIA refers to total private investment and thus includes investment in inventories. Our interest however, is in the "fixed" component of this variable. Secondly we do not have data for pirvate fixed investment by sectors. Thus, we can only estimate an aggregate investment function for this sector. These problems can be dealt with by making some simplifying assumptions. One approach to the first problem would be to assume that the inventory component is proportional to total investment. Under this assumption equation (5.65) would only be scaled by the factor of proportionality and could be used to explain private fixed investment. Alternatively, it could be assumed that inventory investment is proportional to the change in output, a proxy for which is disposable agricultural income YAD. In other words, under the latter assumption,

$$(5.66)\quad \left(\frac{PINVT.NPIA}{PAD}\right) = NFPIAA + INVPAA = NFPIAA + b(YAD-YADL)$$

where NFPIAA = net fixed private investment in the agricultural sector in terms of agricultural goods prices.

INVPAA = private inventory investment in the agricultural sector in terms of agricultural goods prices

$0 < b < 1$ is the factor of proportionality.

It can easily be shown that under this assumption equation (5.66) reduces to

(5.67) $NFPIA = a_0 PADPV + (a_1 - b)(YADPV) + b(YADL)(PADPV)$

where PADPV = PAD/PINV and YADPV = (PAD.YAD)/PINV, and PINV is the fixed investment deflator.

In dealing with the second problem we make use of the following identity:

(5.68) $NFIA = NFPIA + NFGIA$

where NFIA = aggregate net fixed investment in agriculture.

NFGIA = government net fixed investment in agriculture.

Under the simplyfying assumption that NFGIA is a linear function of total net fixed government investment:

$$NFGIA = k_0 + k_1 NFIG$$

we can write (5.68) as

(5.69) $NFPIA = NFIA - k_0 - K_1 NFIG$

Most of our empirical results indicated that $k_0 = 0$, so we dropped it. Substituting (5.69) without k_0 in (5.67) we get

(5.70) $NFIA = a_0 PADPV + (a_1 - b)(YADPV) + b(YADL)PADPV)$

$$+ k_1 NFIG$$

Equation (5.70 is thus the aggregate fixed investment equation for the agricultural sector. Our estimated equation is

$$(5.71)\quad NFIA = \underset{(-.786)}{-193.597\ PADV} - \underset{(-.665)}{.0203\ YADPV} + \underset{(1.452)}{.0390}\ (YADL)(PADPV) + \underset{(2.491)}{.3093\ NFIG}$$

$$R^2 = .6693,\ \bar{R}^2 = .6035,\ D.W.\ 2.0627,\ \hat{\rho} = .6296$$

As far as the estimated coefficients are concerned,only the coefficient of NFIG is significant, though the coefficient $\hat{b}$ is larger than its standard error. The coefficient of YADPV is negative, but statistically insignificant implying $a_1 = b$. However, since $\hat{b}$ is not statistically significant the implied value of $\hat{a}_1$(= .184) is also not significant. The negative sign on the PADPV coefficient is to be expected since this coefficient is the intercept in the private saving function. However, it too, is not statistically significant. Thus, equation (5.70) does not perform well at all. We re-estimated the equation without PADPV but this did not change the general pattern of results in terms of significance of the coefficients.

We also dropped the simple Keynesian hypothesis and considered a "permanent" income-type model. Gupta found support for this model in his study of rural saving[29]. Thus, we rewrote (5.63) as

(5.72) $SAP = a_0 + a_1 YAD^P + a_2 YAD^T$

where YAD^P = "permanent" agricultural disposable incme

YAD^T = "transitory" agricultural disposable income

It can be shown that if YAD^P is defined as

$$YAD^P + \sum_{i=0}^{\infty} q^i (1-q) YAD_{t-i}$$

the aggregate fixed investment equation reported above becomes

$$\begin{aligned}(5.73)\quad NFIA = {} & a_0 PADPV - a_0 qPADPVL + [a_1(1-q) + a_2 q - b] \\ & (YADPV) - (a_2 - b)q(YADL)(PADPVL) \\ & + b(YADL)(PADPV) - bq(PADPVL)(YADL2) \\ & + qNFIAL + k_1 NFIG - k_1 qNFIGL\end{aligned}$$

This equation is complicated and requires estimation by nonlinear methods due to nonlinear constraints acorss parameters. Further, it raises a serious multicollinearity problem. We also considered a simpler version of this equation. One reason for the complicated nature of the equation is the adjustment made to get rid of the inventory component of total investment. If we take the simpler approach by assuming that the inventory investment component is proportional to saving (total investment), equation (5.73) simplifies to

$$(5.74) \quad NFIA = d_0 PADPV - d_0 qPADPVL + [d_1(q-q) + d_2 q]YADPV - d_2 q(YADL)(PADPVL) + qNFIAL + k_1 NFIG - k_1 qNFIGL$$

where $d_0 = a_0 v$, $d_1 = a_1 v$, $d_2 = a_2 v$, $(1 - v)$ being the proportion of saving (investment) going into inventories.

The coefficient estimates of both these equations are reported in Table 5.3

It can be seen that, apart from the coefficients of NFIA lagged one period and NFIG, all other coefficients are statistically insignificant in both equations. In particular, the distinction between "permanent" and "transitory" income does not change anything as the coefficients of both types of income are insignificant, as is also the case with the relative price variable. It appears that the saving function alone does not provide a suitable model for explaining the variations in net investment in the sector[30]. We also found that the deletion of the relative price variable PADPV or the inclusion of an intercept did not alter the results to any significant extent. In all the experiments attempted, however, we found considerable stability in the estimates of the NFIG and the NFIAL coefficients.

TABLE 5.3: A SET OF NFIA EQUATIONS.

Equation	$\hat{a}_0, \hat{d}_0$	$\hat{a}_1, \hat{d}_1$	$\hat{a}_2, \hat{d}_2$	$\hat{b}$	$\hat{c}_1$	$\hat{q}$	R^2	$\bar{R}^2$	D.W.
5.73	-228.4	.0300	.0288	.0306	.2603	.6307	.6591	.5374	2.12
	(-.729)	(.676)	(.436)	(.837)	(2.160)	(2.918			
5.74	-35.7	.0272	-.0172	-	.2718	.6254	.6403	.5444	1.94
	(-.162)	(.091)	(-.474)		(2.338)	(3.010			

In view of the above results, we tried another approach, which is similar to the foregoing one, but which does not assume that the private investment function is also the private saving function. We assume that private fixed investment depends primarily upon the ability of farmers to generate a marketable surplus. In particular, we assume

(5.75) $NFPIAA = a_0 + a_1 MSA$

where NFPIAA = net fixed private investment in terms of agricultural goods prices

MSA = marketed surplus (of agricultural goods)

Marketed surplus can be expected to depend mainly upon: (a) the level of output, and (b) the price of agricultural goods relative to the price of non-agricultural goods. _A priori_, both these relationships can be expected to be positive. Thus, for instance, a rise in the relative price of agricultural goods raises the relative cost of farm consumption, at the same time increasing the real value of farmers' incomes in terms of all goods. Under normal conditions, both these factors would lead to an increase in marketed surplus. However, in the Indian context, where a substantial proportion of cultivators are at the subsistence level, these effects may be absent since most output is self-consumed. There are in fact, other factors, more closely related to the institutional features of the sector than to market phenomena, that probably explain the behaviour of marketed surplus. But these are hard to quantify and we did not consider them. We postulated a function for MSA of the following kind:

(5.76) $MSA = f(YAD, RP)$

where YAD is taken as a proxy for output, and RP is an appropriately defined relative price variable. In the absence of data for MSA, we can specify the form of f(YAD, RP) and sutstitute this in (5.75), from which an aggregate investment function for the agricultural sector can be derived as before. But for the RP variable, it is clear that the investment function is identical to that obtained under the Keynesian saving hypothesis. Our experiments showed that the RP variable is not, in fact, statistically significant, and the general nature of results, therefore, were similar to those obtained earlier. Consequently, we considered some additional extensions of the present model.

Thus, we can rewrite (5.75) as

$$(5.77)\quad NFPIA = (NFPIAA)PADPV = a_0 PADPV + a_1(MSA)(PADPV)$$

We then considered the possiblity that private investment depends additionally upon government investment in the agricultural sector. In particular, it could be argued that heavy infrastructural investments (viz., in irrigation, etc.) by the government would be a stimulus to complementary private investment. On the other hand, it could also be argued that such investment is a substitute for private investment. Indeed, given that the ability to invest of the bulk of the farming population is limited by low incomes (and hence saving) as well as by the general lack of access to credit at reasonable rates, such government investment could directly substitute for private investment. Additionally, it may be noted, that government investment could also weaken the willingness to invest, which is likely to be weak to begin with. Thus, partly due to the reasons just mentioned, most farmers raise funds from village money lenders, etc., at exorbitant interest rates, often merely for consumption purposes, and rural indebtedness tends to run high. In a situation of this sort, which is characteristic of the Indian agricultural sector as a whole, the inducement to invest can be expected to be weak. Thus, it is possible that government investment in necessary areas like irrigation may well be a disincentive to private investment. In fact, our empirical results showed this to be the case, though the evidence is far from conclusive since this effect was not always found to be significant. We incorporated this effect in the investment function by introducing lagged government investment in equation (5.76).

We took a linear version of the marketed surplus function (ignoring the RP variable). Thus

(5.78) $NFPIA = a_0 PADPV + a_1 (PADPV)(MSA) + a_2 NFGIAL$

Assuming, as before, that

$NFGIA = k_0 + k_1 NFIG$, we can write

(5.79) $NFPIA = k_0 a_2 + a_0 PADPV + a_1 (PADPV)(MSA) + a_2 k_1 NFIGL$

a_2 thus incorporates the impact of government investment upon private investment.

We took a simple linear version of the marketed surplus function (5.76) (ignoring the relative price veriable on the grounds stated earlier). Thus,

(5.80) $MSA = b_0 + b_1 YAD$

Substitution of (5.80) into (5.79) yields

$$NFPIA = k_0a_2 + a_0PADPV + a_1b_0PADPV + a_1b_1(YADPV)(PADPV) + a_2k_1NFIGL$$

or

$$NFPIA = NFIA - k_0 - k_1NFIG = k_0a_2 + (a_0 + a_1b_0)PADPV + a_1b_1(YADPV)(PADPV) + a_2k_1NFIGL$$

or

$$NFIA = (k_0a_2 + k_0) + (a_0 + a_1b_0)PADPV + a_1b_1(YADPV)(PADPV) + k_1NFIG + a_2k_1NFIGL$$

(5.81) or $$NFIA = d_0 + d_1PADPV + d_2(YADPV)(PADPV) + d_3NFIG + d_4NFIGL$$

where $d_0 = (k_0a_2 + k_0)$, $d_1 = (a_0 + a_1b_0)$, $d_2 = a_1b_1$, $d_3 = k_1$, $d_4 = a_2k_1$.

Our estimated equation is as follows:

(5.82) $$\underset{}{NFIA} = \underset{(-1.405)}{-212.139} + \underset{(.572)}{113.195\ PADPV} + \underset{(2.0932}{.0447\ YADPV} + \underset{(2.376)}{.2948\ NFIG} - \underset{(-2.312)}{.3159\ NFIGL}$$

$R^2 = .6552$, $\bar{R}^2 = .5757$, D.W. = 2.0072, $\hat{\rho} = .0538$

We note that the equation is quite similar to previous ones in terms of fit and the D.W. statistic.

However, one major difference is the income coefficient which is now statistically significant. The coefficient of government investment lagged one period (NFIGL) is negative and significant, thus implying that government investment *per se*, has adverse effects upon private investment. This could be interpreted as implying that government investment induces farmers to switch contemplated investment spending out of a given marketed surplus towards consumption. This is plausible due to the reasons stated earlier. It may be noted, however, that the (negative) coefficient of NFIGL is greater than the (positive) coefficient of NFIG, so that the net effect upon overall investment in any period can be positive or negative, depending upon the volume of government investment in that and the previous period.

Even though an adverse effect of government investment on private investment is plausible, its magnitude in equation (5.82) along with its implications are unrealistic. In other words, the implied substitutive effect in equation (5.82) appears to be too large.

We estimated equation (5.81) without the relative price variable since it was found to be statistically insignificant. Our results are

$$(5.83) \quad \underset{}{NFIA} = \underset{(-1.2580)}{-124.769} + \underset{(2.239)}{.0440}\, YADPV + \underset{(2.342)}{.2886}\, NFIG + \underset{(-2.036)}{.2641}\, NFIGL$$

$R^2 = .6493$, $\bar{R}^2 = .5792$, D.W. = 2.0441, $\hat{\rho} = .1728$

The equation is similar to equation (5.82) in terms of fit, the D.W. statistic and the significance of estimated coefficients. However, interestingly enough, the negative NFIGL coefficient is now smaller than the NFIG coefficient. These results are more reasonable than those obtained earlier.

We also developed and estimated dynamic versions of equations (5.81) and (5.83). In particular, we made private investment a function of current and past trends in marketed surplus (or output). Even under simplifying assumptions regarding the determinants of marketed surplus, the resulting equations are complex. Nevertheless, we experimented with various versions, but the results were unsatisfactory, as lagged agricultural investment (NFIAL) and current government investment appeared to be the only significant coefficients. However, a simpler version of the above hypothesis performed well. Thus, instead of a distributed lag of marketed surplus (or income), we took a simple two-year average of marketed surplus to incorporate the impact of past income. The estimating equation in this case is

$$(5.84)\quad NFIA = a_0 + a_1 PADPV + a_2\left(\frac{YADPV + YADPVL}{2}\right) + a_3 NFIG + a_4 NFIGL$$

But for the income term, this equation is the same as equation (5.81). The relative price variable was not found to be significant, so we estimated (5.84) without it. Our results are

$$(5.85)\quad NFIA = \underset{1.1685)}{-149.089} + \underset{(1.916)}{.0389}\left(\frac{YADPV + YADPVL}{2}\right)$$

$$+ \underset{(2.879)}{.3367}\ NFIG - \underset{(-2.017)}{.2516}\ NFIGL$$

$$R^2 = .6886,\ \bar{R}^2 = .6263,\ D.W. = 2.1145,\ \hat{\rho} = .3746$$

Once again we find that all the coefficients are statistically significant at the 5% level, and the positive NFIG coefficient is considerably larger than the negative NFIGL coefficient than in previous equations. The adverse substitutive effect of government investment is still evident. However, it is lower than than implied in previous equations. Further, as indicated by $\bar{R}^2$, this equation provides the best fit to the data (relatively speaking). The coefficient of NFIG, however, appears to be on the high side compared to all previous equations. Equation (5.83) was used in the simulation experiments reported in Chapter 7. Some of the experiments were also conducted using equation (5.85) but the differences in the results were marginal.

This concludes our discussion of the capital formation relationships of the model. In the next chapter we develop and estimate the final part of the model.

FOOTNOTES

Chapter 5

1. A separate treatment of government saving also enables us to look at another issue of interest. In particular, we examine whether foreign capital inflows have adverse effects on government saving. We do not attempt to link private saving to foreign capital inflows because to the extent these inflows have an impact upon saving, this effect operates primarily *via* its effect on government saving.

2. See Mikesell and Zinser (1973), p. 9.

3. Note that the short run MPS, $a_1(1-q)$, is the MPS out of measured income, and is different from the MPS out of "transitory" income. The latter is simply a_2.

4. Recall that all inferences about the significance of coefficients are made with reference to the 5% level of significance.

5. Gupta (1970b), pp. 245-246. For other Indian saving studies see Gupta (1970a), Joshi (1970), Bhagwati and Srinivasan (1975), Chapter 15.

6. Williamson (1968), p. 204 Table IV.

7. Gupta (1970a), pp. 580-581.

8. Ibid.

9. See Gupta (1970a) and Joshi (1970) for the empirical evidence. See also Raj (1962).

10. Equation (5.11) can be viewed diagrammatically in terms of a plot of SG1 against GRN for a *given* capital inflow. If b_2 and a_2 are negative, the effect of an increase in the capital inflow is reflected in a downward shift of the saving function *and* a decrease in its slope. For any given level of revenues, the volume of saving (and hence the saving rate) falls. There is a range of other interesting possibilities if b_2 and a_2 have opposite signs.

11. Thus, it is possible that, on balance, foreign capital does not have an adverse nor favourable effect on saving. The results from equations (5.10) and (5.11) could be given this interpretation.

12. Strictly speaking CG1, measured in this manner, refers to current (as opposed to capital expenditures), and includes some items of expenditure not treated as consumption *per se* in the government budget.

13. It may be noted that $\overline{XRS}$ is a measure of extra revenue resources of the public sector as a whole. We have not been able to measure its breakdown between government (proper) and departmental enterprises, on the one hand, and nondepartmental enterprises on the other, because data in the requisite detail, and on a continuous basis are not available. Our estimate of the aggregate measure $\overline{XRS}$ has been obtained by subtracting total government saving from its investment (fixed and inventory) expenditure.

14. It must be noted that R^2 and $\bar{R}^2$ as measures of the goodness of fit are not strictly correct in these equations because the intercept has been suppressed. This is also true of the D.W. statistic in this context.

15. In general, one would expect economic growth (i.e., income growth) to be associated with an increasing tax effort, particularly in a context in which the government plays an increasing role in development activity, taxation being an important means through which resources are mobilized for this purpose. However, the ability and willingness of the government to mobilize resources from an additional unit of income is likely to be determined by trends in the standard of living. Consequently income per capita which reflects both these features, is more appropriate and income itself.

16. A similar point has been made by Rahman (1967), p. 150. Rahman argues that there may be no relaxation in the tax effort geared to achieve targeted rates of growth due to an inflow of foreign resources, if there is, amongst other things, no "psychic disutility" attached to increased foreign resources.

17. A similar equation has been used by Landau (1969) in an empirical study on the relationship between the tax effort and foreign capital inflows in Latin American countries. However, in his equation, the ratio of total tax revenue to income is the dependent variable. The sign of the coefficient (FK/NY) was found to be evenly distributed between positive and negative values, though the coefficient was mostly insignificant.

18. Agarwala (1970) however, has private agricultural and non-agricultural investment functions in his model.

19. In the UNCTAD (1973) model of the Indian economy, the role of the saving-investment identity is ambiguous as there appear to be missing equations/definitions. It appears that a change in saving has no direct effect on investment, though an indirect effect seems to operate via the investment goods deflator.

20. A simpler approach would be to make investment in each sector a simple linear function of NFIG and NFIP and to interpret the coefficients of the latter variables as the proportion of aggregate government and private investment respectively, going to each sector. We attempted this but the results were not very encouraging.

21. See, for instance, Agarwala (1970), pp. 56-57.

22. With some exceptions investment in most Indian models is demand-determined. The approach adopted here is just the opposite, in that investment is supply constrained. Apart from the constraint imposed by the availability of resources and controls, other constraints arising due to the limited capacity of the domestic capital goods industry, as well as foreign exchange constraints on the import of various types of capital goods, may also be of some importance in this connection.

23. In broad terms, the approach we have adopted is similar to the one adopted by Agarwala (1970) who formulates his non-agricultural investment function on the basis of an equation like (5.49). However, the proportion of investment

demand that is realized, c, is interpreted in a more precise and appropriate manner in his model. Thus, in Agarwala's model c is taken as the percentage of applications for capital issues for which consent is granted. In our model, c is formulated so as to reflect primarily the constraint imposed by the availability of resources, but also to stand as a proxy for government controls on private investment.

24. We also tried a non-proportional relationship which however, led to an estimating equation, the results from which supported the postulated proportional relation.

25. We also conducted some of the experiments using (5.59) and obtained results which were very similar.

26. Agarwala (1970).

27. Ibid., pp. 54-55.

28. Ibid., pp. 56.

29. Gupta (1970b).

30. We also took a simple two-year average as a measure of "permanent" income but this did not change the situation.

CHAPTER 6

FOREIGN TRADE, MONEY, PRICES AND MISCELLANEOUS RELATIONSHIPS

In this chapter, we develop and estimate the relationships that determine exports, imports, the total availability of foreign exchange, prices, etc., as well as other relationships that are required to complete the model. In Section (6.1) we deal with the determinants of the pattern of merchandise exports and imports. The balance of payments identity closes the foreign sector model. Below we shall attempt to integrate the foreign trade sector with the rest of the system. In Section (6.2), we look at price formation in the economy, as well as at the role of money. Money enters the system in simple fashion, but the approach adopted is relevent in the Indian context. In particular, it is argued that the main impact of the money supply is on prices. This impact is not modelled in standard neoclassical fashion in that this relationship is not one between the level aggregate money income and the money supply. Instead, we try to model the direct impact at the level of sectoral prices, while the impact on the general price level is indirect as it operates indirectly *via* sectoral prices. In Section (6.3) we present the remaining relationships of the model.

The overall estimated model, and the definitions of variables are presented in an appendix to this chapter.

(6.1) THE FOREIGN SECTOR

At a broad level, the approach adopted in this study involves the following breakdown of the current account of the balance of payments.

1. *Merchandise Trade*

a) Merchandise exports, which are further split into three categories or commodity groups.

b) Merchandise imports, which are split into four categories or commodity groups.

2. *Invisible Trade*

a) Payments abroad in respect of factor services (net) .

b) Payments received in respect of all other invisible trade (net).

The Indian economy is not subject to inflows and outflows of short-term capital, in the sense that developed market economies are, given the "soft" nature of the Indian rupee, the relatively under-developed nature of financial markets and the strict regime of exchange control. Long-term capital movements are important, but they are in the nature of officially negotiated loans or transfers. For these reasons, we summarize the capital account by the net inflow of foreign capital which corresponds to the deficit on current account.

Merchandise Exports.

Merchandise exports are broken down into the following two broad categories:

a) Exports of manufactures[1].

b) Other (mainly primary) exports, henceforth referred to as primary exports[2].

Further, we also consider separately a sub-group of (a) - viz., "non-traditional" manufacturing exports[3]. These exports have been the dynamic element in Indian export growth since the early 1960's, as we saw in Chapter 3, Section 3.4.

Two main considerations have governed the chosen breakdown: (i) the availability of data, and (ii) the need to maintain compatibility between the breakdown on the export side and the level of disaggregation adopted in the rest of the model. The main difficulty that arises in the context of the latter is that disaggregated export (and import) data are on a commodity basis while the supply side of the model is on an industrial origin basis. These two types of disaggregation are, in general, not compatible with one another, thus raising difficulties when an attempt is made to link exports (disaggregated on a commodity basis) to the relevant supply side (which is disaggregated, as in the national accounts, on an industrial origin basis). Within the constraints imposed by the availability of data, we have tried to link the aforementioned export categories to the supply side in an approximately consistent manner.

At the first stage, we develop and estimate export functions for each of the above categories. Here we follow standard procedures and relate the export of each category to the relevant scale (income) and price variables. Export demand, export prices, domestic supply and demand factors, together form an inter-dependent system which determines, amongst other things, realized exports and export prices. Let us first look at the export functions.

Exports of Manufacturers.

For these exports we postulate the following equation:

(6.1) $$EM = a_0 + a_1(\overline{Q\ W\ I}) + a_2\left(\frac{PEM}{\overline{PWM}\cdot\overline{EI}}\right)$$

where EM = exports of manufactures

$\overline{QWI}$ = an index of world income

PEM = unit-value index of manufacturing exports

$\overline{PWM}$ = world price index of exports of manufactures

$\overline{EI}$ = index of the exchange rate expressed in rupees per U.S. dollar.

Our estimated equation is

(6.2) $$EM = \underset{(5.154)}{666.132} + \underset{(9.988)}{2.6064}\ \overline{QWI} - \underset{(-5.782)}{770.064}\left(\frac{PEM}{\overline{PWM}\cdot\overline{EI}}\right)$$

$$R^2 = .9615,\ \bar{R}^2 = .9567,\ DW = 1.8381,\ \hat{\rho} = .1852$$

The equation performs well in all respects. Thus, the fit is quite good, the D.W. statistic is sufficiently close to 2 to imply the absence of significant autocorrelation, and all the coefficients have the right sign and are statistically significant. Noteworthy, is the significant relative price coefficient implying that exports of Indian manufactures are sensitive to relative prices and hence subject to competitive pressures in world markets. These exports are also positively and significantly related to world income.

"Non-Traditional" Manufacturing Exports.

The equation postulated for explaining these exports is similar to equation (6.1). Thus,

$$(6.3) \qquad ENTM = b_0 + b_1 \overline{QWI} + b_2\left(\frac{PENTM}{\overline{PWM} \cdot \overline{EI}}\right)$$

where ENTM = "non-traditional' manufacturing exports

PENTM = unit-value index of "non-traditional manufacturing" exports.

The use of the world price index of exports of manufactures as the measure of the competing price is particularly relevant here, since this index is heavily weighted in the export prices of developed economies, which are the main competition to India in respect of exports of "non-traditional" manufactures.

The estimated equation is

$$(6.4) \quad ENTM = 49.2286 + 3.6944\ \overline{QWI} - 377.415\left(\frac{PENTM}{\overline{PWM}\cdot\overline{EI}}\right)$$

$$(.184) \quad (3.946) \quad (-1.887)$$

$$R^2 = .9488,\ \bar{R}^2 = .9424,\ DW = 1.4967,\ \hat{\rho} = .7464$$

Again the results indicate that the equation fits well, though some autocorrelation may be present. Both the income and relative price coefficients have the right sign and are statistically significant at the 5% level. The negative relative price variable has important implications because exports in this category have come to constitute a major proportion of manufacturing exports and are hence a major source of foreign exchange. Their ability to compete in world markets thus will play an important role in determining the country's export earnings in the future.

Primary Exports.

The following equation is postulated for this category of exports:

$$(6.5) \quad EO = c_0 + c_1\ \overline{QWI} + c_2\left(\frac{PEO}{\overline{PELDC}\cdot\overline{EI}}\right)$$

where EO = primary exports

PEO = unit-value index of primary exports.

$\overline{PELDC}$ = price index of exports of less-developed countries.

The price index for the exports of less-developed economies is used here since in the present context it is likely to represent the price of exports that are approximately competitive to Indian exports in this category. The price index ($\overline{PELDC}$) excludes the export prices of oil-exporting countries, and this is appropriate since India is not an exporter of oil. On the other hand, a large proportion of exports of the remaining less-developed economies consists of other (mainly) primary products such as tea, tobacco, cashew, spices, minerals, etc., which also form the bulk of Indian exports in this category. However, on *a priori* grounds, we would expect only a small to moderate relative price or income response, features that have been commonly associated with primary exports. Our results seemed to confirm this as the relative price variable was found to be statistically insignificant. Our estimated equations were

$$(6.6) \qquad EO = \underset{(1.126)}{304.603} + \underset{(3.195)}{1.7181}\,\overline{QWI} - \underset{(-.399)}{93.4069}\left(\frac{PEO}{\overline{PELDC}\cdot\overline{EI}}\right)$$

$$R^2 = .7214,\ \bar{R}^2 = .6886,\ D.W. = 1.0390$$

$$(6.7) \quad EO = -97.5736 + 2.7848\ \overline{QWI} + 189.562\left(\frac{PEO}{\overline{PELDC} \cdot \overline{EI}}\right)$$
$$(-.38) \qquad (4.603) \qquad (.903)$$

$$R^2 = .8330, \quad \bar{R}^2 = .8121, \quad DW = 1.4230, \quad \hat{\rho} = .35385$$

Equation (6.7) is the estimated equation resulting from a correction for autocorrelation, which appears to be a problem in (6.6). Equation (6.7) performs better in all respects. However, the relative price coefficient has the wrong sign. Since we would expect relative prices to have a statistically significant negative effect, however small this may be, we use (6.6) in our simulation experiments. We also consider the following equation, in which the relative price variable does not appear at all:

$$(6.8) \quad EO = 124.397 + 2.3865\ \overline{QWI}$$
$$(2.219) \qquad (6.202)$$

$$R^2 = .8247, \ \bar{R}^2 = .8177, \ DW = 1.3867, \ \hat{\rho} = .3856$$

The above estimated equations do not give us any idea of the income and relative price elasticities. We re-estimated these equations in constant-elasticity (log linear) form[4]. The estimated elasticities are presented in Table 6.1 below.

TABLE 6.1: EXPORT PRICE AND INCOME ELASTICITIES.

	EXPORT CATEGORY	INCOME ELASTICITY	RELATIVE PRICE ELASTICITY
1.	Manufactures (EM)	.8271**	-1.2152**
2.	Non-Traditional Manufactures (ENTM)	1.7101**	-1.5445**
3.	Primary Exports (EO)	.7462**	.1847*

Note: ** Statistically significant at the 5% level.
* Statistically insignificant at the 5% level.

The table shows that both manufactures as a whole and "non-traditional" manufactures have estimated export price responses that are elastic. The price elasticity of "non-traditional" manufactures is, as was expected, larger. Further, while these exports show a highly elastic income response, the income elasticity of overall manufacturing exports is less than unity. This is indicative of a low income elasticity of traditional manufacturing exports (mainly jute and cotton textiles) and is consistent with most other findings on the subject. Primary exports, as can be observed from the table, show low income and relative price elasticities, the latter being positive but insignificant. Again, but for the positive price elasticity of primary exports, these results are plausible.

Merchandise Imports.

A common approach to import functions is to make imports a function of the appropriate relative prices and an income or activity variable, defined appropriately to reflect the nature of the good in question. Often other variables are included to incorporate other relevant information[5]. Thus, in studies on imports of developing economies, a foreign exchange variable is often included to incorporate the foreign exchange constraint[6]. In some cases, relative prices are excluded on the grounds that in the case of particular import categories (e.g., machinery and equipment) some developing economies simply do not produce competing products[7].

Our approach to the structure of Indian imports is governed by 2 sets of factors: (1) the nature of the Indian import regime, and (2) the chosen level of disaggregation.

The most significant feature of India's import trade, as noted in Chapter 3, is that it has been subject to strict and direct control administered through the policy of import licensing since the beginning of the Second Five-Year Plan in 1956. Since this control has, in general, been comprehensive in scope and coverage, the traditional approach which relates imports to relative prices, income, etc., does not appear to be appropriate. Thus, for instance, in the kind of institutional environment surrounding import trade, the traditional role of relative prices in reflecting the pulls of competing sources of supply is undermined. The volume and pattern of imports reflect more the operation of the licensing system than the outcomes of free market choices. Consequently, import functions of the traditional type might not be appropriate[8].

While considerations of the kind listed in the foregoing paragraph have governed our approach to the determination of imports, other considerations relate to the disaggregation of imports into various categories and the relationship of the latter to other parts of the model. In this study, imports have been broken down into the folloiwng categories:

(1) Imports of foodgrains

(2) Imports of raw materials and intermediate goods[9].

(3) Imports of capital goods[10].

(4) Fertilizer imports

(5) "Other" imports.

Barring foodgrains and fertilizer, which are "priority" imports, the policy of import licensing has shifted the structure of imports heavily in favour of categories (2) and (3)[11]. Thus, apart from foodgrains, the only consumer goods imported are in category (4), which forms a very small proportion of overall imports. (See Chapter 3, Section 3.4)

The approaches adopted in explaining each of these categories are different from one another. Nevertheless, the overall framework allows us to incorporate certain institutional features as well as the notion of a foreign exchange constraint. Thus, as an approximation to what actually happens, it is assumed that the exchange allocations for "non-priority" imports are made on the basis of the net availability of foreign exchange[12]. The net available supply of foreign exchange in any period is determined by netting out "priority" imports of foodgrains and fertilizer, amongst other things. In this manner, we are able to provide an important link between the foodgrains sector and the imports of raw materials, intermediate and capital goods via the effects of the former on the exchange constraint. However, we do not deal with the latter two categories of imports in the same manner. Also, the category of "other" imports is determined residually from the balance-of-payments identity.

Foodgrain Imports.

Foodgrain imports are divided into 2 categories: (a) commercial imports, and (b) PL 480 foodgrains imports (food aid). The latter are assumed to be exogenous, while the former are assumed to be endogenous. We write

$$ZF = ZFCOM + \overline{ZFPB}$$

where ZF = total foodgrain imports (millions of tons)

ZFCOM = commercial foodgrain imports (millions of tons)

$\overline{ZFPB}$ = PL 480 foodgrain imports (millions of tons)

Commercial foodgrain imports are necessity imports, largely undertaken by the government in response to unfavourable domestic supply conditions. Domestic supply factors would be one of the major determinants of such imports. Another important factor is PL 480 foodgrain imports. In particular, one would expect that PL 480 imports have a substitutive effect upon commercial imports, especially since they enable a saving of scarce foreign exchange[13]. Withdrawals from existing stocks of foodgrains, too, can be viewed as a substitute for imports and are thus likely to be negatively related to such imports. We postulated the following equation for commercial imports of foodgrains:

$$\text{(6.9)} \quad ZFCOM = a_0 + a_1 YFN + a_2\overline{N} + a_3\overline{ZFPB} + a_4 DSF$$

where YFN = net production of foodgrains, taken to be 87.5% of gross production YF (millions of tons)[14].

$\overline{N}$ = population (millions)

DSF = addition to foodgrain stocks (millions of tons)

Thus, YFN and N reflect the impact of domestic supply and demand factors, respectively, while $\overline{ZFPB}$ and DSF incorporate the substitutability among PL 480 imports, stock changes and commercial imports[15]. Our estimated equation is reported below.

$$\text{(6.10)} \quad \underset{}{ZFCOM} = \underset{(-2.158)}{-3.5812} \; \underset{(-3.622)}{-.1768\, YFN} + \underset{(5.339)}{.0398\overline{N}} \; \underset{(-2.749)}{-.2596\, \overline{ZFPB}} + \underset{(6.639)}{.6580\, DSF}$$

$$R^2 = .8833, \quad \overline{R}^2 = .8522, \quad D.W. = 2.0899$$

The equation appears to perform well in all respects. All the coefficients have the right sign and are statistically significant. Imports are negatively related to domestic supply conditions (reflected by YFN) and positively related to demand (reflected by $\overline{N}$). The negative coefficient of

$\overline{ZFPB}$ implies that such imports directly substitute for commercial imports. The same is true of withdrawals from stocks. However, since the coefficient of $\overline{ZFPB}$ is significantly different from unity, PL 480 imports are not a one-for-one substitute for commercial imports. This has interesting implications. Thus, we write

$$\Delta ZF = \Delta ZFCOM + \Delta \overline{ZFPB}$$

Consider a unit decline in $\overline{ZFPB}$ ($\Delta\overline{ZFPB} = -1$) holding other variables constant. From (6.10), we get

$$\Delta ZFCOM = .2596$$

$$\Delta ZF = .2596 - 1 < 0$$

implying a decline in overall imports. Food aid would appear to have <u>some</u> foreign exchange saving effects, for in its absence, increased commercial imports are implied even though the latter increase by significantly less than any given reduction in PL 480 imports.

We adopt equation (6.10) for explaining commercial foodgrain imports.

<u>Other Merchandise Imports.</u>

Of these, fertilizer imports are treated as the other "priority" imports. These imports are primarily undertaken by the government, and for purposes of the present study, are assumed to be exogenously determined. They are assumed to be undertaken to the extent considered necessary.

Of the remaining imports, imports listed above as "other imports" are determined residually by the balance-of-payments identity. Thus, we require equations for explaining imports of raw materials and intermediate goods,and imports of capital goods. It may be noted that the latter, which constitute capital formation in imported capital goods, have already been determined (implicitly) as part of overall capital formation. Instead of developing an independent equation for this category of goods, we shall develop an equation that determines the import content of overall capital formation in the economy, from which imports of capital goods can then be determined, given that overall capital formation is determined elsewhere in the system. In the case of both capital goods imports and imports of raw materials and intermediate goods, the net supply foreign exchange is a major determinant. For, even though the principles of exchange allocation (under the system of import licensing) determine the level and pattern of imports, it is reasonable to assume that these allocations are positively related to the availability of foreign exchange in any period. We define the net available supply of foreign exchange in any period as

EXCHS = Total supply of foreign exchange - "priority" imports - other necessary payments.

EXCHS is consequently the amount of foreign exchange that is available for the import of producer goods and other goods. We shall define it precisely very shortly.

Raw Material and Intermediate Good Imports.

Given the nature of import trade in India, the import function as traditionally formulated in terms of relative price and activity (income) variables does not appear to be suitable for explaining import behaviour. However, one possible approach could involve postulating an *ex ante* function of this kind, which is then reduced to a realized import equation by introducing, in some way, the effects of exchange licensing.

Thus, consider the following import demand equation:

$$(6.11) \quad Z\hat{R}AW = c_0 + c_1 YM + c_2 RP$$

where

where $\hat{ZRAW}$ = planned imports of raw materials and intermediate goods.

YM = industrial output.

RP = an appropriate relative price variable.

We can argue that, given exchange licensing and the constraints imposed by the supply of foreign exchange, only some proportion k of planned imports is realized.

$$(6.12) \quad ZRAW = k \cdot \hat{ZRAW}, \text{where} \quad 0 < k < 1$$

k would, most likely, depend upon the principles of exchange allocation. Thus, we could postulate

$$(6.13) \quad k = k_0 + k_1 \left(\frac{ARIS/\overline{PZRAW}}{\hat{ZRAW}} \right)$$

where $\overline{PZRAW}$ = unit-value index of raw material and intermediate good imports.

ARIS = amount of foreign exchange allocated for the import of raw materials and intermediate goods.

Substituting (6.13) in (6.12), we get

$$(6.14) \quad ZRAW = k_0 \hat{ZRAW} + k_1 \left(\frac{ARIS}{\overline{PZRAW}} \right)$$

We make the reasonable assumption that ARIS is positively related to the net availability of foreign exchange EXCHS. In particular, we assume

$$(6.15) \quad ARIS = v\ EXCHS, \qquad 0 < v < 1$$

Thus, (5.14) becomes

$$(6.16) \quad ZRAW = k_0\ \hat{ZRAW} + k_1 v\left(\frac{EXCHS}{PZRAW}\right)$$

Substituting equation (6.11) in (6.16), we get

$$(6.17) \quad ZRAW = c_0k_0 + c_1k_0(YM) + c_2k_0(RP) + k_1v\left(\frac{EXCHS}{PZRAW}\right)$$

We defined RP as

$$RP = \frac{PM}{PZRAW}$$

where PM = index of prices of manufactured goods

PM is a proxy for the price of domestic substitutes. A more precise price variable could not be defined given the nature of disaggregation and commodity classification adopted in this study. Equation (6.17) can now be written as

$$(6.18) \quad ZRAW = b_0 + b_1YM + b_2\left(\frac{PM}{PZRAW}\right) + b_3\left(\frac{EXCHS}{PZRAW}\right)$$

where $b_0 = c_0k_0$, $b_1 = c_1k_0$, $b_2 = c_2k_0$, $b_3 = k_1v$

The estimated equation is

$$(6.19)\quad ZRAW = \underset{(-.638)}{-151.18} + \underset{(1.943)}{.0893}\ YM + \underset{(.393)}{59.4301}\left(\frac{PM}{PZRAW}\right) + \underset{(2.449)}{.3039}\left(\frac{EXCHS}{PZRAW}\right)$$

$R^2 = .7668$, $\bar{R}^2 = .7202$, D.W. = 2.2016, $\hat{\rho} = .6313$

The foreign exchange variable coefficient is statistically significant, while the income variable is also significant at the 5% level. On the other hand, the relative price variable has the "right" sign, but is not significant. In any case, caution is required in interpreting the sign of this coefficient. In particular, given the controlled nature of the import regime, the "right" sign of the coefficient of the relative price variable may have little to do with the usual interpretation given to it.

Equation (6.18) also implies that imports are determined by a combination of supply as well as demand factors since both the supply of foreign exchange and output enter as variables. If this scheme is adopted, the implication is that output (in the manufacturing sector) is not entirely supply-constrained - in particular, import capacity is not necessarily a constraint on output. However, if we wish to incorporate the notion of a foreign exchange constraint on output, we must assume that the line of causation runs primarily from raw material imports to output and not the other way around, even though one would suspect that this relationship is subject to other influences over time. In particular, while short-run movements in the availability of foreign exchange are likely to be the major determinants of imports, they alone cannot explain long-term trends in these imports. In fact, it can be expected that the licensing mechanism itself adjusts (even if imperfectly or partially) to various long-run factors. Thus, we adopted an import equation of the following kind:

$$(6.20) \qquad ZRAW = ZRAV + v\left(\frac{EXCHS}{PZRAW}\right)$$

where ZRAV is some long-run average level of imports of raw materials and intermediate goods. Realized imports thus reflect the effects of foreign exchange fluctuations,and of the factors influencing ZRAV which can be viewed as representing basic import requirements. The latter, in turn, depend upon the growth and structure of capacity, import substitution, etc.[16]. We assume

$$(6.21) \qquad ZRAV = a_0 + a_1 YNYML + a_2 \overline{TEE}$$

where YNYML = ratio of "non-traditional" manufacturing output to total manufacturing output (lagged one period).

$\overline{TEE}$ = time trend.

YNYML is used to capture the long-run effects of import substitution in intermediate goods supplying industries, while the time trend captures the effects of trends in the growth and structure of capacity[17].

Equation (6.20) can thus be written as

$$(6.22)\quad ZRAW = a_0 + a_1 YNYML + a_2\overline{TEE} + v\left(\frac{EXCHS}{\overline{PZRAW}}\right)$$

The estimated equation is

$$(6.23)\quad ZRAW = \underset{(3.367)}{1330.95} + \underset{(6.452)}{.3841}\left(\frac{EXCHS}{\overline{PZRAW}}\right) - \underset{(3.335)}{4486.19}\ YNYML + \underset{(4.557)}{44.0491}\ \overline{TEE}$$

$R^2 = .8915$, $\bar{R}^2 = .8698$, D.W. = 1.9378, $\hat{\rho} = .1957$

It is clear from the equation that the availability of foreign exchange has a highly significant positive impact upon imports of raw materials and intermediate goods. The negative (and significant) coefficient of YNYML is suggestive of import substitution. Actually, a positive coefficient is also plausible because many "non-traditional industries (e.g., chemicals) have been intensive in the use of imported inputs. Thus, the negative coefficient may well reflect the net outcome of two opposing tendencies resulting from an increase in the share of "non-traditional" manufacturing output. The significant positive trend, on the other hand, is suggestive of a secular upward movement in the raw material requirements of the economy, reflecting the expansion of industrial capacity.

We estimated equation (6.23) without YNYML since this variable itself exhibits much upward trend and its inclusion (in addition to the time trend variable $\overline{TEE}$) may be superfluous, and may in fact, lead to difficulties in interpreting the separate effects of these two variables. Our estimated equation is

$$(6.24)\quad ZRAW = \underset{(.045)}{4.4958} + \underset{(4.979)}{.3965}\ (EXCHS/\overline{PZRAW}) + \underset{(3.486)}{14.8223}\overline{TEE}$$

$$R^2 = .8302,\quad \overline{R}^2 = .8090,\quad D.W. = 2.2109,\quad \hat{\rho} = .4708$$

This equation performs reasonably well, though in terms of fit, it is poorer than equation (6.23). Both were tried in our simulation experiments. Equation (6.24) seemed to forecast marginally better than equation (6.23) largely because it is not subject to the forecast errors in the variable YNYML. Most of the simulation experiments reported in this study were conducted using equation (6.24).

Capital Goods Imports.

As indicated earlier, the approach adopted here is to explain the import content of overall capital formation[18]. It can be reasonably argued that while overall resource constraints (domestic and foreign) determine aggregate capital formation in the economy (a matter that was dealt with in Chapter 4), the import content of this capital formation is likely to depend mainly upon the constraint imposed by the foreign exchange content of overall available resources, amongst other things. In addition, import substitution in the economy would have a negative impact on the import content of capital formation, particularly in the Indian context where import substitution in capital goods has been the central feature of industrial growth. To incorporate the effects of import substitution in explaining the import content of capital formation, we once again, took the ratio of "non-traditional" manufacturing output to total industrial output since capital goods industries have been an important element in their growth, as we saw in Chapter 3. We introduced this variable with a one period lag. We also considered a variable reflecting the pattern of capital formation in the economy. In particular, given the nature of the development strategy adopted in the country, we would expect the import content of overall capital formation to be positively related to the share of the manufacturing and infrastructural sectors in total capital formation, since investment in these sectors is, by nature, much more import-intensive than investment in agriculture, etc. Thus, we would expect that structural shifts in the pattern of capital formation that favoured the manufacturing and infrastructure sectors would raise the import content of capital formation in the economy[19].

On the basis of the foregoing discussion, we can write

$$(6.25) \quad ZCIN = b_0 + b_1\left(\frac{EXCHS}{\overline{PZCAP}\cdot NFIT}\right) + b_2\left(\frac{NFIM + NFINF}{NFIT}\right) + b_3\, YNYML$$

where ZCIN = imports of capital goods as a proportion of fixed net investment.

$\overline{PZCAP}$ = unit-value index of capital goods imports.

NFIM = net fixed capital formation in the industrial sector.

NFINF = net fixed capital formation in the infrastructure sector.

NFIT = net fixed aggregate capital formation.

Our estimated equation is

$$(6.26)\quad ZCIN = \underset{(2.270)}{.282235} + \underset{(2.469)}{.1032}\left(\frac{EXCHS}{PZCAP\ NFIT}\right) + \underset{(3.374)}{.3225}\left(\frac{NFIM + NFINF}{NFIT}\right) \underset{(-4.126)}{-.9659}\ YNYML$$

$R^2 = .8840$, $\bar{R}^2 = .8608$, D.W. = 1.8909, $\hat{\rho} = -.2521$

The equation fits well, and the coefficients have the right sign and are statistically significant. As is to be expected, the foreign exchange variable has a significant positive effect upon the ratio of imported capital goods to capital formation. Further, the negative (highly significant) coefficient of YNYML appears to capture, quite dramatically, the effects of import substitution in the economy. The higher average import intensity of investment in the manufacturing and infrastructure sectors is also confirmed by this equation. We re-estimated the equation, by expressing the variables in terms of <u>gross</u> rather than <u>net</u> fixed capital formation. The results were very similar to those obtained on a net basis. Since most of the model is constructed on a net basis, we adopt the net version of the import-intensity equation reported above.

Invisible Trade and the Balance of Payments.

For the purposes of this study, invisible trade is divided into 2 main categories: (a) factor payments and receipts, and (b) other non-factor payments and receipts. Flows in the former category are made up primarily of payments arising out of debt service, the repatriation of profits on direct private foreign investments, etc., and of receipts on India's loans and investments abroad. In the Indian context net factor receipts have been negative and increasing over time, reflecting mainly the resort to external capital in financing the counrty's development plans. Flows in category (b) arise in respect of a number of things - freight, transportation and insurance charges arising from the act of trading, travel expenditures abroad (by Indians) and similar expenditures by foreign tourists. These flows also include private transfer payments and receipts. In respect of category (b), the country has had a modest surplus, but its importance in financing the current account deficit has declined markedly since the 1950's.

In our model, we assume that non-factor net receipts on current account (i.e., non-factor net invisible trade) are exogenous. However, we treat net factor payments endogenously. There are obvious difficulties in explaining aggregate net factor payments, since such payments are in respect of different types of loans, with different rates of interest, terms to maturity, etc. Thus, these payments are likely to depend upon the size as well as on the structure of the outstanding external debt. An approach that is often used involves postulating an equation of the following kind[20]:

$$\text{NFPS} = c_0 + c_1\text{DSL} \qquad (6.27)$$

where NFPS = net factor payments

DSL = size of nominal external debt outstanding (at the end of the previous period).

c_1 can thus be viewed as an average interest rate on debt outstanding. The difficulty with this equation is that c_1 is a constant, whereas in fact, it is likely to change over time due to changes in the structure of debt and the implied changes in the structure of interest rates. However, there is little we can do to overcome this problem. One approach is to allow for the effects of the evolving structure of debt by arguing that net factor payments are a function not only of debt outstanding at the end of the previous period, but of past trends in the size of this debt as well. Then, under a Koych transformation, we can write

$$(6.28) \quad NFPS = c_0(1-q) + c_1(1-q)\ DSL + q\ NFPSL$$

where q is the adjustment parameter. Note that the size of the debt outstanding at the end of the previous period can be written as

$$DSL = DS_0 + \sum_{\tau=1}^{t-1} \overline{FBS}_\tau$$

DS_0 = initial outstanding debt

$\overline{FBS}$ = net borrowing in each period

$\overline{FBS}$ can be approximated by the net inflow of foreign capital ($\overline{FKS}$) in each period, less net capital transfers. Thus,

$$(6.29) \quad \overline{FBS} = \overline{FKS} - \overline{KTRS}$$

where $\overline{KTRS}$ = net capital transfer receipts.

We can therefore rewrite (6.28) as

$$NFPS = c_0(1 - q) + c_1(1-q)[DS_0 + \sum_{\tau=1}^{t-1} (\overline{FKS} - \overline{KTRS})_\tau$$

$$+ qNFPSL$$

$$\therefore NFPS = \{c_0(1-q) + c_1(1-q)DS_0\} + c_1(1-q) \sum_{\tau=1}^{t-1} (\overline{FKS}-\overline{KTRS})_\tau$$

$$+ qNFPSL$$

(6.30) or $NFPS = d_0 + d_1 SFBSL + d_2 NFPSL$

where $d_0 = c_0(1 - q) + c_1(1 - q)\ DS_0$

$d_1 = c_1(1 - q)$

$d_2 = q$

and $SFBSL = \sum_{\tau=1}^{t-1} (\overline{FKS} - \overline{KTRS})_\tau$

We estimated equation (6.30) and obtained the following results:

(6.31) $NFPS = \underset{(1.301)}{26.2725} + \underset{(2.961)}{.0248}\ SFBSL + \underset{(1.835)}{.3394}\ NFPSL$

$R^2 = .9741$, $\bar{R}^2 = .9709$, D.W. = 1.7406, $\hat{\rho} = .5691$

We adopt this equation for explaining net factor payments abroad.

This concludes our discussion of the endogenous components of the balance of payments. However, we still need to state the balance of payments identity, and define precisely the net foreign exchange availability variable (EXCHS).

The balance of payments identity can be stated as

$$\text{(6.32)} \quad EXCHS = \overline{PZCAP} \cdot ZCAP + \overline{PZRAW} \cdot ZRAW + ZOS + \overline{ERS}$$

where

$$EXCHS = PEM \cdot EM + PEO \cdot EO + \overline{NEIS} + \overline{FKS} - \overline{PZCRP} \cdot ZCRP - \overline{PZFRT} \cdot \overline{ZFRT} - NFPS$$

where

- ZOS = "other" imports.
- $\overline{NEIS}$ = net exports of invisibles (other than factor payments) - assumed exogenous.
- $\overline{PZCRP}$ = unit-value index of imports of cereals and cereal preparations.
- $ZCRP$ = imports of cereals and cereal preparations.
- $\overline{PZFRT}$ = unit-value index of imports of fertilizers.
- $\overline{ZFRT}$ = fertilizer imports.
- $\overline{ERS}$ = an error variable measuring the discrepancy between the national accounts estimates of merchandise trade and those made on a detailed commodity basis[21].

The other variables have already been defined. This identity determines, as indicated earlier, the category of "other" imports[22]. It may be noted that foodgrain imports (discussed on pages 226-228) do not enter the identity. Instead, we have an import category called cereals and cereal preparations. The reason for this is that foodgrain imports, as determined by equation (6.10), and PL 480 imports are on a crop year basis (and in physical terms) while the balance of payments identity is on a fiscal year basis. Thus, in order to link foodgrain imports to the balance of payments identity we had to define the category called cereals and cereal preparations, data for which are on a fiscal year basis. In order to achieve this link we needed to specify a relationship between foodgrain imports (on a crop year basis and expressed in millions of tons) and imports of cereals and cereal preparations (which are expressed in 1960-61 rupees). We did this by postulating and estimating a linear relationship between imports of cereals and cereal preparations and commercial foodgrain imports and PL 480 foodgrain imports[23]. Since an overwhelming proportion of food imports have been cereal imports, one would expect this relationship (which is basically a statistical approximation) to fit quite well. Further, since the fiscal year leads the crop year by one quarter, we considered both commercial and PL 480 imports as weighted averages of current and lagged imports. Thus, we postulated the following relationship:

$$(6.33) \quad ZCRP = a_1(ZFCOMW) + a_2(\overline{ZFPBW})$$

where $\quad ZFCOMW = w_0(ZFCOM) + w_1(ZFCOML)$

$\quad \overline{ZFPBW} = w_0(\overline{ZFPB}) + w_1(\overline{ZFPBL})$

and $\quad w_0 + w_1 = 1$.

We estimated equation (6.33) by scanning over different weights. The equation with the best fit was chosen. This equation is

$$(6.34) \quad ZCRP = \underset{(12.335)}{38.2851}\ ZFCOMW + \underset{(18.344)}{37.5349}\ \overline{ZFPBW}$$

$$R^2 = .9069,\ \bar{R}^2 = .9014,\ D.W.\ 2.3858,\ \hat{\rho} = .0318$$

$$w_0 = .7, \quad w_1 = .3$$

This equation enables us to link PL 480 foodgrain imports and commercial foodgrain imports to the foreign exchange situation represented by the EXCHS variable

This concludes our discussion of the determinants of foreign trade. We turn now to the role of money and price formation in the economy.

(6.2) MONEY, PRICE FORMATION AND RELATED RELATIONSHIPS.

In this section, we develop the relationships pertaining to the money market and those governing the behaviour of prices. A detailed model of financial markets in India is beyond the scope of our study, though obviously efforts in this direction would be desirable. As issue that has been keenly debated in theoretical circles, is that of the links between the real and financial sectors of the economy. In Keynesian analysis, the major link between these markets is provided by the interest rate, liquidity preference providing the basis for this link. In a naive Keynesian world, in which supply elasticities are infinite, an increase in the supply of money (assumed to be exogenous) depresses the rate of interest, thus raising investment and hence real income, with no impact upon prices. If supply elasticities are less than infinite, some of this increase in the money supply is absorbed by rising prices. In a full employment neoclassical world, however, an increase in the money supply simply raises prices in the same proportion, with no impact upon real income, whether we take a simple quantity-theory approach in which money demand is independent of the rate of interest, or a Patinkin-type approach in which it is not.

In the Indian context, a quantity-theory type of framework appears to be relevant for a number of reasons. First of all, in spite of developments since 1950, financial markets are relatively under-developed, with a large unorganized financial market existing alongside an organized financial market. A large proportion of the population has neither access to nor knowledge of financial markets. Additionally, there is a lack of attractive financial assets which can act as effective alternatives to money holding. In fact, the main alternative to holding money, appears to be to use it for consumption. In a situation of this sort, the portfolio approach to money demand, where the individual chooses an optimal mix of money and other financial assets based on various rates of return, does not appear to be appropriate. There is a fairly extensive empirical literature on money demand in India, which suggests that money demand is, in general, insensitive to most short-term interest rates that appear to be relevant[24]. However, irrespective of the sensitivity of money demand to interest rates, a more general point is that the interest rate linkage between financial and commodity markets is likely to be weak. This is not only because the comprehensive controls on the volume and pattern of investment are most effective in those sectors (viz., the modern sectors) in which this link could be of importance, but also because of the underdeveloped nature of capital markets[25]. For these reasons, an interest rate mechanism based on liquidity preference is not built into our model. Instead, we take the view that the main impact of money supply changes is on prices since, by and large, the main alternative to holding money is to use it for consumption. However, this impact is not modelled using a quantity-theory type of equation which relates aggregate nominal expenditures to the money supply[26].

(6.35) $P \cdot NY = f(MS)$

where MS = money supply.

The approach taken here is to introduce the money supply variable in sectoral demand functions, which are used in conjunction with other relationships to determine some important sectoral prices in the model. In fact, sectoral prices, sectoral income deflators and the national income deflator are all determined simultaneously in the model. The introduction of the money supply variable in sectoral demand functions is akin to the Patinkin-type approach in which real balances enter commodity demand functions[27]. The nominal quantity of money is assumed to be exogenously determined. Having briefly outlined our approach to the role of money and to price formation in the economy, we turn now to the particular equations that are involved.

Our approach to prices is to explain certain major sectoral prices in terms of the standard forces of demand and supply, and then to explain all other prices in terms of these main prices, since the latter are highly correlated with the former. Ideally, a distinction ought to be made between wholesale and retail or consumer prices. However, the implied extension of the model is not necessary, because in practice these prices are highly correlated, and one can be determined in terms of another in simple fashion, or the same result can be achieved by first developing a set of equations which imply a relationship between wholesale and retail prices, and using it to eliminate the latter from all equations[28].

Foodgrain Prices

Foodgrain prices are explained in terms of the foodgrains sub-model, which has been partly developed above. In particular, we use the following demand-supply identity to explain foodgrain prices:

$$(6.36)\quad DF = YFN + ZFCOM + \overline{ZFPB} - DSF$$

where DF = demand for foodgrains (millions of tons).

YFN = net production of foodgrains (millions of tons).

ZFCOM = commercial foodgrain imports (millions of tons).

$\overline{ZFPB}$ = PL 480 foodgrain imports (millions of tons).

DSF = addition to foodgrain stocks (millions of tons).

We have already developed and estimated equations for YF and ZFCOM, while $\overline{ZFPB}$ is exogenous. All quantities in (6.36) are on a crop year basis. In order to complete this system, we need equations for DSF and DF.

For explaining DSF, we adopted a simple partial adjustment model, where

$$(6.37)\quad DSF = SF - SFL = m(\hat{SF} - SFL) \qquad 0 < m < 1$$

where SF, SFL stand for end-of-period and end-of-previous - period stocks of foodgrains respectively; $\hat{SF}$ is the desired end-of-period stock and m is the partial adjustment parameter. We assumed that $\hat{SF}$ is positively related to the net supply of foodgrains in any period.

$$(6.38)\quad \hat{SF} = a_0 + a_1(YFN + ZFCOM + \overline{ZFPB})$$

Using (6.38) in (6.37), we get

$$(6.39)\quad DSF = a_0m + a_1m(YFN + ZFCOM + \overline{ZFPB}) - DSFL$$

We can write

$$SFL = SF_0 + \sum_{\tau=1}^{t-1} DSF_\tau$$

where SF_0 = initial stock of foodgrains

$$\therefore DSF = a_0 m - mSF_0 + a_1 m(YFN + ZFCOM + \overline{ZFPB}) - m \sum_{\tau=1}^{t-1} DSF_\tau$$

$$(6.40) \qquad DSF = b_0 + b_1(YFN + ZFCOM + \overline{ZVPB}) + b_2 SDSFL$$

where $b_0 = m(a_0 - SF_0)$, $b_1 = a_1 m$, $b_2 = m$, and

$$SDSFL = \sum_{\tau=1}^{t-1} DSF_\tau$$

Our estimated equation is

$$(6.41) \qquad \underset{}{DSF} = \underset{(-3.970)}{-17.1743} + \underset{(4.432)}{.2357}(YFN + ZFCOM + \overline{ZFPB}) - \underset{(-2.011)}{.6296}\, SDSFL$$

$R^2 = .6230$, $\bar{R}^2 = .5758$, D.W. 1.7016, $\hat{P} = .7181$

The equation fits only moderately well, but this is expected of a change-in-stocks equation. All the coefficients have the correct sign, and are statistically significant. However, in dynamic simulation the forecasting ability of this equation was found to be quite poor. In fact, the equation, unadjusted for autocorrelation appeared to perform better in this respect, even though it was less satisfactory than (6.41) in terms of it. The unadjusted estimated equation is

$$\text{(6.42)} \quad DSF = \underset{(-4.085)}{13.9665} + \underset{(4.283)}{.2025}\,(YFN + ZFCOM + \overline{ZFPB}) \underset{(-2.859)}{-.8079}\,SDSFL$$

$$R^2 = .5228,\ \bar{R}^2 = .4667,\ D.W. = 1.0460.$$

All the coefficients have the right sign and are not statistically significant. However, the fit of the model is rather poor. Nevertheless, it performs somewhat better in historical simulation as compared to equation (6.41) primarily because the latter has lagged DSF on the right-hand side and is consequently subject to this additional source of forecast error. We use (6.42) in our simulation experiments inspite of its poorer fit. Most of the results of our experiments are not sensitive to the choice of equation to any significant degree.

In explaining (relative) foodgrain prices, we postulated a demand function for foodgrains and took its inverse, thus making the (relative) price of foodgrains dependent variable. This approach implies a sequential determination of prices. Thus, (6.36) determines DF, which along with other variables in the inverted demand equation, subsequently determines prices.

We postulated the following demand equation:

(6.43) $DFF = a_0 + a_1 NY + a_2 PFFR$

$$a_1 > 0 \qquad a_2 < 0$$

where DFF = demand for foodgrains in the fiscal year.

PFFR = $\frac{PFF}{P}$ where PFF = foodgrains prices in the fiscal year, and P is the general price level, which is taken as a proxy for the price of all other goods.

Our data for DF are on a crop year basis. Thus, in order to reduce equation (6.43) to a form in which all variables in it refer to the same time period, a modification is required. This can be achieved by assuming that demand in the fiscal year t (DFF_t) is a weighted average of demand in crop years t and t - 1. Thus,

(6.44) $DFF = w_0 DF + w_1 DFL$

where DF, DFL stand for crop year demands in the current year and the previous year respectively. Substituting in (6.43) we get

$$w_0 DF + w_1 DFL = a_0 + a_1 NY + a_2 PFFR$$

Inverting this equation, we get

$$PFFR = \frac{-a_0}{a_2} \quad \frac{-a_1}{a_2}(NY) + \frac{w_0}{a_2}(DF) + \frac{w_1}{a_2}(DFL)$$

(6.45) or $PFFR = b_0 + b_1 NY + b_2 DF + b_3 DFL$

where $b_0 = \frac{-a_0}{a_2}$, $b_1 = \frac{-a_1}{a_2}$, $b_2 = \frac{w_0}{a_2}$, $b_3 = \frac{w_1}{a_2}$

We estimated equation (6.45) and obtained the following result:

(6.46) $PFFR = 1.3388 + .00009NY - .0136DF - .0072DFL$
(3.954) (2.504) (-1.702) (-1.702)

$R^2 = .6492$, $\bar{R}^2 = .5790$, D.W. = 1.9197, $\hat{\rho} = .3074$

The equation fits only moderately well, but is reasonable given that the dependent variable is a relative price. However, all the coefficients have the right sign, and while the NY coefficient is highly significant, the coefficients of DF and DFL are close to significance at the 5% level. We attempted to introduce a liquidity variable into the equation, but the results were not reasonable. Consequently, we decided to adopt equation (6.46) for explaining the relative price of foodgrains. Since this equation explains the relative price of foodgrains (in the fiscal year) and we have an independent equation for determining the general price level P, the nominal price of foodgrains PFF (in the fiscal year) can be obtained from

(6.47) $PFF = (PFFR)(P)$

Further, since in our model of the foodgrains sector, foodgrains prices in the crop year (PF) play an important role, we postulate a simple linear relationship between crop year foodgrains prices and fiscal year foodgrains prices to determine the former.

(6.48) $PF = c_0 + c_1 PFF$

where, as before, PF = crop year foodgrain prices.

The estimated relationship is

(6.49) $PF = .0510 + .9925PFF$
$\quad\quad\quad (.888) \quad (35.318)$

$R^2 = 9876, \quad \bar{R}^2 = .9869, \quad D.W. = 1.8648$

As is to be expected, this equation fits very well and we use it to convert fiscal year foodgrain prices to crop year foodgrain prices. This concludes our discussion of the determinants of foodgrain prices in the model.

The Industrial Sector.

The main price explained here is the price of manufactured goods. We first set out the basic framework. Consider the following identity:

(6.50) $Q_i = X_i + D_i$

where Q_i = production of the i^{th} commodity.

X_i = that part of Q_i that is exported.

D_i = that part of Q_i that is domestically consumed.

(6.51) $(Q_i - X_i) = D_i$

Domestic demand D_i can be assumed to be a function of income and prices

(6.52) $(Q_i - X_i) = D_i(Y, P_i, \underline{P})$

where Y = income, P_i = price of the i^{th} commodity, and $\underline{P}$ is a vector of substitute prices. From (6.52), it follows that

(6.53) $P_i = H((Q_i - X_i), Y, \underline{P})$

Thus, equation (6.53) explains the price of the i^{th} commodity. In the scheme outlined, it is being implicitly assumed that good i is not imported, though the effects of other imported goods that may be substitutes for i are incorporated by including the appropriate import prices in $\underline{P}$.

While the above scheme is theoretically simple, it raises a number of difficulties at the empirical level. First of all, since we are dealing with aggregates instead of individual commodities, the quantities in (6.51) refer to constant rupee magnitudes, while prices must be indices. While this does not raise any difficulty *per se*, the problem arises due to the nature of the data, a problem that is,however, not unique to India. For one thing, there is a basic incompatibility between export data (disaggregated according to the SITC - Standard International Trade Classification) and price data, on the one hand, and output measures pbulished in the national accounts, on the other. Thus, while the former are on a commodity basis, the latter are on an industrial origin basis, where output typically refers to net or gross value added. This raises considerable difficulties in defining the variables in (6.51) consistently. Suppose X_i refers to the constant rupee value of textile manufactures; Q_i would then refer to value added in textile manufacturing industries (if taken from national accounts data). However, the variable $(Q_i - X_i)$ is not meaningful because since X_i is measured on a commodity basis it would also include the value added by agriculture. Since all our sectoral output measures are taken from the national accounts and refer to sectoral value added, while our export groups are on a commodity basis (as in the SITC), we cannot use (6.51) directly. Thus, we cannot use output of the industrial sector along with exports of manufacturing as defined in this study in (6.51) to explain prices of manufactured goods since the former measures value added in the industrial sector while the latter includes as well value added by agriculture. We adopted the following procedure to deal with this problem in explaining the price of manufactured goods.

(6.54) Let $QM_t = \sum_{i=1}^{n} P_{i,1960}q_{it}$

where QM_t = total value of output of manufactured goods (i = 1,2,...n) in 1960-61 prices.

The set of commodities 1 to n corresponds to the set included in our definition of manufacturing exports (i.e., it excludes food, food articles, beverages, tobacco, minerals, etc.).

We can then re-write (6.51) as

(6.55) (QM - EM) = DM

or

(6.56) $(\sum p_{i,1960}q_{it} - EM) = DM$

where EM = exports of manufactures in 1960-61 prices.

DM = demand for manufactured goods in 1960-61 prices.

We can rewrite (6.56) as

$$(6.57)\quad \sum p_{i,1960}\, q_{i,1960}\left(\frac{\sum p_{i,1960} q_{it}}{\sum p_{i,1960}\, q_{i,1960}}\right) - EM = DM$$

$$(6.58)\quad \text{or } v\left(\frac{\sum p_{i,1960} q_{it}}{\sum p_{i,1960} q_{i,1960}}\right) - EM = DM$$

where $v = \sum p_{i,1960} q_{i,1960} = \text{constant}$

Now, the bracketed expression is a base-weighted production index, which we call MFGI(1960-61 = 100)

$$(6.59)\quad v(MFGI) - EM = DM$$

Using data on indices of industrial production for various industry groups we were able to construct a series for MFGI. We postulated the following demand function DM:

$$(6.60)\quad DM = b_0 + b_1 NY + b_2 PMPR + b_3 LIQ$$

where PMPR = the price of manufactured goods relative to all other prices, for whom the general price index P was taken as a proxy.

LIQ = liquidity variable, for which we considered two alternative definitions.

Further, $b_1 > 0$, $b_2 < 0$, $b_3 > 0$

Substituting (6.60) in (6.59) we get

$$vMFGI - EM = b_0 + b_1NY + b_2PMPR + b_3LIQ$$

$$\therefore \quad PMPR = \frac{-b_0}{b_2} + \frac{v(MFGI)}{b_2} - \frac{b_1}{b_2}(NY) - \frac{1}{b_2}(EM) - \frac{b_3}{b_2}(LIQ)$$

(6.61) or $PMPR = c_0 + c_1MFGI + c_2NY + c_3EM + c_4LIQ$

where $c_1 < 0$, $c_2 > 0$, $c_3 > 0$, $c_4 > 0$

We considered 2 measures of the liquidity variable: (a) the volume of real balances defined as (MS + MSL)/2P where MS is the money stock at the end of the period, and MSL is the beginning-of-period money stock and (b) the ratio of average real balances to national income defined as [(MS + MSL)/2·P·NY]. We estimated equation (6.61) using both definitions of the liquidity variable. Our main results are reported below in Table 6.2

Row (1) gives the estimated coefficients for equation (6.61) when the second definition of LIQ is used, while row (3) gives the estimated coefficients for the first definition of LIQ. The coefficient of the exports variable is insignificant in both and is highly so in row (1). In fact, other experimentation

TABLE 6.2: THE EQUATIONS FOR PMPR

	Intercept	MFGI	NY	EM	$(\frac{MS+MSL}{2.P})$	$(\frac{MS+MSL}{2.P.NY})$	R^2	$\bar{R}^2$	D.W.
1	.31605	-.00479	.00004	.00028	--	2.3937	.7801	.7173	1.965
	(.818)	(-2.579)	(1.965)	(.895)		(1.627)			(.6744)
2	.17015	-.00425	.00005	--	--	2.7974	.7682	.7218	1.6800
	(.488)	(-2.519)	(2.371)			(2.019)			(.6340)
3	.83452	-.00479	.00001	.00035	.00012	--	.7736	.7089	1.5715
	(5.434)	(-2.561)	(.582)	(1.127)	(1.473)				(.6671)
4	.76307	-.00413	.00002	--	(.00014	--	.7540	.7048	1.6855
	(5.669)	(-2.405)	(.697)		(1.732)				(.6194)
5	.82311	-.00357	.00004	--	--	--	.7055	.6687	1.5236
	(5.620	(-1.939)	(1.722)						(.6649)
6	.80306	-.00325	---	--	.00017	--	.7460	.7143	1.5612
	(6.65)	(-2.786)			(2.501)				(.6238)

Notes: The numbers in parentheses in the column for the D.W. statistic, are the estimates of the first order autocorrelation coefficient P used in the Cochrane-Orcutt technique for correcting for autocorrelation.

with equation (6.61), the results for which are not reported here, gave similar results with regard to this coefficient. This finding, however, is plausible given that manufacturing exports as a whole constitute only a small proportion of manufacturing production. Consequently, we dropped this variable altogether.

The MFGI index, which reflects domestic supply conditions, on the other hand, is seen to have the right sign and to be significant in all of the equations reported in the table. This finding persists in other equations that were estimated but are not reproduced here. The behaviour of the estimates of the NY and LIQ coefficients, on the other hand, is sensitive to the definition of the latter adopted. Let us consider first the second definition of LIQ (rows (1) and (2)). In row (1), we see that the NY coefficient, which reflects the impact of demand, is just significant at the 5% level, while the LIQ coefficient comes close to attaining significance. However, if we drop the highly insignificant exports variable EM, both the NY and LIQ coefficients become statistically significant (row (2)). It is evident that,in a real sense, the fit of the latter equation is better as $\bar{R}^2$ rises with the exclusion of the EM variable. Further, in an absolute sense too, the fit is quite reasonable, given that the dependent variable is a price ratio.

Consider next, the equations with the first definition of LIQ(row (3), (4),and (6)). These results indicate that when NY and LIQ are both present in the equation, their respective estimated coefficients are both statistically insignificant. This is particularly true for the NY coefficient, whether we exclude EM or not (rows (3) and (4)). On the other hand, the exclusion of EM brings the LIQ coefficient to the borderline of significance at the 5% level. Further, we note that if the NY variable is considered alone (row (5)), its coefficient remains insignificant (though not by much). On the other hand, when LIQ is considered alone (row (6)) its coefficient is highly significant. It is further evident by comparing the fits of the equations in rows (4) through (6) that the equation without NY (row (6)) performs the best, while the equation without LIQ (row (5)) performs the worst.

We see therefore, that the behaviour of the coefficients of NY and LIQ is sensitive to the definition of LIQ adopted. The generally poor results when both NY and LIQ are included in the equation, where LIQ is defined as the real stock of money balances, are explained by the fact that on this definition of LIQ, NY and LIQ are highly correlated, so that their estimates are imprecise and have inflated standard errors. By including only one of these variables, we see that NY does not do well, but LIQ is found to have a highly significant coefficient and to lead to a better fit.

The collinearity problem, on the other hand, is not serious when LIQ is defined as the ratio of real balances to national income. The deflation of real balances by NY gets rid of the strong collinearity between NY and real balances. This is partly reflected by the reasonable nature of the results for both NY and LIQ in row (2). We adopt the equation represented by row (2) for explaining the relative price of manufactured goods. The absolute price of manufactured goods is obtained from

$$(6.62) \qquad PM = (PMPR)(P)$$

The chosen equation can also be estimated in terms of absolute prices (i.e., in terms of PM rather than PMPR). We can write the equation in terms of PM by multiplying across by P. This yields

$$(6.63) \qquad PM = c_0(P) + c_1(MFGI)(P) + c_2(NY \cdot P) + c_3(LIQ \cdot P)$$

Our estimated equation is

$$(6.64) \qquad PM = \underset{(1.102)}{.3451P} \; \underset{(-2.917)}{-.0051(MFGI)(P)} + \underset{(1.187)}{1.6188(LIQ)(P)} + \underset{(2.840)}{.000059(NY)(P)}$$

$R^2 = .9801$, $\bar{R}^2 = .9761$, D.W. = 1.9651, $\hat{\rho} = .31923$

As is to be expected, the fit of the equation shows significant improvement. All the coefficients have the right sign though the coefficients of LIQ and P are not statistically significant (but they are larger than their standard errors).

Further, since PM can be expected to be closely related to the deflator for industrial income PMD, we can adopt the following linear relationship between PMD and PM, for explaining PMD. The estimated equation is

$$(6.65) \quad PMD = \underset{(-2.018)}{-.07803} + \underset{(43.921)}{1.11109}\ (PM)$$

$R^2 = .9959$, $\bar{R}^2 = .9957$, D.W. = 1.7887, $\hat{\rho} = .3775$

As expected, this equation fits very well, and we use it to explain the deflator for industrial income. We turn now to the explanation of agricultural prices in the model.

The Agricultural Sector.

The framework adopted for explaining the wholesale price of agricultural goods is similar to the one adopted in the foregoing discussion. Again, we tie the derivation of our estimating equation to an identity similar to (6.41). Thus we postulate

(6.66) (QO - EO) = DO

where EO = primary exports in 1960-61 prices.

QO = output of commodities entering EO in 1960-61 prices.

DO = demand for primary commodities in 1960-61 prices.

QO includes the output of not only agricultural goods proper but also the group of manufactured goods <u>not</u> included in the manufactured goods production index MFGI defined in the foregoing discussion[30]. Consequently we can write

(6.67) QO = QA + QM*

where QA = output of agricultural goods in 1960-61 prices

QM* = output of manufactured goods not entering EM, in 1960-61 prices

Once again, we can convert QA and QM* into base-weighted production indices, following the procedure outlined earlier. This enables us to write

(6.68) QO = v_1AGRI + v_2MFPI

where AGRI = an index of agricultural production (1960-61 = 100).

MFPI = an index of production of manufactured goods not included in MFGI (1960-61 = 100).

v_1 = total value of agricultural output in 1960-61 prices.

v_2 = total value of manufacturing output (of goods not entering MFGI) in 1960-61 prices.

We postulate the following demand function for DO:

(6.69) $DO = c_0 + c_1\ NY + c_2\ PAFPR + c_3\ LIQ$

PAFPR = PAF/P, where PAF is the wholesale price of agricultural goods in the fiscal year, and where P has been taken to represent the price of all other commodities.

It may be noted that while in the case of the price of manufactured goods, PM, we were able to define it quite precisely, in that it represented quite accurately the set of goods entering EM and QM, as defined above the definition of PAF is not as precise. Thus, for example, it does not include the prices of textile manufactures. However, it does include the prices of the raw material content of these goods, and can thus be expected to be highly correlated with textile prices. In general, PAF can be taken as a reasonable proxy for the entire set of prices of goods entering AGRI as well as MFPI.

Substituting (6.68) and (6.69) in (6.66) we get

$$v_1AGRI + v_2MFPI - EO = c_0 + c_1NY + c_2PAFPR + c_3LIQ$$

$$PAFPR = -c_0/c_2 + v_1/c_2(AGRI) + v_2/c_2(MFPI) - 1/c_2(EO)$$
$$-c_1/c_2(NY) - c_3/c_2(LIQ)$$

or

$$(6.70) \quad PAFPR = d_0 + d_1AGRI + d_2MFPI + d_3EO + d_4NY + d_5LIQ$$

where $d_0 = c_0/c_2$, $d_1 = v_1/c_2$, $d_2 = v_2/c_2$, $d_3 = -1/c_2$,

$d_4 = c_1/c_2$, $d_5 = -c_3/c_2$

Further, d_1, $d_2 < 0$, and d_3, d_4, $d_5 > 0$.

In estimating this equation we found that in contrast to our experiences with the equation for the relative price of manufactured goods, the LIQ variable did not perform well, irrespective of how it was defined. In particular, it was found to be consistently negative, and its inclusion with NY and other variables gave rise to collinearity problems. Since the basic forces of demand and supply which are argued to be the major determinants of price are presumably well represented by the other variables in the equation, we decided to drop the LIQ variable.

Our results for equation (6.70) without the LIQ variable, seemed to indicate that exports and the production index MFPI are not statistically significant variables. On the other hand, the variables AGRI and NY are found to be statistically significant and capture reasonably well the effects of supply and demand factors, respectively. Our findings are reported in Table 6.3 below.

TABLE 6.3: THE EQUATIONS FOR PAFPR.

	Intercept	AGRI	MFPI	EO	NY	R^2	$\bar{R}^2$	D.W.*
1	.94518 (8.679)	-.00981 (-2.748)	-.00400 (-1.072)	-.00048 (-1.366)	.00012 (2.19)	.8264	.7768	1.8491 (.1932)
2	.98532 (9.561)	-.00760 (-2.599)	-- --	-.00029 (-.945)	.00006 (4.003)	.8122	.7746	1.8772 (.1980)
3	.95846 (8.571	-.00891 (-2.456)	-.00147 (-.445)	--	.00008 (1.694)	.8035	.7642	1.8791 (.2287)
4	.97322 (9.538	-.00794 (-2.736)		--	.00006 (3.923)	.8010	.7761	1.8948 (.2074)

* The numbers in parentheses in the column for the D.W. statistic, are the estimates of the first-order autocorrelation coefficient ρ used in the Cochrane-Orcutt method for correcting for autocorrelation.

We note from the table that both exports EO and the production index MFPI are insignificant (row (1)), and are found to remain insignificant when either of them is considered separately (rows (2) and (3)). In fact, the coefficient of EO has the wrong sign in both the equations in which it enters. On the other hand, both AGRI and NY are found to have the right signs and are statistically significant throughout (with the one exception of the coefficient of NY in row (3)). We adopt the equation reported in row (4) in which both EO and MFPI are absent. It can be seen that no worsening of fit results from this exclusion. The fit of the equation in row (1) is rather good to begin with and does not change with the exclusion of EO and MFPI. If this equation is estimated after expressing it in terms of absolute rather than relative prices (i.e., after multiplying across by P), both R^2 and $\bar{R}^2$ show a marked improvement as expected. This is evident from the following equation which was estimated after this change was made[31]:

$$(6.71)\quad PAF = \underset{(12.378)}{.98717P} - \underset{(-3.498)}{.00805(AGRI)(P)} + \underset{(5.098)}{.00006(NY)(P)}$$

$$R^2 = .9954,\ \bar{R}^2 = .9948,\ D.W. = 2.1138,\ \hat{\rho} = =.2419$$

This equation can also be used directly to explain agricultural prices in the fiscal year (PAF). On the other hand, if the equation reported in row (4) of Table 6.3 is used, the following identity is required to determine PAF.

(6.72) $PAF = (PAFPR)\cdot(P)$

In turn, agricultural prices in the fiscal year (PAF) can be used to explain two other price variables with which it is likely to bear a close relationship, viz., agricultural prices in the crop year (PA) and the deflator for agricultural income (PAD). Thus, for these latter prices, we estimated simple linear functions relating each to PAF. Our results are

$$(6.73)\quad \underset{}{PA} = \underset{(.4393)}{.01701} + \underset{(46.987)}{1.0089PAF}$$

$$R^2 = .9919, \quad \bar{R}^2 = .9915, \quad D.W. = 2.0857$$

$$(6.74)\quad PAD = \underset{(1.602)}{.1613} + \underset{(18.353)}{.9504\ PAF}$$

$$R^2 = .9788, \quad \bar{R}^2 = .9776, \quad D.W. = 1.4325, \quad \hat{\rho} = .3737$$

Having determined foodgrain prices in the crop year (PF) earlier on, we use the following definition to obtain the crop year price of non-foodgrain agricultural goods (PNF):

$$PA = w_0PF + w_1PNF \text{ where } w_0 + w_1 = 1$$

(6.75) $\therefore$ $PNF = (1/w_1)(PA - w_0 PF)$

This concludes our discussion of agricultural and related prices.

The Non-Agricultural, Non-Manufacturing Sectors.

These sectors of the economy are, as a whole, non-material product producing sectors, viz., infrastructure and other services. We do not treat these two sectors separately for explaining their respective deflators. Instead, we lump them into one and explain the deflator of the sum of their respective incomes. Thus, we denote the sum of value added (net output) in these sectors by YIV.

(6.76) $YIV = YINF + YSV$

and denote the deflator implicit in YIV by PSD.

We assume for simplicity that YIV is proportional to the total output of these sectors taken together (QIV). Thus

(6.77) $YIV = bQIV$

We postulate, further, the following demand function for the output of these sectors

(6.78) $DIV = a_0 + a_1 NY + a_2 PSDP, \qquad a_1 > 0, \quad a_2 < 0$

where DIV = demand for services.

PSDP = PSD/P = relative price of services

Imposing the condition DIV = QIV, we get

(6.79) $1/b(YIV) = a_0 + a_2NY + a_2PSDP$

$\therefore PSDP = -(a_0/a_2) + 1/a_2b)(YIV) - (a_1/a_2)(NY)$

or

(6.80) $PSDP = c_0 + c_1YIV + c_2NY$

Alternatively, in terms of absolute prices, we can write

(6.81) $PSD = c_0(P) + c_1(YIV \cdot P) + c_2(NY \cdot P)$

where $c_0 = (-a_0/a_2)$, $c_1 = (1/a_2b)$, $c_2 = (-a_1/a_2)$

Further, $c_1 < 0$, $c_2 > 0$

The estimated counterpart of equation (6.80) is

(6.82) $$PSDP = \underset{(5.337)}{.759016} - \underset{(-3.337)}{.000221}(YIV) + \underset{(2.787)}{.000085}(NY)$$

$R^2 = .7902$, $\bar{R}^2 = .7655$, D.W. = 1.2176

While the equation fits well and the coefficients have the right signs and are statistically significant, it appears to suffer from autocorrelation. When, however, we made a correction for it, all the coefficients became insignificant. We therefore estimated the absolute price equation (6.81), and our results were

$$(6.83) \quad PSD = .6869P - .00020(YIV \cdot P) + .000081(NY \cdot P)$$
$$\qquad\qquad (4.860) \quad (-2.829) \qquad\qquad (2.622)$$

$$R^2 = .9873, \quad \bar{R}^2 = .9857, \text{ D.W.} = 1.7980, \ \hat{\rho} = .3342$$

The equation fits well, and all the coefficients have the right sign and are statistically significant. Further, autocorrelation appears to be slight. We adopt equation (6.83) for explaining PSD.

This concludes our discussion of the determinants of various sectoral prices. The remaining prices in the model are such that they can conveniently be explained in terms of these prices and/or others that are exogenous to the model.

Export Prices.

In the foregoing discussion we attempted to integrate the export sector with the rest of the economy in the determination of major prices. However, our findings suggest that export volumes do not play a significant role in determining the major domestic prices. Another potential link between the export sector and other sectors of the economy is provided by export prices. The export price (or more appropriately the unit-value index) of each category of exports considered in this model, is assumed to depend upon the appropriate "world" export price index and the relevant domestic prices. World export prices reflect demand and supply conditions in the world market, which can be argued to be a major determinant of Indian export prices. Domestic prices on the other hand, reflect the conditions of internal supply and demand and are likely to exert some influence on export prices. Consequently, we postulated the following equations for explaining the export price (unit-value index) of manufacturing and primary exports:

(6.84) $PEM = a_0 + a_1(\overline{PWM} \cdot \overline{EI}) + a_2PM$

(6.85) $PEO = b_0 + b_1(\overline{PELDC} \cdot \overline{EI}) + b_2PAF$

where PM = index of prices of manufactured goods

PAF = index of prices of agricultural goods (in the fiscal year)

and where the world export price of manufactures $\overline{PWM}$ and the price of exports of less developed countries $\overline{PELDC}$ are taken as the relevant "world" prices.

Since "non-traditional" manufacturing exports are a part of manufacturing exports, the export unit-value of the former is explained simply in terms of the export unit-value of the latter.

(6.86) $PENTM = c_0 + c_1\ PEM$

Our estimated equations are

(6.87) $$PEM = .4364 + .5811\ (\overline{PWM} \cdot \overline{EI}) + .0703\ PM$$
$$(2.138) \quad (5.769) \qquad\qquad (.341)$$

$$R^2 = .9837,\ \bar{R}^2 = .9817,\ D.W. = 1.6014,\ \hat{\rho} = .7607$$

(6.88) $$PEO = .2593 + .7049(\overline{PELDC} \cdot \overline{EI}) - .01919\ PAF$$
$$(6.187) \quad (9.879) \qquad\qquad (-.232)$$

$$R^2 = .9878,\ \bar{R}^2 = .9864,\ D.W. = 1.7530$$

(6.89) $$PENTM = .0041 + .9590\ PEM$$
$$(.037) \quad (14.968)$$

$$R^2 = .9652,\ \bar{R}^2 = .9632,\ D.W. = 1.8834,\ \hat{\rho} = .3905$$

While all equations fit well, domestic prices are found to have a highly insignificant impact on the export unit-values of both manufacturing and primary exports. In the case of the latter, it is negative. On the other hand, the respective "world" price variables appear to be the major determinants of these export unit-values. We also considered other versions of equations (6.84) and (6.85). Thus, in place of PM and PAF we considered the deflators for industrial income (PMD) and agricultural income (PAD), while in equation (6.85) we also included the index of manufactured goods prices

PM (and alternatively, the industrial income deflator PMD) since primary exports include items of manufacture as well[32]. In all cases, however, only the "world" price variables were found to have a significant influence on export prices. The coefficients of the domestic price variables were found to have the wrong signs and/or to be statistically insignificant. In view of this and the assumption that "world" prices are exogenous, we decided to drop each of equations (6.84) , (6.85) and (6.86) and to treat each of the export prices as exogenous.

Other Prices.

The only other price variables that are endogenous in the model are the national income deflator P, the deflator for fixed capital formation PINV and the inventory investment deflator PVD. The national income deflator P is determined by its components, which in the present context are the sectoral income deflators PAD, PMD and PSD[33]. Consequently, for explaining P, we estimate

$$(6.90) \quad P = a_0 PAD + a_1 PMD + a_2 PSD$$

The estimated equation is

$$(6.91) \quad P = \underset{(17.861)}{.4164\ PAD} + \underset{(1.981)}{.1629\ PMD} + \underset{(5.194)}{.4215\ PSD}$$

$$R^2 = .9979,\ \bar{R}^2 = .9976,\ D.W. = 2.4084,\ \hat{\rho} = -.4649$$

Equation (6.91) is actually a part of a simultaneous set of price equations which imply mutual interaction between P and sectoral prices. In other words, sectoral prices affect the general price level P, which in turn has feedback effects on sectoral prices. These feedback effects have been ignored in other Indian models.

The fixed capital formation deflator PINV is explained in terms of the unit-value index of capital goods imports and the general price level P, while the inventory investment deflator PVD is explained simply in terms of the deflators for agricultural and industrial incomes. Our estimated equations for PINV and PVD are respectively,

$$(6.92)\quad \underset{}{PINV} = \underset{(-.187)}{-.0229} + \underset{(5.460)}{.3464}\ \overline{PZCAP} + \underset{(6.144)}{.6120}P$$

$$R^2 = .9836,\ \bar{R}^2 = .9816,\ D.W. = 1.8873,\ \hat{\rho} = .5664$$

$$(6.93)\quad PVD = \underset{(-3.490)}{-.1762} + \underset{(4.394)}{.3325}\ PAD + \underset{(7.656)}{.81109}\ PMD$$

$$R^2 = .9892,\ \bar{R}^2 = .9879,\ D.W. = 2.2938$$

Both equations fit well and the estimated coefficients have the correct sign and are statistically significant. We adopt equations (6.92) and (6.93) for explaining the fixed and inventory investment deflators respectively.

(6.3) MISCELLANEOUS RELATIONSHIPS.

In this section we discuss the final set of relationships that comprises our model. We consider these in turn.

Inventory Investment.

An explanation of inventory change is required in the present model, since this variable closes the overall savings-investmtne identity discussed in Chapter 5. In particular, it determines the volume of private fixed investment in the economy. Since we are dealing with inventory investment at the aggregate level, no distinction is made between the various types of goods that go into and out of inventory holdings (e.g., raw materials, finished goods, etc.). While such a distinction is clearly important we simply do not have the requisite data.

The real inventory investment equation is based on a standard stock-adjustment model.

(6.94) $INV = a[S\hat{V} - SVL] \qquad 0 < a < 1$

where INV = real inventory investment.

$\hat{SV}$ = desired (end-of-current-period) stock.

SVL = actual (end-of-previous-period) stock.

$\hat{SV}$ is assumed to depend upon expected sales which can be represented by a geometric weighted average of actual current and past material output - i.e., by $\sum_{i=0}^{\infty} q^i(1-q)(YA + YM)_{t-i}$ where $0 < q < 1$. In the Indian context, speculation in commodity stocks is a very common phenomenon, so one might expect $\hat{SV}$ to depend additionally upon price expectations. In particular, if prices are expected to rise, this would induce stock accumulation in order to realize capital gains. In fact, such expectations are likely to induce higher desired stocks, because in a context where shortages are common, such expectations would also signal oncoming shortages which stockholders (of finished goods and raw materials) would attempt to guard against.

Thus, we can postulate

(6.95) $$\hat{SV} = b_0 + b_1 \sum_{t=0} q^i(1-q)(YA + YM)_{t-i} + b_2P^e$$

where P^e = expected prices

For simplicity we assume

(6.96) $$P^e = w_0P + w_1PL \quad \text{where } w_0 + w_1 = 1$$

$$(6.97)\quad SV = b_0 + b_1\sum q^i(1-q)(YA + YM)_{t-i} + b_2w_0P + b_2w_1PL$$

Substituting (6.97) in (6.94), we get

$$(6.98)\quad INV = b_0a + b_1a\frac{(1-q)}{(1-qD)}(YA + YM) + ab_2w_0P - ab_2w_1PL - aSVL$$

where D = lag operator.

Note that $SVL = SV_0 + \sum_{\tau=1}^{t-1} INV_\tau = SV_0 + SINVL$,

where SV_0 = initial stock of inventories, and

$$SINVL = \sum_{\tau=1}^{t-1} INV_\tau$$

$$INV = a(b_0-SV_0) + b_1a\frac{(1-q)}{(1-qD)}(YA + YM) + ab_2w_0P + ab_2w_1PL - a\ SINVL$$

or

$$INV = do + \frac{d_1(1-q)}{(1-qD)}(YA + YM) + d_2P + d_3PL - d_4SINVL$$

where $d_0 = a(b_0-SV_0)$, $d_1 = b_1a>0$, $d_2 = ab_2w_0> 0$

$d_3 = ab_2w_1 > 0$, $d_4 = a > 0$

$$(6.99)\quad INV = d_0(1-q)+d_1(1-q)(YA+YM)+d_2P+(d_3-d_2q)PL -d_3qPL2-d_4SINVL + d_4qSINVL2+qINVL$$

We estimated this equation by nonlinear methods. Our results were as set forth below.

$\hat{d}_0$	$\hat{d}_1$	$\hat{d}_2$	$\hat{d}_3$	$\hat{d}_4$	$\hat{d}_5$
-4065.79	.3699	927.143	707.391	.6493	.5157
(-.958)	(.793)	(2.767)	(.702)	(1.194)	(1.147)

$R^2 = .7726$, $\bar{R}^2 = .6914$, D.W. = 1.5230

While all the coefficients have the theoretically correct signs, only the price variable is statistically significant. In fact, the expectations hypothesis does not appear to be relevant as $\hat{q}$ is statistically insignificant. In fact, the partial adjustment parameter $\hat{a}$ itself, is not significant. Consequently, we dropped the expectations hypothesis, while retaining equation (6.95). Thus, we considered

$$(6.100)\quad \hat{SV} = b_0 + b_1(YA + YM) + b_2w_0P + b_2w_1PL$$

which leads to

$$(6.101)\quad INV = a(b_0 - SV_0) + b_1a(YA + YM) + b_2aw_0P + b_2aw_1PL - a\ SINVL$$

or

$$INV = d_0 + d_1(YA + YM) + d_2P + d_3PL + d_4SINVL$$

where $d_0 = a_1(b_0 - SV_0)$, $d_1 = b_1a$, $d_2 = b_2aw_0$, $d_3 = b_2aw_1$, $d_4 = -a$

Our estimated equation is

$$(6.102)\quad INV = \underset{(-2.528)}{-2652.78} + \underset{(2.019)}{.2114}(YA + YM) + \underset{(3.883)}{1164.66}P + \underset{(.713)}{298.86}PL \underset{(-2.694)}{-.5013}\ SINVL$$

$R^2 = .7766$, $\bar{R}^2 = .7138$, D.W. = 1.6400, $\hat{\rho} = .4649$

The equation fits reasonably well, and all the coefficients have the expected signs, and are significant (except for the coefficient of PL). The coefficient of current price P is highly significant, suggesting that price considerations are an important factor governing stock formation. Presumably, the positive effect of P reflects, as argued above, not only speculative effects but also uncertainties on the supply side. We adopt this equation for explaining real inventory investment.

Some Final Equations.

The remaining equations of the model which are required are those pertaining to the following outputs:

(1) the supply of industrial power - INPOW.

(2) net output of "non-traditional' manufacturing industries - YNTM.

(3) the index of manufacturing production - MFGI.

(4) the index of agricultural production - AGRI.

The supply of industrial power INPOW is simply related to infrastructural capital stock (KINFL). If we make the reasonable assumption that the factors determining net output or production of a subset of industries in the industrial sector (viz., YNTM and

MFGI) are the same as those determining the output of the industrial sector as a whole (YM), these outputs can be explained in terms of YM. Similarly, the index of agricultural production can be explained in terms of the output of the agricultural sector (YA)[34]. Our estimated equations for each of these outputs/indices, are

(6.103) $INPOW = -2338.0 + .6712\ KINFL$
$(-6.733) \quad (18.404)$

$R^2 = .9942,\ \bar{R}^2 = .9939,\ D.W. = 1.1556,\ \hat{\rho} = .6966$

(6.104) $YNTM = -463.073 + .4997\ YM$
$(-14.717) \quad (59.422)$

$R^2 = .9963,\ \bar{R}^2 = .9961,\ D.W. = 1.7408,\ \hat{\rho} = .1192$

(6.105) $MFGI = -18.549 + .0461\ YM$
$(-5.341) \quad (49.647$

$R^2 = .9946,\ \bar{R}^2 = .9943,\ D.W. = 1.8135,\ \hat{\rho} = .1118$

(6.106) $AGRI = -23.159 + .0182\ YA$
$(2.870) \quad (16.593)$

$R^2 = .9386,\ \bar{R}^2 = .9352,\ D.W. = 2.1940$

This concludes the detailed description of the model[35]. The entire estimated model, along with definitions of variables is presented in the appendix to this chapter.

APPENDIX TO CHAPTER 6.

THE COMPLETE MODEL:

The complete model along with the definitions of the variables, is presented in this appendix. But for the minor modification indicated in Chapter 7, our simulation experiments have been based on the version presented here. In presenting the equations here, we have altered slightly the manner in which ratio, interaction and other composite variables were presented in the foregoing chapters. This has been to avoid specifying an unnecessary large number of definitions, which would otherwise be required in order to explain these variables.

1. $$\ell n YLD = \underset{(5.442)}{1.539} + \underset{(8.064)}{.5530}\, \ell n(KAL/A) + \underset{(3.220)}{.1527}\, \ell n\overline{WI}$$

$R^2 = .82$, D.W. = 1.84

2.* $$YMKR = -.095 + .8478(ZRAW/KML) - .7441(ZRAW_{L}/KML2)$$
$$+ .9481(INPOW/KML) - .832(INPOWL/KML2)$$
$$+ 1.1497(YNTML/YML) - 1.0089(YNTML2/YML2)$$
$$+ .0491(ZCAPL/NFIML) + .8776YMKRL,$$

$R^2 = .97$, D.W. = 1.77

3. $$YINF = \underset{(-.092)}{-6.087} + \underset{(16.970)}{.1197}KINFL, \quad R^2 = .99, \ D.W. = 1.06$$

4. $$YSV = \underset{(1.019)}{705.104} + \underset{(7.809)}{.2725}\, KSVL, \quad R^2 = .99, \ D.W. = 1.63$$

5. $AGRI = -23.1586 + .0182\ YA$, $R^2 = .94$, D.W. = 2.19
$\quad(-2.870) \quad (16.593)$

6. $YNTM = -463.073 + .4997YM$, $R^2 = .99$, D.W. = 1.74.
$\quad(-14.717) \quad (59.422)$

7. $MFGI = -18.549 + .0461\ YM$, $R^2 = .99$, D.W. = 1.81
$\quad(-5.341) \quad (49.647)$

8. $INPOW = -2338.0 + .6712KINFL$, $R^2 = .99$, D.W. = 1.16
$\quad(-6.733) \quad (18.404)$

9*. $SP = -1045.45\ DIST + 463.44\ DISTL + .2348\ NDY$
$\quad -.1492\ NDYL + .4433\ SPL$, $R^2 = .95$, D.W. = 1.94

10. $CG1 = .7538\ GRN + .0145\ \{(\overline{KTRS}.GRN)/\overline{FKS}\}$
$\quad(18.478) \quad (2.397)$
$\quad +.3572\ \{(\overline{XRS} - \overline{KTRS})/P\}$, $R^2 = .99$, D.W. = 1.59
$\quad(2.600)$

11. $NFIA = -124.769 + .0440(PAD.YAD/PINV) + .2886NFIG$
$\quad(-1.258) \quad (2.239) \quad (2.342)$
$\quad - .2641\ NFIGL$, $R^2 = .65$, D.W. = 2.04
$\quad(-2.036)$

12. $NFIM = -114.435 + .2368\ YM(NFIP/NFIT) + .3262\ NFIG$
$\quad(-.684) \quad (3.397) \quad (1.913)$
$\quad R^2 = .73$, D.W. = 1.92

13. $NFISV = -194.506 + .0681\ NY(NFIP/NFIT) + .2911\ NFIG$
$\quad(-1.758) \quad (5.262) \quad (2.526)$
$\quad R^2 = .79$, D.W. = 1.92

14. $INV = -2652.78 + .2114(YA + YM) + 1164.66P + 298.862\ PL$

$(-2.528) \quad (2.019) \quad (3.883) \quad (.713)$

$-.5012 \sum^{t-1} INV, \quad R^2 = .78, \ D.W. = 1.64$

15. $\ln YLDF = -3.677 + .7646 \ln(KAL/AF) + .2245 \ln \overline{WI}$

$(-7.755) \ (7.118) \quad (2.917)$

$R^2 = .78, \quad D.W. = 1.96$

16. $DSF = -13.967 + .2025(YFN + ZFCOM + \overline{ZFPB})$

$(-4.085) \quad (4.283)$

$- .8079 \sum^{t-1} DSF, \quad R^2 = .52, \ D.W. = 1.05$

(-2.859)

17. $ZFCOM = 1.153 - .1768\ YFN + .0398\overline{N} - .2596\ \overline{ZFPB}$

$(-3.622) \quad (5.339) \quad (-2.749)$

$+ .6580\ DSF, \quad R^2 = .88, \ D.W. = 2.10$

(6.639)

18. $ZCRP = 38.285(.7ZFCOM + .3ZFCOML) + 37.5349$

$(12.335) \quad (18.344)$

$(.7\overline{ZFPB} + .3\overline{ZFPBL}), \ R^2 = .91, \ D.W. = 2.4$

19. $ZRAW = 4.496 + .3965(EXCHS/\overline{PZRAW}) + 14.8223\ \overline{TEE}$

$(.045) \quad (4.979) \quad (3.486)$

$R^2 = .83, \ D.W. = 2.21$

20. $ZCIN = .282 + .3225\{(NFIM + NFINF)/NFIT\}$

$(2.270) \quad (3.374)$

$+ .1032(EXCHS/\overline{PZCAP}) - .9659(YNTML/YML)$

$(2.469) \qquad (4.126)$

$R^2 = .88, \quad D.W. = 1.89$

21. $EM = 666.132 + 2.6064\ \overline{QWI} - 670.064(\overline{PEM}/\overline{ERI}.\overline{PWM})$

$(5.154) \quad (9.988) \quad (-5.782)$

$R^2 = .96, \ D.W. = 1.84$

22. $EO = 304.603 + 1.7181\ \overline{QWI} - 93.4069(\overline{PEO}/\overline{ERI}.\overline{PELDC})$

$(1.126) \quad (3.195) \quad (-.399)$

$R^2 = .83, \ D.W. = 1.42$

23. $ENTM = 49.229 + 3.6944\ \overline{QWI} - .377.415(\overline{PENTM}/\overline{ERI}.\overline{PWM})$

$(.184) \quad (3.946) \quad (-1.887)$

$R^2 = .95, \ D.W. = 1.50$

24. $PAFPR = .973 - .0079\ AGRI + .00006\ NY,$

$(9.538) \quad (-2.736) \quad (3.923)$

$R^2 = .80, \ D.W. = 1.90$

25. $PMPR = .170 - .0042\ MFGI + .00005NY + 2.7974$

$(.488) \quad (-2.519) \quad (2.371)$

$\{(MS + MSL)/(2.P.NY)\}, \ R^2 = .77, \ D.W. = 1.68$

26. $PFPR = 1.339 + .00009\ NY - .0136DF - .0072\ DFL$

$(3.954) \quad (2.504) \quad (-1.702) \quad (-1.702)$

$R^2 = .65, \ D.W. = 1.92$

27. $PSD = .6869P + .00008(P.NY) - .0002P(YINF + YSV),$
$(4.860) \quad (2.622) \qquad (-2.829)$
$R^2 = .99$, D.W. = 1.80

28. $P = .4164\ PAD + .1629\ PMD + .4649\ PSD$
$(17.861) \quad (1.981) \quad (5.194)$
$R^2 = .99$, D.W. = 2.41

29. $PAD = .161 + .9504\ PAF$, $R^2 = .98$, D.W. = 1.43
$(1.602) \ (18.353)$

30. $PMD = -.780 + 1.111\ PM$, $R^2 = .99$, D.W. = 1.79
$(-2.018)(43.921)$

31. $PINV = -.023 + .6120\ P + .3464\ \overline{PZCAP},$
$(-.187) \ (6.144) \quad (5.460)$
$R^2 = .98$, D.W. = 1.89

32. $PA = .0172 + 1.0089\ PAF$, $R^2 = .99$, D.W. = 1.81
$(.439) \quad (46.987)$

33. $PF = .043 + .9963\ PFF$, $R^2 = .99$, D.W. = 1.81
$(.837) \quad (38.86)$

34. $PVD = -.176 + .81109\ PMD + .3325\ PAD,$
$(-3.490) \ (7.656) \qquad (4.394)$
$R^2 = .99$, D.W. = 2.29

35. $$NFPS = 26.273 + .0248 \sum^{t-1} (\overline{FKS} - \overline{KTRS}) + .3394\ NFPSL$$
(1.301) (2.961) (1.835)

$R^2 = .97$, D.W. = 1.74

36. $$AF = 118.514 + 10.7052(PFL/PNFL) - 4.6823\ \overline{DUM}$$
(23.033) (3.741) (-12.827)

$R^2 = .95$, D.W. = 2.22

37. $$ANF = 22.274 - 8.1503(PFL/PNFL) + .5792\ ANFL$$
(3.312) (-2.959) (2.541)

$$+ .1707\ \overline{TEE}$$ $R^2 = .87$, D.W. = 1.97
(1.839)

38. $$ORS = 126.213 + .0153(P.NY)$$, $R^2 = .90$, D.W. = 1.71
(1.956) (7.981)

39. $$LRS = 53.134 + .0043(PAD.YA)$$, $R^2 = .64$, D.W. = 1.21
(1.450) (2.313)

40. $ANF = A - AF$

41. $YA = YLD.A.$

42. $YF = YLDF.AF$

43. $YM = YMKR.KML$

44. $DTS = \overline{ADTR}.P.NY$

45. $IDTS = \overline{AITR}.P.NY$

46. $NY = YA + YM + YINF + YSV - (NFPS/\overline{PZ})$

47. $YAD = (PAD.YA - LRS)/PAD$

48. $NDY = (P.NY + \overline{NDRS} - DTS - IDTS - LRS)/P$

49 $YFN = .875YF$

50. $DIST = YA/(NY - YA)$

51. $$GRN = (DTS + IDTS + ORS + LRS - \overline{NDRS})/P$$

52. $$SG1 = GRN - CG1$$

53. $$NFIT = \{P(SP + SG1) + \overline{FKS} - PVD.INV\}/PINV$$

54. $$NFIG = (P.SG1 + \overline{XRS} - \overline{INVGS})/PINV$$

55. $$NFIP = NFIT - NFIG$$

56. $$NFINF = NFIT - NFIA - NFIM - NFISV$$

57. $$DF = YFN + \overline{ZFPB} + ZFCOM - DSF$$

58. $$EXCHS = PEM.EM + \overline{PEO}.EO + \overline{NEIS} + \overline{FKS} - NFPS - \overline{PZCRP}.ZCRP - \overline{PZFRT}.\overline{ZFRT}$$

59. $$ZOS = EXCHS - \overline{PZCAP}.ZCAP - \overline{PZRAW}.ZRAW$$

60. $$ETM = EM - ENTM$$

61. $$ZCAP = ZCIN.NFIT$$

62. $$PAF = PAFPR.P$$

63. $$PM = PMPR.P$$

64. $$PFF = PFPR.P$$

65. $$PNF = 1.8182\ PA - .8182\ PF$$

66. $$KA = KA_0 + \sum^{t} NFIA$$

67. $$KM = KM_0 + \sum^{t} NFIM$$

68. $$KINF = KINF_0 + \sum^{t} NFINF$$

69. $$KSV = KSV_0 + \sum^{t} NFISV$$

*t-scores for these equations have not been reported because the coefficients of the variables are composite parameters.

VARIABLE LIST.

All variables are on a fiscal year (April-March) basis unless explicitly stated otherwise.

1. A = area under all crops, million hectares, crop year.

2. AF = area under foodgrains, million hectares, crop year.

3. ANF = area under non-foodgrain crops, million hectares, crop year.

4. ADTR = average direct tax rate.

5. AITR = average indirect tax rate.

6. AGRI = production of agricultural commodities, index, 1960-61 = 100.0.

7. CG1 = government consumption (excluding non-departmental enterprises), 1960-61 prices, RS 10 million.

8. DF = demand for foodgrains, million tons, crop year.

9. DTS = direct tax revenues (net of land revenue), current prices, RS 10 million.

10. DUM = dummy variable, equal to 1 in 1957-58, 1965-66, 1966-67, 1974-75 and zero elsewhere.

11. DSF = change in foodgrain stocks, million tons, crop year.

12. DIST = ratio of agricultural to non-agricultural income.

13. EXCHS = net availability of foreign exchange, current prices, Rs 10 million.

14. EM = exports of manufactures, 1960-61 prices, Rs 10 million.

15. EO = exports of primary and other goods, 1960-61 prices, Rs 10 million.

16. ENTM = exports of nontraditional manufactures, 1960-61 prices, RS 10 million.

17. ETM = exports of traditional manufactures, 1960-61 prices, Rs 10 million.

18. ERI = exchange rate (Rs per U.S. dollar), index 1960-61 = 1.0.

19. ERS = balance of payments discrepancy, current prices, Rs 10 million.

20 FKS = capital inflow (net), current prices, Rs 10 million.

21. GRN = current government revenues (net), 1960-61 prices, Rs 10 million.

22. IDTS = indirect tax revenues, current prices, Rs 10 million.

23. INV = inventory investment, 1960-61 prices, Rs 10 million.

24. INVGS = government inventory investment, current prices, Rs 10 million.

25. INPOW supply of industrial power, million Kwh.

26. KA = capital stock in agriculture, 1960-61 prices, Rs 10 million.

27. KM = capital stock in industry, 1060-61 prices, Rs 10 million.

28. KINF = capital stock in infrastructure, 1960-61 prices, Rs 10 million.

29. KSV = capital stock in services, 1960-61 prices, Rs 10 million.

30. KTRS = foreign capital transfers (net), current prices, Rs 10 million.

31. LRS = land revenue, current prices, Rs 10 million.

32. MS = money supply (demand deposits and currency) Rs 10 million.

33. MFGI = index of production of manufacturing industries (excluding food, beverage and other primary production industries), 1960-61 = 100.

34. NFIA = net fixed capital formation in agriculture, 1960-61 prices, Rs 10 million.

35. NFIM = net fixed capital formation in industry, Rs 10 million.

36. NFINF = net fixed capital formation in infra-structure, 1960-61 prices, Rs 10 million.

37. NFISV = net fixed capital formation in services, 1960-61 prices, Rs 10 million.

38. NFIT = aggregate net fixed capital formation, 1960-61 prices, Rs 10 million.

39. NFIG = net fixed government capital formation, 1960-61 prices, Rs 10 million.

40. NFIP = net fixed private capital formation, 1960-61 prices, Rs 10 million.

41. NY = national income at factor cost, 1960-61 prices, Rs 10 million.

42. NDY = national disposable income, 1960-61 prices, Rs. 10 million.

43. NFPS = net factor payments abroad, current prices, Rs 10 million.

44. N = population, million.

45. NDRS = interest on national debt, current prices, Rs 10 million.

46. NEIS = net exports of invisibles (other than factor services), current prices, Rs 10 million.

47. ORS = other current revenues of the government current prices, Rs 10 million.

48. P = implicit price deflator for national income, index, 1960-61 = 1.0.

49. PAD = implicit price deflator for agricultural income, index, 1960-61 = 1.0.

50. PMD = implicit price deflator for industrial income, index, 1960-61 = 1.0.

51. PSD = implicit price deflator for other income, index, 1960-61 = 1.0.

52. PA = price of agricultural goods, index, 1960-61 = 1.0, crop year.

53. PAF = price of agricultural goods, index, 1960-61 = 1.0.

54. PF = price of foodgrains, index, 1960-61 = 1.0, crop year.

55. PFF = price of foodgrains, index, 1960-61 = 1.0.

56. PM = price of manufactured goods, index, 1960-61 = 1.0.

57. PMPR = ratio of manufactured goods price to national income deflator, index, 1960-61 = 1.0.

58. PAFPR = ratio of agricultural goods price to national income deflator, index, 1960-61 = 1.0.

59. PFPR = ratio of foodgrains price to national income deflator, index, 1960-61 = 1.0.

60. PNF = price of non-foodgrain crops, index, 1960-61 = 1.0, crop year.

61. PINV = implicit price deflator for net fixed formation, index, 1960-61 = 1.0.

62. PVD = implicit price deflator for inventory investment, index, 1960-61 = 1.00.

63. PEM = unit-value of manufacturing exports, index, 1960-61 = 1.0.

64. PEO = unit-value of primary exports, index, 1960-61 = 1.0.

65. PENTM = unit-value non-traditional manufacturing exports, index 1960-61 = 1.0.

66. PWM = world export price of manufactures, index, 1960-61 = 1.0.

67. PELDC = export price of exports of developing economies (excluding oil exporting countries), index, 1960-61 = 1.0.

68. PZRAW = unit-value of raw material and intermediate good imports index, 1960-61 = 1.0.

69. PZCAP = unit-value of capital good imports, index, 1960-61 = 1.0.

70. PZCRP = unit-value of imports of cereals and cereal preparations, index, 1960-61 = 1.0.

71. PZ = implicit price deflator for net factor payments, index, 1960-61 = 1.0.

72. PZFRT = unit-value of fertilizer imports, index, 1960-61 = 1.0.

73. QWI= real world income ($U.S.), index, 1960-61 = 100.00.

74. SP = net private saving, 1960-61 prices, Rs 10 million.

75. SG1 = net government saving (excluding saving of non-departmental enterprises, 1960-61 prices, Rs 10 million.

76. SG2S = net government saving (departmental enterprises), current prices, Rs 10 million.

77. TEE = time trend.

78. WI = ratio of actual to normal rainfall.

79. XRS = extra-revenue finance of government, current prices, Rs 10 million.

80. YA = value added in agriculture, 1960-61 prices, Rs 10 million.

81. YM = value added in industry, 1960-61 prices, Rs 10 million.

82. YINF = value added in infrastructure, 1960-61 prices, Rs 10 million.

83. YSV = value added in services, 1960-61 prices, Rs 10 million.

84. YNTM = value added in nontraditional manufacturing industries, 1960-61 prices, Rs 10 million.

85. YMKR = output-capital ratio in the industrial sector.

86. YLD = agricultural yield per hectare, 1960-61 prices, Rs. million.

87. YLDF = foodgrain yield per hectare, tons.

88. YF = foodgrains production (gross), million tons.

89. YFN = foodgrains production (net), million tons.

90. ZCIN = ratio of capital goods imports to aggregate net fixed capital formation.

91. ZCAP = imports of capital goods, 1960-61 prices, Rs 10 million.

92. ZRAW = imports of raw materials and intermediate goods, 1960-61 prices, Rs 10 million.

93. ZCRP = imports of cereals and cereal preparations, 1960-61 prices, Rs 10 million.

94. ZFRT = imports of fertilizer, 1960-61 prices, Rs 10 million.

95. ZOS = other imports, current prices, Rs 10 million.

96. ZFCOM = commercial foodgrain imports, million tons.

97. ZFPB = PL 480 goodgrain imports, million tons.

Of a total of 97 variables, the following 28 are assumed to be exogenous: ADTR, AITR, DUM, ERI, ERS, FKS, INVGS, KTRS, MS, N, NDRS, NEINS, PEM, PEO, PENTM, PWM, PELDC, PZRAW, PZCAP, PZCRP, PZ, PZFRT, QWI, SG2S, TEE, WI, XRS, and ZFPB. Consequently, there are 69 endogenous variables as well as equations in the systems thus ensuring a solution to the system provided the model is stable.

FOOTNOTES

Chapter 6

1. Exports of manufactures are defined as the sum of Sections 5, 6, 7 and 8 in the Indian Trade Classification (ITC), which follows closely the Standard International Trade Classification. Further details are provided in the Data Appendix.

2. These exports comprise all other sections, viz., 0, 1, 2, 3, 4, and 9 in the ITC. This group is made up of primary products - viz., tea, spices, tobacco, agricultural raw materials, etc.. See the Data Appendix for details.

3. "Non-traditional" manufacturing exports have been defined rather broadly. Thus, these exports comprise manufacturing exports as defined above <u>less</u> exports of jute and cotton manufactures, the latter two being the dominant "traditional" items of manufacturing exports.

4. Thus, export equations of the following type were postulated $E_i = a_0(\overline{QWI})^{a_1} (RPE_i)^{a_2}$ where E_i = exports of i^{th} good or commodity group, RPE_i = appropriate relative price of the i^{th} export good or commodity group and a_1 and a_2 are the income and relative price elasticities, respectively.

5. See for instance, Leamer and Stern (1970), pp. 11-12.

6. See Marwah (1972), Sharma (1975), and UNCTAD (1973).

7. This was particularly so in early models. See for instance, Narasimham (1955) and Dutta (1965).

8. Some studies of India have incorporated relative price effects in import functions. See for instance, Marwah (1972), Sharma (1975). However, for the reasons just mentioned, a relative price variable whose coefficient has the "right sign" needs careful interpretation.

9. These imports are the sum of Sections 2, 3, 4, 5 and 6 in the ITC, less fertilizer imports. See the Data Appendix for details.

10. In this study, capital goods imports have been defined as imports of machinery and transport equipment - Section 8 in the ITC.

11. Actually, petroleum and related imports are also "priority" imports. However, in this study we include them in the raw materials and intermediate goods category.

12. See Bhagwati and Srinivasan (1975), p. 36.

13. PL 480 imports (food aid) were paid for in rupees and not in foreign exchange.

14. About 12.5% of production is used for seeds, feed or is lost through wastage, etc. See for instance, any issue of Economic Survey, Ministry of Finance, Government of India, New Delhi. See also the UNCTAD (1973) model, in which such an adjustment is made.

15. The magnitude of a_3 in (6.9) is of interest because it would measure the extent to which PL 480 imports substitute for imports that would otherwise have to be made commercially.

16. This amounts to assuming that exchange licensing accommodates certain basic or minimum import requirements, which themselves are subject to change. This assumption is reasonable for a number of reasons. First of all, raw materials and intermediate imports are themselves in the nature of crucial imports as they are required for maintaining capacity. Thus, they are not likely to fluctuate to the extent of fluctuations in the availability of foreign exchange. Secondly these minimum import requirements are, in a sense indirectly planned for because they bear an important relationship to the planned structure of growth; import policy is ostentsibly an important means through which growth objectives have been sought, so that import licensing, the major pillar of this policy, is likely to be geared (even though quite imperfectly) to the planned structure of growth and to changes in it.

17. The effects of import-substitution can be expected to be directly reflected in exchange licensing because, typically, the principle of "indigenous availability" is automatically invoked in reviewing license applications, and it is common for licenses to be refused if an import substitute is known to exist (often irrespective of quality, etc.). See, for instance, Bhagwati and Srinivasan (1975), pp. 37. The time trend,in effect, captures the long term trends in the country's dependence upon imported raw materials and intermediate goods.

18. In a more disaggregated model the import content of investment could be defined with respect to capital formation in machinery and equipment. This is not possible here since we have not disaggregated fixed investment.

19. A case in which this need not happen is one in which structural shifts in investment within the industrial sectoral itself are in favour of the small scale "cottage" industries sector. However, for the period under consideration, investment patterns have been heavily in favour of import-intensive industries.

20. See for instance, UNCTAD (1968, 1973).

21. Aggregate merchandise exports (f.o.b.) and imports (c.i.f.) as published in the national accounts do not tally with those published on a disaggregated commodity basis because the two sets of figures are prepared by different authorities. Differences between the two sets of data are due to differences in methods and coverage. The variable ERS measures the discrepancies between these two sets of estimates.

22. If, on the other hand, "other" imports are made exogenous, the identity will predict $\overline{ERS}$.

23. This relationship is postulated in real terms because the requisite value data were not available on a consistent basis.

24. See for instance, the studies by S.B. Gupta (1975), M. Shahi (1977), Khetan and Waghmare (1971), and B. Singh (1970), in which interest rates are found not to be significant in explaining money demand in India.

25. Further, internal finance appears to be an important source of funds for investment for a substantial proportion of the business sector, mainly due to the reasons alluded to. A possible exception is the corporate component of this sector, for which external funds and the interest rate could be relevant in determining investment. However, the corporate component is small, and there is some evidence that interest rates are not significant factors in corporate investment decisions. See for instance, Bhole (1972). See Rao and Misra (1976), for a study of corporate investment financing.

26. Agarwala (1970) used this approach in his model of the Indian economy.

27. Patinkin (1965).

28. Thus, all prices in our model are wholesale prices - viz., implicit deflators or explicit price indices.

29. This incompatibility can be expected for most countries in which disaggregated trade data are based on the SITC. Of course, no difficulty arises in a model in which output, exports and imports are not disaggregated at all.

30. That is the outputs of mining, food and beverage industries.

31. The multiplication across by P, in order to express this equation (as well as the equation for the relative price of manufactured goods discussed earlier) in terms of absolute prices, can lead tp autocorrelation as well as heteroscedasticity since the disturbance terms implicit in these equations also get multiplied by P. However, the former problem has been dealt with by adjusting for autocorrelation, while an examination of the residuals in both equations suggests that the disturbances are, at worst, only slightly heteroscedastic.

32. In connection with the use of an index of prices of manufactured goods in the equation for the unit-value index of primary exports, it may be noted that PMD is appropriate since it includes the prices of processed and semi-processed primary goods as well (e.g., tea and tobacco) while PM does not.

33. Strictly speaking the sectoral deflators are deflators of the components of domestic product, while P is the national income deflator and implicit in its derivation is the deflator for net factor payments. Since, however, the weight of the latter is extremely small, we ignore it in explaining P.

34. It is important to note the difference between the production indices MFGI and AGRI, on the one hand, and the net outputs YM and YA on the other. While YA and YM are net value added measures, MFGI and AGRI are indices of total production of final and intermediate goods.

35. Our model actually has a set of additional equations explaining sectoral depreciation, which can be used to determine sectoral as well as aggregate gross capital formation. However, since the entire model is set up and solved on a net basis, these equations are not entirely necessary, and are hence not reported in this study.

CHAPTER 7

EXPERIMENTAL SIMULATION WITH THE MODEL

(7.1) INTRODUCTION

In this chapter we discuss the forecasting abilities of the model and the results of twelve experiments that were conducted under alternative assumptions about foreign and domestic resource availabilities, amongst other things. The experiments are broken up into and discussed under three broad categories:

(a) a set of experiments involving changes in the foreign capital inflow.

(b) a set of experiments dealing with the issue of PL 480 foodgrains aid, and

(c) a set of experiments involving changes in various other exogenous variables or parameters in the model.

These experiments are the subject matter of Sections (7.3), (7.4) and (7.5). In Section (7.2) which follows below, we evaluate the model in terms of its ability to track over the sample period. Before turning to this however, let us breifly outline the approach adopted in the presentation of the results and indicate some changes that were made in the model before it was used in our simulation experiments[1].

In Section 7.2, simulation over the sample on the basis of the actual values of the exogenous variables yields a solution for the entire set of endogenous variables in the system. This is the "control" solution with which the results of our experiments are compared. The simulation is dynamic in that generated (solution) values instead of actual values of lagged endogenous variables are used. The year 1959-60 is chosen as the starting year for the simulation period, for no particular reason other than it enables us to start the simulation period with somewhat better results in terms of deviations of the "control" solution from actual values, as compared to the simulation in which 1958-59 is the starting year. Further, the two years prior to 1958-59 are ruled out as starting years since some equations in the model have two-period lags which have to be accommodated in the simulation.

In our simulation experiments discussed in Sections (7.3), (7.4) and (7.5), the solution generated in Section (7.2) is taken as the "control" solution. "Disturbed" solutions are generated on the basis of alternative assumptions about the values of exogenous variables. A comparison of the deviation between the "disturbed" and the "control solution" for a particular endogenous variable can then enable us to evaluate the impact and dynamic multi-period effects of changes in exogenous variables. In presenting the results of our simulation experiments we report the percentage deviation between the "disturbed" and "control" value of each variable for selected years.

Finally, it may be noted that since we considered and estimated alternative specifications of a number of equations, there are a number of alternative versions of the model which can be used in simulation. The experiments reported here, however, are based on the model reported in the appendix to Chapter 6, with the minor modification that overall acreage, A, is treated exogenously[2].

(7.2) TRACKING WITH THE MODEL

There exists no unique set of criteria for evaluating the accuracy with which a model predicts. Often the deviation of the "control" solution from the actual values expressed in absolute units or in percentage terms is reported on a year-to-year basis for each variable. Alternatively, or in addition to this, various summary measures are constructed to evaluate the quality of forecasts. Most of these measures are based on the forecast or prediction error given by the deviation of the "control" solution from the actual values:

(7.1) $$D_{it} = Y^{c}_{it} - Y^{a}_{it}$$

where Y^c_{it} = "control" solution for the i^{th} variable in period t.

Y^a_{it} = actual value of the i^{th} variable in period t

D_{it} = deviation of the "control" solution from the actual value of the i^{th} variable in period t.

Some of the common measures based on D_{it} are:

(7.2) Mean deviation $MD_i = \frac{\sum_{t=1}^{T} D_{it}}{T}$

where T = length of simulation period.

(7.3) Mean absolute deviation $MAD = \frac{\sum_{t-1}^{T} |D_{it}|}{T}$

(7.4) Mean percentage deviation $MPD = \frac{1}{T} \sum_{t=1}^{T} (\frac{D_{it}}{Y^a_{it}})100$

(7.5) Mean absolute percentage deviation

$$MAPD = \frac{1}{T} \sum (\frac{|D_{it}|}{Y^a_{it}})100$$

The advantage of the MPD and MAPD over MD and MAD is that they are independent of the units of measurement and can thus enable comparisons between variables measured in different units. But for this, either set of measures can be used. We shall consider only the MPD and MAPD[3]. The MPD would enable us to judge whether positive and negative forecast errors tend to cancel out thus giving a value for the MPD close to zero. The problem with this measure is that it could be close to zero in cases where large positive errors cancel with large negative errors. The MAPD, on the other hand, does not suffer from this drawback. Consequently, we use both measures to evaluate the forecasting power of our model. However, even these measures are subject to an important drawback since they concentrate only upon the magnitude of forecast errors. While these are clearly important in evaluating the tracking abilities of a model, there are other criteria which are important as well. Thus, it is possible for the forecasts of a particular variable to be good when evaluated in terms of its forecast errors. Yet, the forecasts may well miss turning points in the data. More generally, a model may predict the levels of variables well, and yet perform poorly by not predicting changes in these variables in these variables. Clearly, in evaluating the tracking power of a model it is desirable to look at both the forecast errors as well as its ability to predict correctly the turning points. There are a number of ways of evaluating the predictive power of a model in terms of its ability to predict turning points[4]. We adopt the somewhat simple procedure of considering, for each variable, the year-to-year changes in the "control" solution and using the proportion of changes whose direction is correctly predicted as a measure of the ability of the model to track turning points[5].

The results from simulation over the historical period are presented in Table 7.1. In it are presented, for selected variables, the "control" solution and the forecast error in absolute units for each year. The last three columns in the table give the MPD, MAPD and the proportion of changes (in each variable) whose direction is correctly forecast (PTCF). The overall tracking abilities of the model are evaluated in terms of these measures for each variable. On the other hand, to provide a general idea of the forecasting power of the model, these results are presented in condensed form in Table 7.2 which gives the percentage distribution of the MAPD by PTCF and some additional information. Let us look at the broad picture first.

Table 7.2 shows that 50% of the variables have an average absolute prediction error below 6% and that for almost two-thirds of them the average absolute forecast error is 11% or less. In fact, only 4% of the variables have an average prediction error in excess of 16% but no greater than 27%. The mean of the relative frequency distribution of the MAPD gives an average percentage error of 8.9% which is distinctly higher than the median error of 6.8%. This is due to the fact that the relative frequency distribution is positively skewed thus pulling up the mean, the mean being sensitive to extreme values. The median error of 6.8% would seem to be a more appropriate measure of the overall average MAPD.

The table also shows that a third of the variables predict year-to-year changes correctly over 90% of the time, while at least 70% of the changes are correctly predicted for three-fourths of the variables[6]. Again, for only about 4% of the variables (viz., 1 variable) are the changes predicted correctly less than half the time. Since the relative frequency distribution of PTCF is negatively skewed, the mean of the percentage of correct predictions of changes (80.9) is appreciably below the median of 86.5. Again, the median would appear to give a more accurate indication of the overall average percentage of correct predictions.

Certain additional inferences can be made from Table 7.2. Thus, for instance, calculations show that almost 59% of the variables have a MAPD less than 11% and correctly predicted changes over 80% of the time. Further, almost two-thirds of the variables have an MAPD lying in this range, and changes are correctly predicted over 70% of the time. These numbers are part of a discernible pattern in Table 7.2. Thus, the MAPD and PTCF appear to be related. In particular, we note that variables with lower MAPDs are also variables for whom PTCF is higher. This suggests that in instances where our model predicts the <u>levels</u> of variables well, the <u>changes</u> in these variables are also correctly predicted. There are obvious exceptions to this, as we can see that 4.2% of the variables have changes correctly predicted between 70%-79% of the time; yet, the MAPD is in the range of 21%-27% which is quite high. These exceptions can be clearly seen in Table 7.1 to which we shall turn shortly in order to evaluate the predictions of individual variables.

The broad picture presented above suggests that on the basis of the sample of 24 variables considered important, our model tracks reasonably well. On average, year-to-year changes in these variables are correctly predicted about 87% of the time, while the average of the MAPD of all variables is about 7%. In addition, we note that the relative frequencies of the MAPD and PTCF are favourably distributed - e.g., for almost 67% of the variables the MAPD's are less than 11%, and the percentage of correctly predicted year-to-year changes is 70% or greater. However, at least two points warrant consideration. Firstly, since at least in the case of <u>some</u> variables the model does not do very well, the relative importance of these variables could be of some significance. We consider this shortly. Secondly, we have presented the results for only 24 (important) variables. The inclusion of other variables could alter the picture outlined above. Thus, there are some variables (e.g., change-in-stocks variables) which are not well predicted so that inclusion would worsen the results presented above. On the other hand, there are a greater number of variables (e.g., agricultural yields, food-grain yields, acreage and various prices) which are well predicted in the sense outlined above, and hence, their inclusion would tend to improve the above results. We would expect, in general, that the broad picture presented in Table 7.1, would not be adversely affected. In any case, the excluded variables, are by themselves, not particularly important in the model, except in that they are useful in tracing the origins of forecast errors in the variables presented here.

Let us now turn to Table 7.1 from which a somewhat more detailed picture of the tracking abilities of the model can be drawn. Looking at the MPD we note that, on average, there is a tendency in the model for positive forecast errors to dominate negative forecast errors as a greater proportion of the variables have positive MPD's. The reverse is true in some cases,while in only a handful of cases do positive errors tend to cancel negative errors. The variables for which the dominance of positive errors appears to be significant are agricultural investment and capital goods imports[7]. On average, the model overstates the levels of these variables by 8.27% and 7.63%, respectively. For a large number of variables - e.g., foodgrains production, infrastructural investment, investment in services, raw material imports and the national income deflator - the average overstatement varies in the range of 1%-3.5%. For other variables such as the supply of foodgrains, food imports, national income, government consumption, manufacturing exports and agricultural output, the average error (positive or negative) is found to be smaller than 1%. However, the MPD itself does not give us any indication of the size of positive or negative errors. Thus, it is possible that for some variables for which the MPD $\simeq$ 0, this is because <u>large</u> positive errors cancel <u>large</u> negative errors. On the other hand, for variables for which the MPD is quite different from zero, it does not necessarily follow that errors (positive or negative) are large. For instance, a large positive MPD could be the result of relatively more frequent positive errors, or of a few large positive errors even when the remaining positive and negative errors are small. These factors can be ascertained by looking at the year-to-year forecast errors or the MAPD for each of the variables.

In general, the variables with MPD's lower than 1%, also have relatively small mean absolute percentage forecast errors - e.g., the supply of foodgrains, sectoral outputs and national income, all have MAPD's below 5%. The interesting cases are private saving and food imports. Thus, private saving has an MPD which is virtually zero but its MAPD is close to 8%. This suggests that there are positive errors on the high side which cancel with negative errors on the high side in the private saving forecasts. An examination of the year-to-year forecasts seems to confirm this, though this is true for only some years. In fact, more than 50% of the forecast errors are on the low side. Additionally it may be noted that the model predicts correctly the year-to-year changes in private saving 81% of the time. The case of food imports is quite similar. The MPD is .27% but the MAPD is a high 19.26%. This high average percentage error results mainly, as an examination of the year-to-year forecast errors will suggest, from bad predictions for three to four years. These increase the MAPD. But for these few years, the absolute prediction error would be considerably lower. Further, insofar as predictions of the turning points in food imports go, it is clear that the model does well, since 85% of the year-to-year changes are correctly predicted. In general, but for a few exceptions like these, variables with MPD's on the low side have MAPD's on the low side as well, and tend to have high PTCF's. This is evident from an examination of Table 7.1.

It is also clear from the table that, with the exception of government investment, the model's tracking abilities with respect to the other investment variables appear to be distinctly below par in comparison to the quality of forecasts obtained for most other variables. The quality of the government investment forecasts are reasonably good with an MAPD of 6.82% and correct predictions for year-to-year changes 94% of the time. Though the MPD for the private investment forecasts is comparable to the MPD for the government investment forecasts, the MAPD for the former is considerably higher. Further, the model predicts the changes in private investment correctly only 50% of the time. These results are seen to hold even for the forecasts for investment in the services sector. Though the MAPD's for forecasts of agricultural, industrial and infrastructural investment are also relatively large, there are some interesting differences. Agricultural investment forecasts have the highest MPD and MPAD; yet, the year-to-year changes in agricultural investment are predicted correctly surprisingly well (viz., 75% of the time).Thus, while the model does not appear to predict the level of agricultural investment relatively well, changes in the variable are predicted reasonably well. Industrial investment and infrastructural investment are also associated with average forecast errors on the high side, but in contrast to private investment their predictions of changes are appreciably more accurate (viz., in excess of 60%).

In conclusion, it can be said that the model tracks reasonably well on the whole, and is stable since there does not appear to be any inter-temporal accumulation of errors. It is nevertheless true that the model's tracking abilities in respect of the investment variables mentioned above are relatively inferior to those in respect of most other variables, which are tracked quite well. The tendency for larger forecast errors for investment variables is not an uncommon feature in econometric models and can be found in Agarwala's model of the Indian economy as well[8]. In our model, private investment is determined residually from the overall saving-investment identity and hence subject to errors in the rest of the system. This factor is undoubtedly one reason for the forecast errors in private investment. Further, private investment itself enters the equations for investment in the industrial sector and services sectors while infrastructural investment is itself residually determined, thus making it a residual of a residual. This makes these sectoral investment variables subject to additional sources of error. However, in all cases, the errors do not accumulate over time, thus attesting to the basic stability of the model. An important aspect of this stability emerges from the fact that, even though sectoral investment feeds directly into the appropriate sectoral output and hence national income, these latter variables display small forecast errors. Thus, it would appear that not only do the larger percentage forecast errors in the investment variables have no destabilizing effects on outputs and on other parts of the system, but that their magnitude does not lead to significant errors in important variables such as sectoral output and national income, amongst others.

(7.3) A QUANTITATIVE ANALYSIS OF THE EFFECTS OF FOREIGN CAPITAL ON SAVING, CAPITAL FORMATION AND NATIONAL INCOME.

In this section we report the results of a set of four simulation experiments involving different assumptions about the magnitude of foreign capital inflows into India in the period 1960-1976. In earlier chapters we discussed the likely effects of foreign capital on important variables such as saving, capital formation and output. These experiments enable us to quantify, at a much more disaggregated level, the pattern and magnitude of these total, general equilibrium effects. The results of these experiments are reported in Table 7.3 at the end of the chapter[9].

Experiments 1 and 2

The Second Plan (1957-1961) and the Third Plan (1962-1966) were a period of intense development activity in the country, as we saw in Chapter 3. It was also a time when foreign capital inflows were relatively heavy. After 1966, the tempo of development slowed down and there was a decline in the magnitude of foreign assistance. Experiments 1 and 2 are designed to examine the short and longer run consequences of reduced foreign capital over the period, beginning in 1960. Consequently, we consider a 20% annual reduction in the nominal foreign capital inflow over the period, leaving unchanged the magnitude of capital transfers.

In Experiment 1 we assume that the decline in foreign capital is due to lower private foreign capital inflows, or alternatively, increased private capital outflows. In Experiment 2, on the other hand, we assume that the capital inflow reduction takes the form of reduced capital inflows to the government sector.

In both experiments the reduction in the capital inflow in years 0 through 6 is found to result in a reduction in private and government investment, as well as in national income,well after the capital inflow is returned to its actual level. Thus, reduced capital inflows appear to have adverse effects on output even over the longer term. They are small in the initial periods, but rise subsequently, peaking between years 4-6, and then, tapering off and stabilizing towards the end of the simulation.

The decline in the time-path of national income is mirrored in the decline in sectoral output. In both experiments, industrial output appears to suffer the largest percentage decline. This is partly because the reduction in private and government investment has a significant negative effect on industrial investment and hence on the growth in productive capacity. More important however, are two other factors which directly affect only the industrial sector: (1) the decline in infrastructural output has adverse effects on the availability of industrial power which declines sufficiently to lower the output-capital ratio, and (2) the reduction in the capital inflow stiffens the foreign exchange constraint up to year 6, and consequently has adverse effects on the output-capital ratio by leading to a decline in raw material and intermediate good (as well as capital good) imports. After year 6 the foreign exchange situation improves,thereby partly dampening the decline in the output capital ratio.

The improvement in foreign exchange availability after year 6 is reflected in the reversal of the direction of change in the imports of raw materials and intermediate goods. The increase in availability of foreign exchange after year 6 is due to two main factors: (1) after year 6 the capital inflow is back to its actual level, and (2) external debt is below its actual level due to the cumulative reduction in it during the period 0-6 as a result of the reduction in capital inflows (assumed to be in the form of loans). The lower external debt implies lower factor payments abroad even after year 6 and this has favourable effects on the foreign exchange constraint.

As is to be expected, private and government investment are adversely affected by the foreign capital inflow reduction and by the induced contractionary effects of the latter. Government investment declines by a greater percentage in Experiment 2 largely because the 20% reduction in capital inflow here is in the form of reduced aid flows to the government, while in Experiment 1 the reduction in investment results mainly from induced effects on government saving through the effects on revenues. These latter effects are relatively weaker. The behaviour of private investment is a little different. Expectedly, the greater percentage decline occurs in Experiment 1. But this is true only till year 6. Thereafter, private investment declines by a greater percentage in Experiment 2. Private investment in the model is determined residually from the overall saving-investment identity and consequently depends upon the behaviour of private saving, government saving and government investment, amongst other factors. The greater percentage decline in private investment in Experiment 2 after year 6 is mainly because both private and government saving decline by a relatively greater percentage, while the percentage decline in government investment is relatively smaller. Expectedly, both government and private saving decline in response to lower revenues and income, respectively, in Experiment 1. In Experiment 2, on the other hand, while private saving declines as in Experiment 1, government saving is observed to rise up to year 6 and decline thereafter. This is simply explained by the fact that in Experiment 2, government saving responds to not only its revenues but also to the decline in capital inflow. In particular, the reduction in capital inflow and government revenues both reduce government consumption and, government saving, determined residually from government revenues, rises simply because the latter do not decline to the extent that government consumption does. After year 6, however, saving declines largely in response to declining revenues as foreign capital inflows are now at their actual levels.

In our model, the national income deflator, as a measure of the general price level, depends upon sectoral prices and also determines the latter. All prices (that are endogenous in the model) are simultaneously determined and it is difficult to isolate cause and effect in a simulation context. However, generally speaking, the national income deflator would reflect the forces of sectoral supply and demand, both of which determine sectoral prices. The magnitude and direction of changes in the deflator in our experiments reflect the net effects of the strengths of changes in sectoral prices, which themselves reflect the strength of sectoral supply effects relative to demand effects. The magnitude of these effects appear to be generally small in both experiments but, while in Experiment 1 the effects are particularly small and on average tend to lead to a rise in the general price level, in Experiment 2 the effects, though still small, show a deflationary impact. Thus, in Experiment 1, the inflationary supply effects (due to declining sectoral output) tend to be offset by deflationary demand effects (due to declining income). In Experiment 2, on the other hand, the former effects appear to be more than offset (though only slightly) by the latter effects.

A further comparison of the two experiments suggests that the contractionary effects of the reduced capital inflow on sectoral and national output are somewhat stronger in the case where the reduction is in the form of reduced foreign aid to the government (Experiment 2), although the effects on national income are more or less of the same magnitude. It is inherently difficult to explain these differences in terms of differences in specific effects given their general equilibrium nature. Nevertheless, some general points can be made.

First of all, even if we ignore induced effects on saving, investment and income, the impact or direct effects of the reduced capital inflow have different implications for the overall level of investment, due to the differential effects on private and government investment. The latter effects, being different in the two experiments, have consequently, differential direct effects on sectoral investment, in addition to the various (different) induced effects through other variables (e.g., prices). Thus, for instance, given the structure of the model, the direct effects of foreign capital impinge on agricultural investment primarily through government investment which is relatively lower in Experiment 2. Additional effects on agricultural investment operate via prices (of agricultural and investment goods) as well as agricultural income. It appears to be the case that the net effect comes out to be stronger in Experiment 2 than in 1 because of the larger effect on government investment in the former. Through the capital stock variable, therefore, the effect on agricultural output is stronger in Experiment 2. Investment in the industrial and services sector depends upon the share of private investment in aggregate investment, the level of government investment, industrial output (in the case of industrial investment) and national income (in the case of investment in services). Consequently, the effects of the reduced capital inflow on investment in these sectors depends upon the relative strength and direction of the effects on these variables. That the effects on investment in these sectors are different in the two experiments, is evidence of differences in the relative strength of the effects on the share of private investment, industrial/services output and government investment. Infrastructural investment is determined residually in the model. Consequently, differences in the effects on this investment arise due to differences in the effects on overall investment in the economy, as well as due to differences in the effects on investment in other sectors of the economy. A second point about the differences in the results of the two experiments worth noting is that though the effects on sectoral investment affect sectoral output <u>via</u> the effects on sectoral capital stock, the latter are not necessarily the only, nor the most important effect,on output for all sectors. In our model, this is only true for services and infrastructural output since they depend only upon capital stock. However, in the case of the industrial sector, the effects on output depend not only upon the effects on the capital stock but also upon the output-capital ratio, since it is the interaction between the two that determines industrial output. The relatively stronger adverse effects on industrial output in Experiment 2 arise because the adverse effects on both the output-capital ratio and the capital stock are relatively stronger. The relatively stronger adverse effects on the output-capital ratio in Experiment 2 appear to be primarily due to the stronger adverse effects on infrastructural output which has adverse effects on the availability of industrial power. Even though the adverse effects on services output are relatively <u>weaker</u> in Experiment 2, the relatively <u>stronger</u> adverse effects on output in the other sectors are large enough to imply a lower time-path for national income as compared to its time-path in Experiment 1.

The above is an outline of some of the factors that explain the differences in the effects of reduced capital inflows on sectoral and national output in the two experiments. These effects are part and parcel of a wider set of general equilibrium effects which,however, cannot be easily traced here. Further, the differences in the effects of the two experiments are specific to the period in which the shocks were administered. They themselves could change if the shocks are administered over a different sub-period in the sample. Nevertheless, from both experiments it is clear that reduced capital inflows over the period 0-6 lower the time-path of sectoral and national output permanently, and the latter appears to stabilize at a level that is about 1.5% below its actual path.

Experiments 3 and 4.

In the preceding experiments we considered an annual capital inflow change during the years 1960-1966, a period in which the government actively sought to force the pace of development in the economy. In Experiments 3 and 4 we deal with the subsequent five-six years, in which there were important economic and political changes as we stated in Chapter 3. Thus, there was a slow-down in the development drive partly due to a definite slow-down in capital spending by the government and, a sharp decline in aid flows, particularly after 1967-1968. In the next two experiments, we deal with the post-1966 period.

In Experiments 3 and 4 we consider the implications of higher aid inflows during the period 1966-1971 (i.e., years 6 to 11). The foreign capital inflow was at its peak of $1.3 billion in 1965 during the period 1960-1971. In Experiments 3 and 4 we consider the effects of maintaining this level of capital inflow annually over the period 1966-1971[10].

The difference in Experiments 3 and 4 is simply that in the former the increased inflows are in the form of increased inflows of private capital, while in the latter they are in the form of aid to the government. The results are reported in Table 7.4. For these experiments, a slightly different set of variables are reported. In particular, some price variables are presented in order to look at the effects on prices. Further, since we have already discussed, in some detail in the preceding experiments, some of the major linkages through which the direct and induced effects of foreign capital operate, our discussion in these experiments, which are essentially similar in nature, will be brief. Generally speaking, the main difference between this and the former set of experiments is that the foreign capital changes are in the opposite direction, so that of the foregoing discussion applies here in reverse. The other major differences are: (1) the periods in which the shocks are administered, and (2) the non-proportionality of the shocks in each period.

It is clear from the results of both experiments that there are expansionary effects on most of the variables. Further, there seems to be much similarity in the magnitude of the effects involved. There are a few differences in some variables - viz., private and government saving and investment. But these are to be expected given the difference in the experiments. Thus, expansionary effects on government investment in Experiment 4 are relatively larger because the increased capital inflows here represent aid flows to the government sector. The difference in government saving behaviour is also due to the difference in the two experiments. Thus, in Experiment 3, both government saving (residually determined) and consumption rise as its revenues rise. In Experiment 4, on the other hand, consumption rises due to increasing revenues as well as foreign capital. Government saving obtained residually from revenues falls since the latter do not rise in the same proportion as consumption. Only when foreign capital inflows are back at their actual levels after year 11, does government saving rise as in Experiment 3.

But for these differences most other variables are similar in both experiments in terms of both the time pattern and magnitude of responses. This is clear from the table. The magnitude of responses are relatively small to begin with, but tend to increase over the period 6-11, largely because the capital inflow increases are small (in percentage terms) in earlier years, but rise sharply thereafter. Thus, the capital inflow increase is only 5% in year 7, rises to 15% in year 8, to 128% in year 9, and is highest at 263% in year 10 before declining to 130% in year 11. It is no coincidence, therefore, that the responses of most variables are particularly sharp between periods 8-10.

In both experiments the effects tend to taper off after year 11, as is to be expected, but it is clear that the increased capital inflows during periods 6-11, lift the economy permanently on to a higher time-path. Thus, for instance, national income appears to stabilize at a level about 3% higher than its original level by the end of the simulation. Presumably, it would stabilize at a higher level, if the substantially increased capital inflows were in the form of grants instead of loans as we have been implicitly assuming here. The effect of increased loans is to raise the volume of factor payments abroad in subsequent periods and hence to subtract from the increases in domestic product. The same general trend is shown by sectoral output, all of which tend to respond favourably to increased sectoral investment and/or other factors.

An interesting feature of these results is that the magnitude of responses of sectoral and national output, in general, appear to be rather similar in both experiments. This similarity was less evident in the comparison between Experiments 1 and 2. Another aspect of the present experiments worth noting is that the relatively stronger effects on sectoral and national income arise when the capital inflow changes represent changes in private capital flows. This is a reversal of our findings in Experiments 1 and 2 which were suggestive of relatively weaker effects under a similar assumption about the changes in foreign capital[11]. This reversal probably reflects differences in the relative strengths of direct and induced effects on government and private investment, sectoral investment and sectoral output, which themselves primarily stem from the differences in the periods being considered in the two sets of experiments and the fact that in Experiments 3 and 4 the percentage changes in capital inflow are not only large, but vary from year to year.

For the present experiments, we have also reported the percentage changes in the agricultural, industrial and national income price deflators in order to evaluate the magnitude of the price effects involved. The direction and magnitude of the price effects appear to be quite similar in both experiments. The agricultural income deflator is seen to rise in each period largely because the demand effects resulting from income growth dominate the favourable supply effects, and this itself seems to follow from the fact that the favourable effects on supply are small, given the small percentage increase in agricultural output, while since national income rises by a greater percentage, the demand effects are stronger. The deflator for industrial income, on the other hand, falls in each period, reflecting the relatively more favourable supply effects. This again follows partly from relatively strong favourable effects on industrial output. Another contributing factor here is the effect of the liquidity variable (defined as the ratio of average real money balances to national income). Since the money supply is unchanged, the liquidity variable shows a decline in all periods, as national income rises. This too exerts a negative influence on the industrial income deflator. The national income deflator rises primarily because of the much greater influence of agricultural prices and the fact that the deflator for services output (another component of the national income deflator but not reported here) also rises. We note finally that becuase of the stronger demand and supply effects in these experiments relative to those found in the previous experiments, the percentage price responses are also significantly larger.

In conclusion it can be said that by maintaining the inflow of foreign capital at the 1965 peak level (in dollar terms) during periods 6 through 11, the path of national output is permanently raised in all periods and is about 3.5% above its actual path at the end of the simulation. However, in terms of income per capita this increase is small, amounting to about Rs 14 per head (in real terms). Further, while the time path of national output is indeed higher, there is no indication that the large increase in foreign capital inflow sustained over a short period of 4-5 years leads to an <u>acceleration</u> in growth rates except in the short-run. In fact, the annual rates of growth along the higher output-path are quite the same over the long-run.

(7.4) A QUANTITATIVE ANALYSIS OF THE EFFECTS OF PL 480 FOODGRAINS AID.

In this section, we conduct a set of experiments to investigate the short and longer run effects of PL 480 foodgrains assistance to India[12]. PL 480 assistance can be evaluated in terms of its effects on specific magnitudes/ sectors (e.g., foodgrains production, sectoral incomes) as well as in terms of aggregate or economy-level effects (e.g., national income, saving, etc.). This would enable us to not only test the Schultz-type argument in which commodity aid has adverse long-run effects on production and investment in agriculture, but also to evaluate PL 480 aid at a more general level in terms of its overall effects on national income, saving and capital formation.

There are a number of alternative experiments that can be conducted depending upon the assumptions we make about the foreign capital inflow and government borrowing. PL 480 foodgrains assistance is recorded as an import in the current account and is matched by a corresponding capital inflow in the form of loans and capital transfers to the government, loans to the private sector (made by the U.S. government from PL 480 counterparts funds that represent the Indian government's rupee payments for the foodgrain imports), and/or an addition to U.S. PL 480 balances in India (which are subsequently disbursed as loans or grants)[13]. Thus, if a change in PL 480 foodgrain imports is considered, some assumption about the composition of the foreign capital inflow change and about its destination has to be made. A number of possible assumptions exist, but few are implementable within the context of an aggregative model such as ours; nor is there sufficient information available on the flow-of-funds involved in PL 480 transactions. Another question that arises in the context of a PL 480 experiment pertains to the effect of PL 480 imports on government borrowing. If the government pays for PL 480 imports by borrowing from the Central Bank (e.g., printing money) instead of using the receipts from PL 480 sales to make payment to the U.S. account, monetary expansion would be involved. However, the effect on borrowing is really not a consequence of PL 480 assistance, and is likely to take place inspite of it. It appears more likely that PL 480 is the pretext under which the government resorts to borrowing to finance expenditures. It is unlikely that, in the event of lower PL 480 imports, deficit spending (i.e., borrowing) would be any lower. However, in an experimental situation, this is a matter of assumption unless the borrowing effects of PL 480 are explicitly modelled.

Our PL 480 experiments involve examining the effects of a 20% annual reduction in PL 480 foodgrain imports over 1960-1967, a period in which these imports were the heaviest[14]. Two experiments are conducted and, in both, it is assumed that there is no effect on government borrowing. The two experiments differ only in respect of the assumptions made about the capital inflow. In Experiment 5 it is assumed that there is no change in the capital inflow because other non-PL 480 foreign exchange aid is substituted for PL 480 aid. Consequently, the effects of PL 480 operate mainly through foodgrains and agricultural output and the supply of foreign exchange. In Experiment 6, on the other hand, it is assumed that the reduced level of PL 480 imports is associated with a correspondingly lower level of capital transfers to the government. These results are reported in Table 7.5.

Experiment 5.

The results show that foodgrains, agricultural, industrial and national output are all favourably affected. The output of foodgrains is determined by the interaction of yield and acreage. Acreage is seen to rise over periods 0 through 7 since the relative price of foodgrains rises in response to the reduction in PL 480 imports. This is a general equilibrium effect, reflecting the interaction of demand and supply factors. In particular, it is clear from the table that there are adverse effects on the total supply of foodgrains in the economy and that these effects more than offset the expansionary demand effects resulting from the rise in income. Consequently, the relative price of foodgrains and hence acreage are observed to rise. However, these acreage effects do not persist and after year 7, they are virtually absent. The total supply of foodgrains declines up to year 7 mainly on account of two factors. The reduction in PL 480 imports induces greater commercial foodgrain imports. But the relationship between the two types of imports is not one-to-one. In particular, even though there is a large percentage increase in commercial imports, in absolute units total foodgrain imports fall. The second factor is that the favourable production effects are not sufficiently strong to offset the decline in total imports. However, these adverse effects on the total supply of foodgrains tend to fade away after year 7.

It is interesting to note that the favourable effects on production arise even though yield falls. Yield is seen to fall because it depends, amongst other things, on the ratio of capital to acreage, and this ratio falls over this period primarily because investment in agriculture rises at a smaller rate than acreage. However, the unfavourable effect on yield is more than offset by the acreage increase thus accounting for the observed rise in production. These results thus support the view that increased PL 480 imports have adverse effects on foodgrains production, even though, as the results suggest, there would be favourable effects on total supply, the higher the volume of PL 480 imports.

The results also suggest that agricultural output as a whole is favourably affected. However, in the version of the model used here, this must necessarily be the case as long as there are favourable effects on agricultural investment (as is the case here). This is because agricultural output is determined by the interaction of overall acreage (foodgrains and other) and agricultural yield. Overall acreage does not respond to prices, as it is exogenous in this version of the model. Given that agricultural yield depends upon the ratio of capital to overall acreage, yield must necessarily respond favourably to PL 480 imports as long as agricultural investment is not adversely affected. Consequently, agricultural output must rise, as it does here. However, if overall acreage is endogenously determined as the sum of foodgrains and non-foodgrains acreage (as in Chapter 4), changes in the relative price of foodgrains will involve switches in acreage, which in the aggregate could be positive or negative. We did in fact conduct the present experiment using a model which allows for such acreage switches and thus makes overall acreage endogenous. Our results indicated a negative overall acreage response, which, in addition, was large enough to lead to a mild negative effect on agricultural output. However, in all other respects the results were virtually the same as those reported here. We decided to retain the exogeniety assumption about overall acreage[15].

The foreign exchange effects of PL 480 imports in the experiment are felt primarily on industrial output *via* its effects on raw material and capital good imports. These effects are favourable in this experiment as industrial output rises over the whole period. These favourable foreign exchange effects can be explained in the following terms. Changes in PL 480 imports (matched by corresponding changes in the capital inflow) would not, *per se*, have any effect on the supply of foreign exchange, since they involve changes in rupee payments and receipts. But if, due to a fall in PL 480 imports, the corresponding reduction in capital is exactly offset by non-PL 480 foreign exchange aid, the supply of foreign exchange would, *ceteris paribus*, rise. However, the reduction in PL 480 imports induces an increase in commercial imports which would reduce the supply of foreign exchange. But this reduction would not be equivalent to the PL 480 reduction if the two types of imports do not substitute one-for-one (as is the case in our model). Consequently, the overall effect on the supply of foreign exchange would be favourable. In our experiment this is precisely what happens, and consequently, there are favourable effects on industrial output. There are other favourable effects on industrial output (as also on output in other sectors of the economy) *via* government and private investment, both of which increase, in large measure, due to favourable effects on saving resulting from the increase in national income.

Thus, we can conclude that lower PL 480 imports have favourable effects on foodgrains production, sectoral and national output as well as on investment in the economy. These effects originate primarily from the favourable foreign exchange and relative price effects mentioned above. On the other hand, the *total* supply of foodgrains is adversely affected as domestic production and commercial imports do not match the reduction in PL 480 imports. Most of these effects are, however, confined to the periods

0 to 7 and tend to taper off beyond it.

Experiment 6.

Here the 20% annual reduction in PL 480 imports is accompanied by a matching reduction in grants to the government by the U.S. In this experiment, the primary initial effects are:

(a) the effects on domestic production of foodgrains via the effects on the relative price of foodgrains.

(b) the effects on the supply of foreign exchange

(c) the direct effects on sectoral capital formation due to the reduction in capital transfers to the government.

While the effects under (a) are similar to those in the previous experiment, the effects under (b) are in the opposite direction. The effects under (c) are absent in Experiment 5.

The effects on the supply of foreign exchange are in the opposite direction to those in Experiment 5 (i.e., are adverse) primarily because the reduction in PL 480 imports is no longer compensated for by the substitution of foreign exchange aid. The capital inflow now declines because of the reduction in capital transfers to the government. *Ceteris paribus*, this leaves the supply of foreign exchange unchanged. However, the reduction in PL 480 induces an increase in commercial imports and this results in a net decline in the available supply of foreign exchange. This follows directly from the foreign exchange saving aspect of PL 480 imports.

The effects on acreage up to year 7 are positive as in Experiment 5, primarily because the interaction between the demand and the supply effects results in a higher relative price of foodgrains. The stronger negative effect on foodgrain yield in this experiment is due to the adverse effects on agricultural investment (mentioned above). This explains why, inspite of increased acreage, production is observed to decline right through the period. It also explains the adverse effect on agricultural output[16]. The adverse effects on the supply of foreign exchange (mentioned earlier) are seen to be reflected in the decline in industrial output. This effect operates primarily via its adverse effects on the output-capital ratio. Another factor contributing to the decline in industrial output is the adverse effect on industrial investment resulting from the decline in capital transfers to the government. In general, the adverse effects on sectoral output are reflected in the lower time-path of national income even well beyond year 7. Thus, by the end of the simulation, national income is observed to stabilize at a level 1%

below its actual level. It is interesting to note that most of the output variables are adversely affected well beyond year 7. The adverse effects on government and private (as well as sectoral) investment follow as a consequence not only of reduced capital transfers to the government, but also due to direct and induced adverse effects on sectoral and national output as well as indirect induced adverse effects on government and private saving. It is also interesting to note that, while as in the previous experiment, the total supply of foodgrains is adversely affected, in the present experiment these effects are not only larger but persist to the end of the simulation.

Thus, we find that when the PL 480 reduction is also associated with a reduction in the capital inflow, there are adverse effects on most variables and these persist even beyond period 7. In this experiment, PL 480 imports are similar to an outright grant since they are associated with an equivalent capital inflow. It is thus not surprising that a reduction in such imports has the adverse effects discussed above.

(7.5) THE EFFECTS OF MONETARY EXPANSION, TAXATION AND FOREIGN EXCHANGE.

In this section we undertake and discuss the results of a set of experiments of a different type.

These experiments are a subset of a much wider set of possible experiments that can be conducted. Limitations of time and space confine us to the following set.

Experiments 7, 8 and 9.

In these experiments we consider the effects of monetary expansion associated with government deficit spending based on money creation. The experiments are simplified in that the increase in the money supply is equivalent to the increase in government spending. This follows from the simplified monetary sector in the model, where the money supply is assumed to be exogenous, so that there is no multiple creation of deposits by the commercial banking sector. A compensating factor is that, over the period under consideration, close to 8.70% of the money supply has been held as currency, given the absence of the 'banking habit' among a substantial proportion of the population[17]. Inspite of this, however, our experiments enable us to look at, amongst other things, the effects of deposit creation in an indirect though interesting way. Thus, consider the following:

$$Y_i = F^i(M, X, \underline{Z})$$

where F^i gives the reduced form for the i^{th} endogenous variable ($i = 1,2,..,k$), Y_i = i^{th} engodenous variable, M = money supply, X = government deficit spending, and Z = vector of all other exogenous/predetermined variables in the model.

The general equilibrium effect of a change in M and X can be expressed as

$$dY_i = F_M^i\, dM + F_X^i dX$$

The effect on Y_i is thus the sum of the effect due to the change in M and of the effect due to the change in X. Consequently, in an experimental context, each effect can be examined separately as well as jointly. The decomposition of the total effect on Y_i into the effect due to the change in M with dX = 0, and the effect due to the change in X with dM = 0 could then be used to interpret the results of an experiment in which X and M are simultaneously changed provided there are no significant non-linearities in the model. Experiments 7, 8 and 9 are designed to study the individual effects as well as the joint effects. In Experiment 7, the money supply is held constant while government deficit spending is increased by 10% over the period 0-10. In Experiment 8, government deficit spending is held constant while the money supply is increased by the same amount in absolute units. In Experiment 9, on the other hand, both are increased by an equal amount. Provided there are no significant non-linearities in the system, the linear sum of effects on a particular variable in Experiments 7 and 8 should be reasonably close to the effects on the variable in Experiment 9. If this is so, the effects in Experiment 9 can be interpreted in terms of the individual effects. Additionally, since Experiment 8 isolates the money supply effects, we can use it to make inferences about the likely total effects if the money supply change was not equal to, but, say, greater than, the change in deficit spending. Thus, a money supply change that was greater than the change in deficit spending is similar to allowing for deposit creation, and would give an indication of how the total effect in the simple case (Experiment 9) is likely to be altered.

Experiment 10.

In this experiment we consider a hypothetical increase in the country's foreign exchange earnings to quantify the effects of an easing of the foreign exchange constraint on the economy. We introduce this increase by considering a hypothetical shift in world demand for Indian primary exports. This requires increasing the coefficient of the rest-of-world income coefficient in the adopted primary exports function:

$$EO = 304.603 + 1.7181\ \overline{QWI} - 93.4069(\overline{PEO}/\overline{EI}.\overline{PELDC})$$

where EO = primary exports.

$\overline{QWI}$ = index of world income.

$\overline{PEO}$ = unit-value index of primary exports.

$\overline{EI}$ = index of the exchange rate.

$\overline{PELDC}$ = price index for the exports of developing economies.

This equation was adjusted by replacing the coefficient of $\overline{QWI}$ by 2.5.

Experiments 11 and 12.

In each of the these experiments we consider an important element in the government's resource mobilization drive - viz., taxation. Specifically, we examine, in these experiments, the implications of an annual 10% increase in the "average" direct tax rate. Of particular interest are the effects of this increase on private, government and hence aggregate saving in the economy. This would throw some light on whether the "Please Effect" is valid or not (in the Indian context). The tax rate increase is sustained for a five-year period. Two five-year periods are considered. Thus, in Experiment 11 we consider the implications of a 10% annual increase in the average direct tax rate during the Third Five-Year Plan (1962-1966; years 2 through 6), while in Experiment 11, the same experiment is conducted for the period 1967-1971 (years 7 through 11) which corresponds to the three annual plans and the first two years of the Fourth Five-Year Plan. The objective of the two experiments is to examine the sensitivity of the results, given that the post-1966 period is distinguished from the pre-1966 era by important economic and political changes.

We turn now to a discussion of our results from each of these sets of experiments.

Experiments 7, 8, and 9.

The results for experiments 7, 8 and 9 are reported in Table 7.6A. Let us start first with Experiment 9. The results indicate that the increase in government spending financed via money creation causes national income to rise in all periods, though at it's peak in year 3 the rise is no greater than three-fifths of 1%[19]. That national income rises at all in years 0 through 10 is explained by the fact that while government spending financed through money creation displaces private investment, the increase in government investment manages to more than offset the contractionary effects of declining private investment. Government investment does not rise by the extent of deficit finance since part of this finance is used for consumption, and also because government saving is adversely affected as government revenues do not rise to match increased consumption. After year 10 however, deficit financed nominal expenditures are back at their actual levels. This is reflected in the decline in government consumption and investment, but there is some increase in government saving. However, this is associated with an increase in private investment after year 10, not only because there is no additional draft on private resources, but also because private saving is increasing. Indeed, private saving increases prior to year 10 as well, due to the mild increase in national income, but the increase is more than mopped up by the government, thereby leading to a reduction in private investment.

The behaviour of sectoral output shows that the percentage increase is the largest for industrial output, but services output declines up to year 10 and rises thereafter. Small percentage increases are also shown by agricultural and infrastructural output. As we argued in Section 7.3, the main reason for the increase in agricultural output is that the overall constraint on private investment is not operative in the case of agricultural investment. Consequently, the rise in government investment has favourable effects on agricultural investment and hence output. Infrastructural output rises for similar reasons - viz., that the effects on investment in this sector are dominated by the increase in government investment, while the influence of private investment is weak. The increase in industrial output, which is quite marked, illustrates once again the important point made in earlier discussion that capital formation per se in the industrial sector may not be crucial for output growth. The output-capital ratio also plays an important role. In fact, favourable effects on the output-capital ratio are instrumental in increasing industrial output in the earlier years of the period in this experiment[20].

An obvious question in the context of this experiment pertains to the effect on prices resulting from the increase in money supply. It is evident from the results that the national income deflator depicts what appears to be, only a moderate increase over the entire period. In fact, the simple average percentage price increase during the years 0 through 10 is only about 2.1%. The annual percentage money supply increase implied in this experiment is not constant but, varies from year to year. However, it averages about 2.3% per annum during the period 0-10. In seems that a near-proportional relationship between nominal national income and the money supply is also indicated since the average annual percentage increase in real national income is about .34%, implying a percentage increase in nominal national income of 2.44%. These effects are, of course, total general equilibrium effects and seem to favour a quantity-theory type of relationship between the money supply and nominal national income. There are two rather interesting features of these results. Firstly, they are suggestive of a long-run near-proportional relationship between the money supply and nominal national income, since the effects enumerated above are 11 year averages. The second interesting feature of our findings is that the near-proportionality between nominal income and the money supply is not based upon a quantity-theory type equation, but results from a system in which the national income deflator is determined simultaneously with sectoral prices, which are also dependent upon the interaction of sectoral demands and supplies.

These findings are far from conclusive, but are nevertheless suggestive. Further experimentation over different time periods and with alternative percentage changes in the money supply could shed some more light on this issue.

Let us turn briefly to Experiments 7 and 8. In Experiment 7, there is no money supply change, but increased government borrowing raises government spending. The general direction of effects on the variables is similar to that in Experiment 9. This is to be expected since the only difference here is that there are no money supply induced price effects. These effects now originate from induced demand and supply changes as sectoral output and national income change. Only in the case of the deflator for industrial income, is the direction of change reversed. Thus, in the present experiment, this deflator falls, while in Experiment 9 it increases over the period. This result is due to the fact that, in the model, the price of manufactured goods (which determines the industrial income deflator) is positively related to the ratio of real money balances to national income, and this ratio declines in the present experiment since nominal money supply is unchanged while the general price level and national income rise. In Experiment 9 on the other hand, this ratio rises because of the increase in the money supply. It may be noted that in Experiment 7, the expansionary effects on the various outputs, in general, are relatively stronger than in Experiment 9, with a few exceptions. This follows from the fact that the contractionary effects of money supply induced price increases are absent in this experiment.

In contrast, in Experiment 8, all effects stem from the money supply induced price increases. In particular, in the model, an increase in the money supply impinges directly upon the relative price of manufactured goods. *Ceteris paribus*, it raises the price of manufactured goods and the deflator for industrial income. Since all sectoral prices as well as the national income and fixed investment deflator are simultaneously determined, there are positive effects on all prices. This is clearly seen in the prices (deflators) reported in Table 7.6A. The effect of increased prices (of investment goods in particular) is to lower the volume of investment with consequent deflationary effects on sectoral output (with the exception of agriculture), as well as on national income. It may be noted that government saving rises over the period. But this is because increased prices induce a greater reduction in government consumption than in revenues. A somewhat surprising feature of the results of Experiment 8 is that the effects on the agricultural and national income deflators are relatively weaker as compared to those in Experiment 7. One could argue that in a situation in which there are supply constraints there would be dampening effects on prices as a result of an easing of these constraints (as implied in Experiment 7), while there would be a positive effect on prices when there is a reduction in supplies in the wake of monetary expansion (as implied in Experiment 7).

One reason for our results could be that, in our model, the link between money and prices is through the price of manufactured goods only, and this linkage may be weak[21]. On the other hand, our experiments suggest that income-induced demand effects on prices are strong. Thus, though there is an easing of supply constraints in

Experiment 7, the expansionary demand effects as income rises (precisely due to the easing of these constraints) are sufficiently strong to have relatively stronger effects on prices than in Experiment 8, in which the inflationary demand effects of an increase in the money supply are partly offset by mild deflationary effects resulting from the rather mild decrease in income.

The question of whether the total effects of increased deficit spending based on money creation (i.e., on the printing of money) can be split into two hypothetical, additive sets of effects - viz., those (real) effects resulting from increased government deficit spending but no money creation, and those resulting from money creation but no increased deficit spending - depends upon the accuracy with which the sum of the separate effects (Experiments 7 plus 8) predict the total effects (Experiment 9) given that there are non-linearities in the model. This cannot be ascertained from the results in Table 7.6A since they are expressed in percentages. Table 7.6B has, thus, been constructed for this purpose. In it we report, for selected years and variables, the changes as predicted by Experiment 9 and the sum of changes from Experiments 7 and 8.

The numbers in Table 7.5B suggest that, for most of the variables reported, the assumption of linear additivity of the (real) spending and monetary effects appears to be reasonably accurate as the sum of the effects in Experiments 7 and 8 are rather similar in magnitude to the effects in Experiment 9[22]. If the money supply effects in the total effects can be accurately separated, as appears to be the case here, we can make inferences about the likely total effects for different rates of monetary expansion. Thus in Experiment 9, the increase in government deficit spending does not lead to a multiple creation of deposits - the money supply increases to the extent of the increase in deficit spending, given the simplified nature of the monetary side of the model. However, we can indirectly consider the implications of deposit creation for the results of Experiment 9 by using the results of Experiment 8 to evaluate the effects of money supply increases in excess of the increase in government deficit spending. For one thing, it is clear from Experiment 8 that a money supply increase (considered by itself) results in a decline in national income and an increase in prices. Consequently, if the money supply increase were greater than that considered, these effects would be larger. This implies that the increase in national income would be lower than that implied in Experiment 9. The approximate magnitude of these effects can also be quantified. We do not consider this in any detail here, but can provide some idea of the broad orders of magnitude involved. In Experiment 9, both government spending (borrowing) and the money supply are increased by an annual average of about Rs 1000 million over the period 0-10. The results show that this leads to in an annual average increase in national income of about Rs 505 million over the same period. Experiment 8 shows that when the money supply alone increases by Rs 1000 million, national income declines, on average, by about Rs 115 million (this implies a decrease in national income of about Rs .115 million for an increase in the money supply of Rs 1 million). On the other hand, Experiment 7 shows that the average increase in national income resulting from the Rs 1000 million increase in government spending with no change in the money supply, is about Rs 604 million. The sum of these two separate effects gives an increase in national income of about Rs 489 million, which is quite close to the increase of Rs 505 million implied by the simultaneous increase, by Rs 1000 million, in each of government spending and the money supply in Experiment 9. It is now easy to make rough estimates of the likely increase in national income if the Rs 1000 million increase in government spending is associated with a larger increase in the money supply (due, for example, to deposit creation by commercial banks). Thus, as an illustration consider the case where the Rs 1000 million increase in government deficit spending is accompanied by a Rs 2000 million increase in the money supply. Since our results from Experiment 8 show that a million rupee increase in the money supply alone lowers national income by Rs .115 million, it follows that a Rs 2000 million increase in the money supply will lower national income, on average, by about Rs 230 million. This implies that the total increase in national income would average only about Rs 374 million (Rs 604 million-Rs 230 million). Thus when the increase in government deficit spending by Rs 1000 million is associated with an equivalent increase in the money supply, the increase in national income averages about Rs 604 million. However, when the same increase in government spending is associated with an increase in the money supply that is twice as large (i.e., Rs 2000 million), the increase in national income is, as is to be expected, only Rs 374 million. Similar calculations can be made to evaluate the effects of different rates of monetary expansion on other variables in the system. While the calculations made above are rough - in that they are based on arithmetic averages of annual changes over a 11 year period - they are suggestive. In particular, they show that an average annual increase in government spending by Rs 1000 million raises national by Rs 604 million when there is no money supply increase. About 19% of this increase is lost through price increases if the money supply increases by the same amount, and expectedly, a higher 38% is lost if the money supply increase is twice as large.

Experiment 10.

In this experiment, which involves a favourable shift in the demand for Indian primary exports, the shock to the system is in the form of an easing of the foreign exchange constraint. Consequently, the primary effects operate via increased imports of capital goods and raw materials and intermediate goods. The results of this experiment are reported in Table 7.7.

Industrial output increases since the increased availability of imported inputs has favourable effects on the output capital ratio. The increase in industrial output is sustained through the entire period not only due to increased exchange availabilities but also due to induced secondary effects on investment in the industrial sector[23]. The effects on investment can be ascertained by observing the behaviour of private and government investment. It is clear that the private sector derives the bulk of the beneficial effects on investment arising out of increased foreign exchange availabilities. This is because private saving responds favourably as national income (and disposable income) rises. On the other hand, for given tax rates, government revenues do not increase by much, and this is reflected in the moderately small percentage increases in government investment. The main impact of increased private investment is on industrial and services investment and hence on their corresponding outputs,for reasons outlined in earlier experiments. The increase in agricultural output is due to a mild increase in yield as well as in agricultural investment, primarily because of the mild increase in government investment. Infrastructural output, on the other hand, declines in periods 0 through 7, primarily becuase infrastructural investment declines in the initial periods and rises very slowly thereafter. Nevertheless, national income as a whole does rise, an increase that is more than sustained through the period. In fact, it is interesting to note that the expansionary effects of permanently increased foreign exchange earnings tend to increase over time, though they tend to stabilize at the end of the period. Thus, the percentage increase in national income is .36% in year 0, rises to .90% by period 9 and stabilizes at .85% at the end of the simulation period. It seems to be the case that the effects of increased exchange availabilities tend to have their largest effect on sectoral output, national income, investment, etc., only over the long run. Further, their main effect seems to be on industrial output. This is because an easing of the foreign exchange constraint, by permitting a higher volume of imported inputs, has its main impact upon the output-capital ratio in the industrial sector.

Experiments 11 and 12.

These experiments throw some light on the effects of additional taxation on the pattern of saving (and hence on aggregate saving) and the pattern of investment in the economy. Further, since each experiment is the same but for the difference in periods, they shed light also on the question of whether responses are significantly different in the two periods. The results of these experiments are reported in Table 7.8.

Our findings suggest that there is no significant difference in the effects on the pattern of saving in the two periods. Expectedly, the tax rate increases are associated with a decline in private saving and an increase in government saving, though the magnitude of responses (in percentage terms) is very similar. More importantly, the increase in the tax rate is seen to leave aggregate saving virtually unchanged in both experiments, implying that the increase in government saving is offset by the decline in private saving. These effects are reflected in an increase in government investment and a decline in private investment during the years in which the tax rate is higher. In subsequent years, both rise, though marginally, in both experiments. National income is observed to rise through the entire period in both experiments, even though private investment declines in the years when tax rates are higher, because of the differential impact of private and government investment on sectoral investment discussed in earlier experiments. However, again the percentage rise in national income is very similar in both experiments. In general, it appears that increased tax rates do not appear to change aggregate saving in the economy, nor do the overall results depend upon the two periods considered. However, the pattern of saving affects the pattern of investment and this, given the structure of our model, does affect national income through its differential impact on sectoral output.

(7.6) SUMMARY AND CONCLUSIONS

The foregoing experiments represent a small sample of possible experiments that can be conducted to gain a better understanding of the structural and dynamic features of the model. Our findings suggest that increased foreign capital inflows, irrespective of whether or not they are partly consumed, have favourable secondary effects on saving, investment and income in the economy[24]. While the distribution of the increased foreign capital inflows between the private and government sector has different implications for the pattern of saving and investment, as well as for the sectoral composition of output, it does not appear to lead to differences, to any significant degree, in the effect on the path of national income, or for that matter, on aggregate investment and saving. The 20% annual reduction in the inflow over the Third Plan and the latter half of the Second Plan, does not appear to have significant effects on income over this period. In particular, the contractionary effects of the reduction are mainly felt thereafter, and in the longer term, when national income stabilizes at around 1.5% below its actual path. Similarly, the increase in capital inflows over 1966-1971 implied in Experiments 3 and 4 are found to have expansionary effects beyond 1971 as national income tends to stabilize at a level 3.5% above it's actual path. In terms of the change in per capita income, in absolute units, this change is not very significant. Further, there do not appear to be any significant effects on the growth rate of national income over the long-term. Thus, while the simple average annual growth rate over the period 1960-1976 is about

3.5% along the actual path of national income, it accelerates to only 4% along the higher path. In the short-run, however, there is a definite acceleration in the growth as it jumps from an annual average of 3.9% to 5.1% (over the period 1966-1972). After 1972, the rate of growth of national income averages 2.2% per annum along both paths. Thus, a sharp foreign capital inflow increase that is confined to a short period, leads to an acceleration in the rate of growth, but this is not sustained over the longer term[25]. We also considered the implications of a moderate annual increase of Rs 500 million in the foreign capital inflow over a longer period (1960-1970). The results of this experiment (not reported here) showed that the expansionary effects on national income are felt primarily after a lapse of 5-6 years and that the average percentage increase in national income stabilizes at a level 1% above its actual level by the end of the simulation. On the other hand, there is practically no effect on the growth rate either in the short or long run. It seems that sharp increases in foreign capital inflows would have to be sustained over a long period for them to induce an acceleration in the growth rate that is both significant, and sustained over the long-run. It may be noted in passing that the capital inflow increases considered in our experiments involved loans only. If these increases were in the form of transfers instead of loans, the favourable effects on national income would be stronger as transfers do not involve interest payments in future periods

Our experiments also suggest that an increase in export earnings resulting from a favourable shift in world demand for Indian primary exports leads to expansionary effects on sectoral and national income, though primarily in the longer term. These expansionary effects result from an easing of the foreign exchange constraint as foreign exchange availability, net of food and other 'priority' imports, rises by an average of 15%-17% over the entire period. The main effect of an easing of the foreign exchange constraint is on industrial output which rises by an average of about 1.5% in the short-run, and tends to stabilize at 2.25% above its actual level by the end of the simulation period. The percentage increase in national income is relatively mild, and though it tends to increase over the period, it is just below 1% by the end of the simulation. Thus, an increase in foreign exchange supplies *per se* does not have any dramatic effects on output in the economy. This is because the increase has no *direct* effect on the level of investment in the economy[26]. In contrast, an increase in foreign capital inflows not only involve an increase in the supply of foreign exchange but also *directly* raise the volume of investment.

Our tax rate experiments show that a 10% increase in the average direct tax rate sustained over a five year period, is very similar in terms of it's effects on the pattern of saving, investment and output irrespective of the particular period (in the sample) over which the increase is initiated and sustained. Furthermore, our experiments show that increased direct taxation as a means to greater resource mobilization, succeeds in channelling resources from the private sector to the government sector, but does not raise the volume of saving in the economy since the reduction in private saving exactly offsets the increase in government saving. However, the implied change in the pattern of investment has expansionary effects on national income via its differential impact upon the pattern of output: but these effects are rather mild.

Increased government spending (over the period 1960-1970) based on the printing of money is found to raise output as well as prices. An interesting feature of the results is that the 2.3% average annual increase in the money supply over the period is associated with a .3% average annual increases in national output and a 2.1% average annual increase in prices. Thus, it seems that the bulk of the effects of government deficit spending are absorbed through rising prices[27]. However, the rise in prices is not solely,nor largely,due to the increase in money supply per se (except in the very short run - viz., 2 or 3 periods). Prices also rise becuase the mild expansionary effects on the supply of output are more than offset by the induced demand effects arising due to the increase in income. Nevertheless, the larger the increase in the money supply (say, due to deposit creation) associated with the same given increase in government borrowing, the larger the effect upon prices and the smaller the effect on output.

Our experiments on the effects of PL 480 foodgrains aid suggest that a 20% annual reduction in such aid over the period 1960-1967, accompanied by a compensating increase in foreign exchange aid, leads to favourable effects on sectoral and national output, but that both the short-term and the long-term effects are mild. There is a positive effect on both the domestic production of foodgrains and agricultural investment, but again the effect is mild in the short and long term. There is a sharp increase in commercial foodgrain imports up to 1967 but this drain on export earnings is more than offset by the compensating increase in foreign exchange aid. However, the supply of foodgrains in the economy is adversely affected up to 1967, but shows little change thereafter. Thus, but for this effect, the reduction in PL 480 aid has favourable effects not only on foodgrains production, but also on agricultural output, agricultural investment and national income.

However, when the reduction in PL 480 aid is accompanied by a reduction in capital transfers to the government (i.e., when PL 480 aid is viewed as a grant), the aforementioned favourable effects are overturned. Not only are the effects on foodgrains production, sectoral output, agricultural investment and national income, to name a few, adverse, they are also stronger and tend to persist up to the end of the simulation period. These adverse effects stem from the direct and secondary effects of the reduction in capital transfers to the government, as well as from the adverse foreign exchange effects that arise due to the increase in commercial imports in a situation in which there is no increase in the supply of foreign exchange. In this type of scenario, therefore, lower PL 480 aid is associated with specific as well as general adverse effects. It seems reasonable to conclude that in the absence of (or considerably lower) PL 480 foodgrain imports, government investment (and hence sectoral and national output) would be adversely affected in the short as well as long run, unless other sources of finance were made available to the government.

Needless to say, the reliability of the results of these experiments is dependent upon, amongst other things, the confidence we have on the forecasting abilities of the model. We saw in Section 7.2 that the model forecasts the levels of and changes in most of the important variables reasonably well. However, the sectoral investment and aggregate private investment forecasts are subject to relatively larger errors.

In Chapter 5 we saw that there was some amount of instability in the estimated coefficient of the government investment variable in the agricultural and industrial investment equations. We tracked the model with an alternative set of equations for agricultural and industrial investment, but this did not help very much. We also conducted Experiments 1-4 with this model and found the results to be similar. In general, we also considered various other specifications of the model which differed mainly with respect to the government saving/consumption-investment relationships. For instance, one specification involved making foreign capital exactly additive to domestic resources. The forecasts with this model were quite the same, and the results of some of the experiments considered displayed the same general pattern we have reported above, but for the one difference that foreign capital had greater expansionary effects on income.

We feel that the results of the experiments reported in this thesis are far more reliable at the aggregate level than at the disaggregated level, with some obvious exceptions. At the disaggregated level we feel that the sectoral investment effects and the private investment effects need to be interpreted with some caution, since the forecasts of these variables are subject to relatively large errors. However, as we noted in Section 7.2, these are not likely to have serious implications for the sectoral output, national income, government investment and price effects, since the model forecasts these variables quite well.

TABLE 7.1: THE CONTROL SOLUTION AND FORECAST ERROR (IN ABSOLUTE UNITS) FOR SELECTED VARIABLES - 1960-1976

VARIABLE	UNITS OF MEASUREMENT	0		1		2		3		4		5	
		CONTROL	DEVIATION	CONTROL	DEVIATION	CONTROL	DEVIATION	CONTROL	DEVIATION	CONTROL	DEVIATION	CONTROL	DEVIATION
SF	Million tons	71.15	0.21	72.83	-2.61	75.24	-0.36	75.86	0.77	77.60	1.32	83.20	-2.26
YF	"	77.51	0.39	79.10	-3.24	83.35	0.95	81.90	1.57	82.85	2.15	88.57	-0.80
ZCRP	Rs billion	1.55	0.11	1.53	-0.29	1.23	0.06	1.48	-0.03	1.96	0.10	2.50	-0.09
YA	"	65.27	0.94	66.17	-2.14	69.21	0.32	68.41	1.33	69.04	0.06	72.72	-2.44
YM	"	23.05	-0.73	25.37	-0.78	27.17	-0.91	28.87	-1.16	30.52	-2.27	32.82	-2.33
YINF	"	5.85	-0.05	6.35	-0.11	6.80	-0.20	7.20	-0.34	7.66	-0.57	8.17	-0.45
YSV	"	30.90	0.33	32.12	-0.33	33.74	-0.54	35.44	-0.94	37.19	-1.63	38.96	-2.39
NY	"	124.48	0.50	129.27	-3.36	136.02	-1.27	138.82	-1.12	143.18	-4.53	151.31	-7.54
CGI	"	13.53	-0.46	14.94	1.43	15.75	0.91	18.01	1.00	19.24	-0.17	19.24	0.39
SP	"	7.24	-2.23	8.43	-1.61	9.74	0.88	10.55	-0.12	11.56	0.44	13.24	2.18
NFIG	"	8.25	0.55	8.33	-0.86	7.84	-0.32	9.19	-0.15	9.66	-1.27	10.59	-1.63
NFIP	"	1.71	-2.10	4.68	-0.03	5.68	0.50	6.47	1.79	6.79	0.84	8.36	1.35
NFIA	"	2.44	0.98	2.23	0.38	2.15	0.48	2.68	1.16	2.43	0.24	2.91	0.22
NFIM	"	2.18	-1.63	3.67	-1.50	4.10	-0.19	4.68	0.01	4.99	0.52	5.74	-0.41
NFINF	"	3.42	1.04	3.47	0.93	3.04	-0.97	3.67	-0.96	4.15	-1.30	4.62	-1.06
NFISV	"	1.91	-1.96	3.65	-0.70	4.23	0.88	4.63	1.43	4.89	0.12	5.68	0.97
EM	"	3.11	-0.01	2.55	-0.35	2.73	-0.19	3.16	0.13	3.35	-0.29	3.37	-0.28
EO	"	3.82	-0.21	3.83	0.31	3.92	0.17	4.02	-0.06	4.14	-0.53	4.29	-0.45
ZRAW	"	3.73	-1.18	4.45	-0.95	4.25	-1.09	4.96	-0.42	5.13	-0.36	5.76	0.58
ZCAP	"	2.67	-0.09	3.18	-0.15	2.88	-0.55	3.18	-0.25	3.25	-0.10	3.50	-0.47
PFF	Index	1.02	0.02	1.08	0.08	1.13	0.15	1.17	0.13	1.27	0.14	1.36	-0.07
PAD	"	1.03	0.06	1.10	0.10	1.13	0.10	1.19	0.11	1.29	0.08	1.38	0.02
PMD	"	0.99	0.03	1.00	0	1.02	0.02	1.05	0.03	1.13	0.05	1.20	0.08
P	"	0.01	0.03	1.05	0.05	1.09	0.07	1.12	0.06	1.31	0.06	1.31	0.05

(continued...)

TABLE 7.1: (continued)

VARIABLE	UNITS OF MEASUREMENT	6 CONTROL	6 DEVIATION	7 CONTROL	7 DEVIATION	8 CONTROL	8 DEVIATION	9 CONTROL	9 DEVIATION	10 CONTROL	10 DEVIATION	11 CONTROL	11 DEVIATION
SF	Million Tons	82.14	8.20	82.86	8.51	86.62	-2.71	83.39	-2.30	86.93	-2.61	89.76	-5.46
YF	" "	83.61	11.27	86.74	12.51	91.61	-3.45	89.76	-4.25	95.07	-4.43	99.08	-9.34
ZCRP	Rs billion	3.09	-0.06	2.86	-1.28	2.76	-0.30	1.90	-0.09	1.69	0.09	1.53	0.18
YA	"	69.62	4.83	71.94	7.71	75.38	1.32	73.93	-0.94	76.98	-2.59	79.87	-4.59
YM	"	34.84	-1.26	37.96	1.54	40.43	2.93	41.53	2.76	42.33	0.21	43.30	0.57
YINF	"	8.73	-0.46	9.35	-0.16	9.96	-0.08	10.51	-0.28	11.03	-0.36	11.52	-0.16
YSV	"	40.89	-1.37	42.72	-1.00	44.60	-0.55	46.75	-0.46	48.92	-0.78	51.13	-1.80
NY	"	152.63	1.81	160.83	8.43	168.93	3.99	171.12	1.21	177.52	-3.40	184.07	-5.87
CGI	"	21.84	1.68	22.17	1.53	21.17	0.53	21.60	-0.78	22.43	-1.66	24.46	-1.57
SP	"	14.04	-0.24	16.00	-1.25	17.51	1.90	17.79	2.41	18.91	-0.26	19.86	1.02
NFIG	"	12.47	-1.87	11.39	-1.61	10.50	-0.15	10.40	-0.04	10.46	-0.38	11.39	0.39
NFIP	"	7.04	-1.37	7.70	-2.64	10.71	-0.79	11.05	-0.20	11.12	-1.75	13.74	1.80
NFIA	"	3.11	-0.59	2.04	-0.38	2.59	-0.28	2.66	-0.71	2.75	-1.15	3.40	-0.87
NFIM	"	5.90	-1.32	6.20	-3.88	7.12	0.33	7.32	1.34	7.43	0.47	8.18	1.47
NFINF	"	5.07	-1.47	5.06	0.20	4.60	0.26	4.39	-0.36	4.07	-0.27	5.33	0.91
NFISV	"	5.43	0.14	5.78	-0.19	6.92	-1.24	7.08	-0.51	7.32	-1.18	8.22	0.68
EM	"	3.16	-0.42	3.51	0.46	4.02	0.41	4.36	-0.12	4.49	-0.18	4.92	0.12
EO	"	4.40	0.13	4.60	0.52	4.66	0.47	4.84	0.32	4.98	0.64	5.05	0.26
ZRAW	"	5.51	0.48	6.51	2.01	6.27	1.22	5.67	0.24	5.74	0.75	6.55	0.70
ZCAP	"	3.36	-0.21	3.55	0.93	3.22	0.23	2.85	0.13	2.69	0.77	3.13	0.90
PF	Index	1.43	-0.08	1.73	-0.07	1.89	-0.35	1.97	-0.01	2.10	0.05	2.19	0.16
PAD	"	1.54	0	1.73	-0.13	1.85	-0.15	1.91	-0.02	1.97	-0.03	2.04	0.04
PMD	"	1.26	0.07	1.32	0.02	1.37	-0.02	1.41	-0.02	1.52	-0.01	1.64	0.01
P	"	1.40	0.03	1.58	0.01	1.70	-0.01	1.71	0.02	1.77	0.01	1.85	0.04

(continued...)

TABLE 7.1: (continued)

VARIABLE	UNITS OF MEASUREMENT	12 CONTROL	12 DEVIATION	13 CONTROL	13 DEVIATION	14 CONTROL	14 DEVIATION	15 CONTROL	15 DEVIATION	16 CONTROL	16 DEVIATION	SUMMARY STATISTICS MPD	SUMMARY STATISTICS MAPD	SUMMARY STATISTICS PTCF
SF	million tons	100.54	5.20	89.31	-0.21	95.29	-0.65	94.28	2.79	100.88	-3.81	0.51	3.50	88
YF	" "	115.14	9.98	96.68	-0.35	106.43	1.77	102.81	2.99	112.80	-8.25	1.14	5.07	88
ZCRP	Rs billion	1.10	0.24	0.78	0.39	1.21	-0.33	1.51	-0.46	1.50	-1.38	0.27	19.26	85
YA	"	88.34	4.53	78.28	0.26	85.02	0.97	82.18	0.21	88.54	-2.55	0.78	3.03	81
YM	"	45.63	1.87	48.14	2.46	49.65	1.89	49.21	1.40	49.01	-1.08	0.44	4.24	88
YINF	"	12.16	-0.89	12.80	-0.44	13.49	0.34	14.06	0.12	14.67	-0.52	-2.21	2.62	100
YSV	"	53.56	-1.57	56.07	-0.34	58.35	-0.25	60.61	0.39	63.30	-0.99	-1.86	2.06	100
NY	"	197.71	4.81	193.30	2.38	105.05	4.02	25.06	2.12	214.85	-5.22	-0.14	2.14	94
CGI	"	28.33	-1.57	28.95	-1.32	28.05	1.17	28.73	1.10	33.14	-0.76	1.11	4.92	91
SP	"	21.91	-0.36	21.44	-0.30	23.93	-0.17	23.81	1.28	25.06	-2.02	0.01	7.89	81
NFIG	"	13.78	1.95	16.09	1.93	14.74	0.11	10.44	-0.40	11.85	0.04	-1.90	6.82	94
NFIP	"	12.94	0.91	10.15	-0.60	9.42	-1.56	15.54	4.64	13.08	1.70	1.28	17.70	50
NFIA	"	4.25	0.70	4.07	-0.53	3.41	-0.18	2.18	0.01	3.38	0.93	8.27	23.42	75
NFIM	"	8.59	1.07	8.52	1.55	8.25	0.68	9.23	-0.44	8.81	0.16	-1.71	15.27	63
NFINF	"	5.31	0.62	5.83	0.36	4.72	0.81	5.11	1.56	3.56	-0.52	3.49	19.60	69
NFISV	"	8.58	0.48	7.83	-0.07	7.79	-2.75	9.45	3.10	9.18	1.17	2.53	18.09	44
EM	"	5.10	0.28	5.34	0.07	5.93	0.09	6.25	-0.21	6.92	-0.10	-.92	5.85	94
EO	"	5.17	0.12	5.38	-0.24	5.61	-0.01	5.57	-0.02	5.63	-0.93	1.38	6.85	75
ZRAW	"	7.81	0.13	8.74	0.28	7.73	-0.64	6.12	-0.50	5.87	0.03	2.20	12.96	69
ZCAP	"	3.33	0.55	3.58	0.92	2.93	-0.08	2.65	0.33	2.04	-0.32	7.63	15.56	56
PF	Index	2.27	0.16	2.57	0.14	3.27	0.36	3.55	-0.39	3.51	-0.01	2.72	7.46	75
PAD	"	2.09	0.01	2.53	-0.08	2.86	-0.20	3.30	-0.16	3.13	0.27	1.81	5.13	94
PMD	"	1.79	0.04	1.90	0.04	2.19	0.10	2.47	-0.15	2.66	-0.12	1.37	2.94	100
P	"	1.99	0.09	2.19	0.07	2.55	0.04	2.83	-0.09	2.79	0.30	2.64	3.06	82

Notes:

(1) Deviation = (Control-Actual)

(2) MPD = mean percentage deivation; MAPD = mean absolute percentage deviation

(3) PTCF = percentage of year-to-year changes that are correctly forecast.

(Table 7.1 concluded)

TABLE 7.2: PERCENTAGE DISTRIBUTION OF MAPD BY PTCF FOR 24 ENDOGENOUS VARIABLES

PTCF (percent)	MAPD (percent) 1-6	6-11	11-16	16-21	21-27	Relative Frequency (PTCF)	Cumulative Relative Frequency (PTCF)
90-100	29.2	4.2	-	-	-	33.4	33.4
80-89	20.8	4.2	-	4.2	-	29.2	62.6
70-79	-	8.3	-	-	4.2	12.5	75.1
60-69	-	-	8.3	4.2	-	12.5	87.6
50-59	-	-	4.2	4.2	-	8.4	96.0
0-49	-	-	-	4.2	-	4.2	100.0
Relative frequency (MAPD)	50.0	16.7	12.5	16.8	4.2	100.0	Mean = 80.9 Median = 86.5
Cumulative relative frequency (MAPD)	50.0	66.7	79.2	96.0	100.0	Mean = 8.9 Median = 6.8	

Note : The means and medians reported are calculated from the raw data on MAPD and PTCF presented in Table 7.1.

TABLE 7.3: PERCENTAGE CHANGE IN SELECTED VARIABLES FOLLOWING

A 20% ANNUAL REDUCTION IN CAPITAL INFLOW : 1960-1966

		YEAR IN SIMULATION PERIOD										
Experiment	Variable	0	1	2	3	4	5	7	9	11	14	16
Experiment 1.	YA	0	0	-0.01	-0.01	-0.02	-0.04	-0.09	-0.13	-0.17	-0.24	-0.28
	YM	-0.76	-0.28	-0.30	-1.23	-2.40	-3.61	-4.08	-2.86	-2.45	-2.15	-2.17
20% annual	YINF	0	0.25	-0.16	-0.54	-1.02	-1.39	-2.33	-2.34	-2.43	-2.56	-2.61
reduction in	YSV	0	-0.35	-0.75	-1.00	-1.26	-1.50	-2.12	-2.29	-2.38	-2.47	-2.54
capital inflow-	NY	-0.14	-0.12	-0.23	-0.49	-0.83	-1.18	-1.61	-1.43	-1.38	-1.44	-1.51
private sector;	CG1	-0.01	-0.07	-0.21	-0.39	-0.66	-0.91	-1.37	-1.32	-1.30	-1.42	-1.42
years 0 through	SG1	-1.06	-0.48	-0.35	-1.12	-1.73	-2.53	-3.68	-2.04	-1.86	-1.80	-1.92
6.	SP	-1.02	-0.64	-1.10	-2.21	-3.32	-4.13	-4.18	-3.08	-2.78	-2.54	-2.60
	NFIG	-0.13	-0.14	-0.21	-0.41	-0.63	-0.81	-0.83	-0.88	-0.92	-0.83	-1.10
	NFIP	-31.73	-23.28	-15.02	-16.26	-15.71	-18.08	-8.69	-6.13	-4.93	-7.70	-4.54
	ZRAW	-5.55	-8.71	-6.37	-7.14	-6.81	-8.12	0.95	1.15	0.93	0.51	0.22
	ZCRP	0	0.01	0.03	0.04	0.05	0.07	0.18	0.49	0.85	1.58	1.55
	P	-0.21	0.08	0.28	0.19	0.07	-0.14	-0.12	0.38	0.61	0.70	0.83
Experiment 2.	YA	0	-0.07	-0.14	-0.13	-0.17	-0.20	-0.30	-0.27	-0.32	-0.40	-0.46
	YM	-0.76	-1.95	-3.32	-5.07	-6.36	-7.34	-6.99	-5.07	-4.25	-3.55	-3.41
20% annual	YINF	0	-0.18	-0.87	-1.50	-2.02	-2.46	-3.44	-3.50	-3.56	-3.70	-3.72
reduction in	YSV	0	-0.06	-0.13	-0.22	-0.37	-0.55	-1.05	-1.46	-1.75	-2.08	-2.29
cpaital inflow-	NY	-0.14	-0.43	-0.78	-1.20	-1.57	-1.88	-2.17	-1.87	-1.76	-1.81	1.87
government	CG1	-1.30	-2.47	-2.05	-2.41	-2.52	-3.12	-1.66	-1.61	-1.56	-1.75	-1.75
sector;	SG1	9.68	16.78	6.64	7.50	4.49	5.94	-6.49	-3.38	-3.05	-2.72	-2.90
periods 0	SP	-1.02	-2.39	-3.65	-5.08	-5.85	-6.19	-5.31	-3.90	-3.46	-3.12	-3.13
through 6.	NFIG	-4.10	-8.05	-6.30	-6.66	-6.10	-7.39	-1.03	-1.14	-1.19	-0.85	-1 69
	NFIP	-1.93	-2.41	-4.45	-6.28	-8.13	-9.53	-12.50	-9.18	-7.34	-11.33	-6.43
	ZRAW	-5.55	-8.72	-6.41	-7.20	-6.89	-8.20	0.86	1.05	0.85	0.39	0.10
	ZCRP	0	0.06	0.36	0.56	0.51	0.50	0.68	1.11	1.62	2.77	2.57
	P	-0.21	-0.44	-0.62	-0.86	-1.11	-1.41	-1.44	-0.69	-0.29	-0.07	0.13

TABLE 7.4: PERCENTAGE CHANGE IN SELECTED VARIABLES RESULTING FROM MAINTAINING CAPITAL INFLOW OVER 1966-71 AT 1965 PEAK LEVEL

Experiment	Variable	YEAR IN SIMULATION PERIOD										
		6	7	8	9	10	11	12	13	14	15	16
Experiment 3.	YA	0	0	.01	.02	.09	.22	.38	.53	.61	.69	.82
	YM	.03	.32	1.07	4.53	9.60	13.37	13.32	11.58	10.40	9.85	9.89
Maintaining	YINF	0	.01	.12	.56	2.38	4.37	5.91	5.71	5.81	5.96	6.22
capital	YSV	0	.01	.07	.20	.68	1.30	1.82	2.10	2.45	2.88	3.10
inflow at	NY	.01	.08	.28	1.18	2.57	3.68	3.80	3.76	3.59	3.70	3.74
1965 peak	SG1	.03	.35	1.08	3.28	6.11	9.52	9.69	8.21	6.52	7.40	7.32
level of $1.5	SP	.02	.25	.81	3.30	6.72	8.81	8.15	7.01	6.23	6.28	6.27
billion -	NFIG	0	.04	.16	.91	1.91	2.87	2.55	1.93	1.21	3.76	4.36
private sector;	NFIP	.34	3.74	8.08	31.56	41.58	31.90	14.65	24.18	31.00	15.46	15.79
years 6	PAD	.01	.15	.52	2.22	4.67	7.32	9.68	5.30	5.29	5.11	5.39
through 11.	PMD	-.02	-.26	-.93	-4.04	-8.42	-11.27	-10.66	-11.48	-10.06	-9.06	-7.99
	P	.01	.11	.36	1.58	3.08	4.74	6.42	2.63	2.53	2.32	2.36
Experiment 4.	YA	0	0	.03	.09	.36	.50	.53	.37	.43	.47	.56
	YM	.03	.32	1.07	4.43	8.63	12.02	11.82	11.02	9.90	9.31	9.31
Maintaining	YINF	0	.01	.11	.45	1.69	3.43	4.77	5.01	4.99	5.10	5.35
capital	YSV	0	0	.01	.04	.15	.34	.59	.85	1.19	1.61	1.85
inflow at	NY	.01	.08	.27	1.13	2.28	3.20	3.19	3.23	3.07	3.15	3.19
1965 peak level	SG1	-.25	-3.26	-8.62	-25.27	-26.73	-14.46	8.73	8.14	5.97	6.79	6.75
of $1.5 billion	SP	.02	.24	.77	3.13	5.71	7.38	6.56	5.98	5.29	5.30	5.31
government	NFIG	.12	1.58	4.96	20.89	25.75	20.03	2.14	1.53	.87	3.39	4.05
sector; years	NFIP	.02	.19	.64	1.92	4.94	7.19	11.50	20.16	28.28	14.21	14.45
6 through 11.	PAD	.01	.15	.51	2.15	4.04	6.44	8.65	6.01	5.11	4.92	5.24
	PMD	-.02	-.25	-.93	-3.94	-7.50	-10.02	-9.27	-10.79	-9.67	-8.81	-7.49
	P	.01	.11	.39	1.63	2.99	4.71	6.45	3.89	3.01	2.79	2.91

TABLE 7.5: PERCENTAGE CHANGE IN SELECTED VARIABLES DUE TO

20% ANNUAL REDUCTION IN PL 480 IMPORTS: 1960-67

		YEAR IN SIMULATION PERIOD										
Experiment	Variable	0	1	2	3	4	5	6	7	10	13	16
Experiment 5.	AF	0	.13	.21	.17	.18	.24	.34	.39	0	0	0
	YLDF	0	-.10	-.16	-.12	-.13	-.17	-.25	-.28	-.02	.03	.03
20% annual	YF	0	.03	.05	.05	.07	.09	.11	.11	.03	.03	.04
reduction in	SF	-.65	-.68	-.40	-.65	-.84	-1.09	-1.06	0	.02	.03	.03
PL 480 imports	ZFCOM	13.79	30.12	17.32	21.15	23.78	52.87	351.73	37.67	-.25	-.28	-.16
compensated by	YA	0	0	0	0	.01	.01	.01	.01	.02	.02	.03
foreign	YM	.24	.41	.38	.39	.48	.64	.77	.70	.15	.14	.12
exchange aid;	NY	.05	.08	.08	.09	.12	.16	.20	.20	.08	.09	.09
years 0	NFIA	.06	.12	.12	.10	.15	.18	.21	.31	.11	.10	.11
through 6.	NFIG	.01	.02	.04	.04	.06	.07	.08	.09	.05	.05	.07
	NFIP	.64	.55	.63	.65	.72	.81	1.12	1.09	.54	.45	.30
Experiment 6.	AF	0	.13	.20	.15	.15	.15	.15	.19	-.09	-.09	-.07
	YLDF	0	-.13	-.22	-.17	-.19	-.25	-.36	-.42	-.12	-.19	-.28
20% annual	YF	0	-.01	-.02	-.02	-.04	-.06	-.08	-.11	-.20	-.28	-.31
reduction in	SF	-.65	-.70	-.45	-.71	-.90	-1.18	-1.58	-1.22	-.16	-.22	-.27
PL 480 imports	ZFCOM	13.79	30.35	18.05	22.39	24.83	55.23	368.42	40.26	.95	2.38	1.44
accompanied by	YA	0	-.03	-.05	-.04	-.05	-.07	-.11	-.13	-.13	-.19	-.21
matching reduction	YM	.02	-.13	-.67	-1.28	-1.75	-2.14	-2.62	-2.98	-3.00	-2.41	-2.12
in capital trans-	NY	0	-.05	-.18	-.33	-.46	-.59	-.78	-.94	-1.05	-1.05	-1.03
fers; years 0	NFIA	-1.65	-1.62	.50	-.93	-1.42	-2.26	-1.62	-2.00	-1.54	-1.14	-1.64
through 6.	NFIG	-1.69	-2.97	-2.19	-2.30	-2.76	-3.83	-3.68	-3.98	-.68	-.56	-1.06
	NFIP	.06	-.17	-.85	-1.52	-2.19	-2.75	-4.11	-4.56	-4.73	-5.93	-3.95

TABLE 7.6A: PERCENTAGE CHANGE IN SELECTED VARIABLES DUE TO
10% INCREASE IN GOVERNMENT BORROWING: 1960-1970

		YEAR IN SIMULATION PERIOD										
Experiment	Variable	0	1	2	3	4	5	6	7	8	9	16
Experiment 7.	YA	0	.07	.10	.09	.14	.15	.17	.20	.21	.22	.19
	YM	0	1.83	2.88	3.24	2.98	2.68	2.34	1.99	1.98	1.97	1.42
10% annual	YINF	0	.47	.63	.75	.68	.75	.75	.73	.85	.86	.90
increase in	YSV	0	-.33	-.53	-.61	-.71	-.76	-.79	-.88	-.96	-1.01	-.60
government	NY	0	.34	.53	.60	.55	.50	.44	.37	.36	.35	.29
borrowing	SG1	-13.01	-11.51	-4.69	-6.87	-5.78	-6.31	-10.53	-10.12	-9.63	-4.77	1.07
- no change	SP	0	1.88	2.44	2.38	1.74	1.33	.97	.64	.63	.59	.38
in money	NFIG	4.82	5.54	4.43	5.40	4.86	4.89	5.43	5.32	5.95	4.38	.65
supply;	NFIP	-36.11	-14.34	-6.79	-9.44	-6.70	-5.81	-11.67	-9.02	-6.54	-4.16	1.93
years 0	PAD	0	.63	.95	1.84	1.00	.97	1.33	.88	.94	.94	.97
through 10.	PMD	0	-.83	-1.43	-1.38	-1.70	-1.60	-1.33	-1.45	-1.65	-1.56	-.93
	P	0	.58	.85	1.70	.95	.95	1.33	.99	1.07	1.09	1.05
Experiment 8.	YA	0	0	0	.01	.01	.01	.01	.01	.01	.01	.01
	YM	0	.12	.02	-.10	-.25	-.29	-.28	-.26	-.28	-.33	.12
Annual increase	YINF	0	0	-.09	-.13	-.19	-.19	-.19	-.18	-.20	-.23	-.05
in money supply	YSV	0	-.04	-.08	-.09	-.11	-.11	-.11	-.12	-.13	-.15	-.09
equivalent to	NY	0	.01	-.02	0.05	-.09	-.09	-.10	-.10	-.11	-.13	0
10% of	SG1	.74	1.28	.40	1.19	.40	.35	1.01	1.05	.93	.27	.09
governmeng	SP	.02	.12	-.09	-.22	-.37	-.34	-.30	-.27	-.28	-.32	0
borrowing -	NFIG	-.14	-.20	-.07	-.17	-.10	-.14	-.19	-.12	-.09	-.06	.05
no change in	NFIP	-3.52	-2.54	-.94	-1.17	-.17	-.23	-.53	-1.08	-.88	-.05	.13
government	PAD	.57	.99	.67	1.36	.59	.52	.68	.74	.66	.52	.10
spending	PMD	1.02	1.95	1.71	2.18	2.04	2.05	2.51	2.84	2.79	2.43	-.06
years 0	P	.67	1.21	.89	1.59	.88	.80	1.00	1.08	.99	.12	.14
through 10												

TABLE 7.6A (continued)

EXPERIMENT	VARIABLE	0	1	2	3	4	5	6	7	8	9	16
		YEAR IN SIMULATION PERIOD										
Experiment 9.	YA	0	.07	.10	.10	.15	.17	.19	.23	.23	.25	.21
10% annual increase	YM	0	2.02	3.02	3.18	2.74	2.34	2.04	1.74	1.74	1.71	1.59
in government	YINF	0	.49	.57	.59	.47	.51	.55	.54	.64	.64	.90
borrowing accom-	YSV	0	-.37	-.61	-.72	-.83	-.88	-.91	-.99	-1.08	-1.14	-.66
panied by	NY	0	.36	.53	.56	.47	.39	.34	.28	.27	.25	.32
equivalent increase	SG1	-12.18	-10.04	-3.80	-5.45	-4.77	-5.92	-9.28	-8.96	-8.57	-4.41	1.20
in money supply;	SP	.02	2.08	2.48	2.16	1.36	.91	.65	.40	.39	.33	.43
years 0 through 10	NFIG	4.66	5.30	4.27	5.17	4.66	4.72	5.18	5.17	5.81	4.29	.73
	NFIP	-39.47	-16.70	-8.67	-10.26	-7.13	-5.36	-11.42	-9.57	-9.57	-4.02	2.15
	PAD	.57	1.65	2.44	3.34	2.42	1.48	2.11	1.61	1.61	1.48	1.10
	PMD	1.02	1.07	.57	.73	.64	.39	1.17	1.30	1.14	.77	-1.03
	P	.67	1.81	2.55	3.44	2.65	1.77	2.44	2.06	2.06	1.92	1.19

(7.6A concluded.)

TABLE 7.6B: CHANGE IN SELECTED VARIABLES IN EXPERIMENT 9 COMPARED WITH SUM OF CHANGES PREDICTED BY EXPERIMENTS 7 AND 8.

	YEAR IN SIMULATION PERIOD									
	1		3		5		7		9	
VARIABLE	Ex.9	Ex. 7+8	Ex. 9	Ex. 7+8	Ex. 9	Ex. 7+8	Ex. 9	Ex. 7+8	Ex. 9	Ex. 7+8
YA	4.93	4.91	7.07	6.24	12.36	11.56	16.32	15.51	18.35	17.57
YM	51.06	49.29	91.80	90.59	76.81	78.45	66.24	65.59	70.84	67.98
YINF	3.08	3.01	4.27	4.46	4.15	4.57	5.04	4.99	6.68	6.33
YSV	11.90	11.82	25.48	24.73	34.48	33.71	42.50	42.70	53.13	53.95
NY	47.18	45.44	77.66	77.04	58.85	60.87	45.09	43.59	42.74	37.88
SG1	-18.32	-18.73	-44.58	-15.22	-19.42	-19.55	-25.33	-25.66	-17.44	-16.34
SP	17.57	16.87	22.75	22.79	12.11	13.06	6.35	5.95	5.88	4.71
NFIG	44.12	44.44	47.52	48.10	49.96	50.31	58.84	59.13	44.63	44.66
NFIP	-78.20	-79.04	-66.37	-68.69	-44.76	-50.41	-73.65	-77.71	-44.42	-46.50
PAD	.02	.02	.04	.04	.02	.02	.03	.03	.01	.01
PMD	.01	.01	.01	.10	.02	.01	.02	.02	.01	.01
P	.02	.02	.04	.04	.02	.02	.03	.03	.03	.03

Notes: (1) All changes are expressed in billions of 1960-61 rupees, except for the price variables which are indices with 1960-61 = 1.00

(2) Ex. 9 = Experiment 9; Ex. 7 + 8 = Experiment 7 + Experiment 8.

TABLE 7.7: PERCENTAGE CHANGE IN SELECTED VARIABLES DUE TO FAVOURABLE SHIFT IN WORLD DEMAND FOR PRIMARY EXPORTS.

		YEAR IN SIMULATION PERIOD										
EXPERIMENT	VARIABLE	0	1	2	3	4	5	7	9	11	14	16
Experiment 10.	YA	0	0	.01	.02	.03	.04	.06	.08	.10	.14	.18
Shift in world	YM	1.06	1.67	1.84	1.90	1.84	1.78	1.81	1.91	2.16	2.60	2.25
demand towards	YINF	0	-.05	-.09	-.10	-.14	-.10	-.01	.06	.12	.26	.34
Indian primary	YSV	0	.03	.07	.13	.17	.23	.34	.45	.54	.70	.82
exports.	NY	.20	.34	.39	.43	.44	.46	.54	.62	.71	.90	.85
	CG1	.10	.18	.26	.19	.33	.35	.40	.51	.58	.85	.75
	SG1	.74	1.14	.77	1.69	.97	1.00	1.74	1.27	1.51	1.74	1.75
	SP	1.42	1.92	1.82	1.75	1.54	1.42	1.33	1.38	1.47	1.61	1.40
	NFIG	.03	.09	.20	.15	.23	.21	.25	.38	.48	.26	1.04
	NFIP	2.73	2.24	2.84	2.04	3.30	3.33	3.43	2.73	2.62	5.86	3.55
	ZRAW	7.71	6.97	7.53	7.20	7.35	6.70	6.72	8.60	8.01	8.59	7.56
	ZCRP	0	-.01	-.04	-.07	-.08	-.09	-.13	-.28	-.48	-.96	-.98
	P	.29	.42	.41	1.12	.40	.38	.47	.49	.57	.83	.66

TABLE 7.8: PERCENTAGE CHANGE IN SELECTED VARIABLES DUE TO 10% ANNUAL INCREASE IN AVERAGE DIRECT TAX RATE

Experiment	Variable	YEAR IN SIMULATION PERIOD									
		2	3	4	5	6	8	10	12	14	16
Experiment 11.	YA	0	.02	.02	.03	.03	.02	.02	.03	.04	.04
	YM	0	.09	.24	.41	.54	.64	.56	.48	.42	.39
10% annual	YINF	0	.04	.11	.18	.24	.32	.32	.32	.33	.33
increase in	YSV	0	-.03	-.05	-.06	-.06	-.03	.01	.05	.08	.11
average direct	NY	0	.02	.06	.10	.14	.17	.17	.16	.16	.16
tax rate;	GAN	1.99	2.12	2.30	2.27	2.19	.18	.17	.16	.17	.18
years 2 through	CG1	1.78	1.84	2.03	1.99	1.83	.12	.14	.13	.15	.14
6.	SG1	3.15	4.03	3.89	3.88	5.16	.65	.36	.35	.30	.32
	SP	-.90	-.74	-.59	-.30	-.18	.51	.36	.31	.27	.27
	S	0	0	0	.01	.01	.01	.02	0	0	0
	NFIG	1.24	1.24.	1.35	1.28	1.10	.09	.11	.10	.05	.19
	NFIP	-1.64	-1.41	-1.28	-.76	-.64	.96	.87	.88	1.22	.67

Experiment	Variable	7	8	9	10	11	12	13	14	15	16
Experiment 12.	YA	0	.03	.03	.03	.04	.05	.03	.03	.04	.04
	YM	0	.04	.16	.30	.43	.52	.58	.54	.49	.47
10% annual	YINF	0	.02	.08	.14	.19	.23	.27	.27	.26	.26
increase in	YSV	0	-.02	-.03	-.04	-.05	-.05	-.03	-.01	.02	.03
average	NY	0	.01	.04	.08	.11	.14	.16	.16	.15	.15
direct tax	GRN	2.04	1.98	1.95	2.10	1.94	.14	.17	.17	.16	.17
rate; years 7	CG1	1.74	1.68	1.73	1.87	1.71	.10	.13	.14	.13	.12
through 11.	SG1	4.42	4.31	3.12	3.28	3.23	.35	.45	.35	.37	.35
	SP	-.75	-.47	-.36	-.29	-.16	.48	.41	.32	.27	.25
	S	0	0	0	0	0	.01	0	0	0	0
	NFIG	1.05	1.17	1.19	1.31	1.29	.09	.07	.03	.18	.21
	NFIP	-1.49	-.88	-.73	-.68	-.43	.83	.96	1.23	.64	.72

DEFINITIONS OF VARIABLES REPORTED IN TABLES 7.1 TO 7.8

	SYMBOL(S)	DEFINITION
1.	AF	acreage under foodgrains
2.	YLDF	yield (foodgrains)
3.	YF	production of foodgrains
4.	SF	total supply of foodgrains
5.	YA	agricultural output
6.	YM	industrial output
7.	YINF	infrastructural output
8.	YSV	services output
9.	NY	national income
10.	CG1	government consumption (excluding consumption of non-departmental enterprises)
11.	SG1	government saving (excluding saving of non-departmental enterprises)
12.	SP	private saving
13.	S	aggregate saving
14.	NFIA	agricultural investment (fixed)
15.	NFIM	industrial investment (fixed)
16.	NFINF	infrastructural investment (fixed)
17.	NFISV	investment in services (fixed)
18.	NFIG	aggregate government investment (fixed)
19.	NFIP	aggregate private investment (fixed)
20.	EM	exports of manufactures

	SYMBOL(S)	DEFINITION
21.	EO	exports of primary goods
22.	EXCHS	net foreign exchange availability (excluding capital inflow)
23.	ZRAW	raw material and intermediate good imports
24.	ZCAP	capital goods imports
25.	ZCRP	food imports (cereals and cereal preparations)
26.	ZFCOM	commercial foodgrain imports
27.	PF	index of foodgrain prices.
28.	PAD	agricultural income deflator
29.	PMD	industrial income deflator
30.	P	national income deflator

NOTE: All variables are in real terms, excepting EXCHS which is a nomina magnitude; price indices have 1960-61 = 100.0. Note that aggregate saving S is defined as the sum of SP and SG1.

FOOTNOTES

Chapter 7

1. All simulation experiments have been conducted using TEMS (Toronto Econometric Model Solution Program) developed by Dr. J.G.A. Vermeeren and adapted for use at McMaster University by Dr. A. Muller, Department of Economics.

2. This simplification hardly alters the results of our experiments. However, on *a priori* grounds it can make a difference in the PL 480 experiments. The implications of making overall acreage, A, endogenous are discussed in connection with the PL 480 experiments in Section 7.4.

3. Other measures like the root-mean-square deviation or the root-mean-square-percentage deviation are also used in evaluating the predictive powers of a model. See, for instance, Pyndyck and Rubenfeld (1976), pp. 314-320 for a discussion of these and other measures.

4. The "inequality-coefficient" developed by Theil (1966), pp. 26-36, is a precise measure of the accuracy with which a model forecast levels as well as turning points.

5. A correct prediction of the direction of change is assigned a value of 1, while an incorrect prediction is assigned a value of zero. When there is a less than .05% change in the value of variable from one year to the next, an incorrect prediction of the direction of change is assigned a value of 1/2. This measure is obviously less precise than the "inequality coefficient" a correct forecast could have a large forecast error. For this reason, it is used in conjunction with the MPD and MAPD to evaluate the model.

6. Henceforeth, the statement that *changes* are correctly/incorrectly predicted should be taken as referring to the *direction* of changes. Further, the terms forecast and prediction are used interchangeably.

7. The definitions of the variables appearing in these and other tables are given at the end of this chapter following Table 7.

8. Agarwala (1970), pp. 139-140.

9. The first year of the simulation period (1960) is denoted by 0, the second year (1961) by 1, and so on, in all our experiments.

10. The changes in the capital inflow (in rupee terms) resulting from the $1.3 billion inflow in each period are large after 1967 not only because the actual capital inflow had declined in rupee terms but also because of the 1966 devaluation of the Indian rupee.

11. In a more disaggregated model in which private investment were linked to private output, and government investment to government output, the type of experiments conducted so far would also throw light on the relative productivity of private and government foreign capital. This cannot be ascertained in the present model because, even though the distribution of foreign capital between the private and government sector has different implications for output, no distinction is made between private and government output - i.e., private and government capital are assumed to be equally productive.

12. The terms PL 480 aid, PL 480 assistance and PL 480 imports are used interchangeably in the subsequent discussion.

13. At the aggregate level of our analysis, we are taking a simplified, though essentially correct view of how PL 480 transactions are recorded in the balance of payments. For example, we ignore U.S. Embassy expenditures in India (out of PL 480 funds) which are recorded as a receipt in the current account. We are also partly ignoring the fact that since India pays a portion of the shipping costs, some foreign exchange cost is involved. However, since such costs would be involved if there were no PL 480 imports (since commercial imports would be higher) this omission is not likely to be significant. In any case, these issues are not critical given the kind of experiments we conduct.

14. We do not go beyond 1967 in our experiments partly because changes in the agreements on PL 480 aid after 1967 required payment for such imports partially in foreign exchange. In any case, India's imports under PL 480 were very small after 1968-69.

15. We did this because a reduction in overall acreage in India is likely only in the event of adverse weather conditions which damage cultivable land. Our estimated equations for acreage under foodgrains and non-foodgrain crops are such that a given increase in the relative price of foodgrains necessarily reduces overall acreage. But this is not reasonable given the population pressure on land, and the rapid growth in demand for agricultural products in the economy.

16. These adverse effects were found to be slightly stronger when we conducted this experiment using a model in which overall acreage is endogenous. However, all other effects were virtually the same those reported here.

17. This dampens the process of credit creation that any given increase in government borrowing may initiate.

18. The "Please Effect" refers to the effect on aggregate saving in the economy of an increase in the tax rate. In particular, if the increase in taxation raises government saving by an amount equal to or less than the fall in private saving, the net outcome is known as the "Please Effect". See Mikesell and Zinser (1973),pp. 15, Please (1967,1970).

19. The terms government spending and borrowing are used interchangeably and are meant to refer to deficit spending/financing.

20. Thus, though industrial investment is lower over this period, the output-capital ratio rises sufficiently (due to the increase in the supply of industrial power and of imported inputs) to result in a higher level of industrial output.

21. While the money supply impinges on other sectoral prices as well, it does so only indirectly. Our attempts in Chapter 6 to model the direct impact of the money supply on agricultural prices, however, were not successful.

22. It must be noted that we are presenting the results for only selected years and a small subset of variables. The accuracy alluded to in the text is not necessarily uniform over the entire set of variables, nor sustained over all years.

23. The increase in industrial output is partially dampened because of the fall in the supply of industrial power that results from the decline in infrastructural output in some years.

24. The case where capital inflows are partially consumed is that in which there is no change in the inflow of private foreign capital.

25. It should be noted that the increase in capital inflows (expressed in rupees) between 1968-1971 is sharp largely because of the 1966 rupee devaluation. The real foreign exchange effect of this increase, on the other hand, is in fact small since the import unit-values reflect the effect of the devaluation. Consequently, these sharp increases in the capital inflow expressed in rupees have small effects on the imports of capital goods and intermediate goods.

26. This is because the capital inflow is unchanged.

27. In fact, the results indicate a near-proportional relationship between the money supply and nominal national income.

CHAPTER 8

SUMMARY AND CONCLUSIONS

In this study, we constructed and estimated an econometric model of the Indian economy in which special emphasis was given to the notion of saving and foreign exchange constraints on investment and output, and in which the role of foreign capital inflows in easing these constraints was explicitly dealt with. In addition, some other aspects of foreign capital were examined. In particular, we examined the question of whether foreign capital inflows are associated with adverse effects on the government's resource mobilization effort. Further, built into the structure of the model was a set of relationships pertaining to the foodgrains sector of the economy that permitted us to evaluate the effects of foodgrain aid to India under U.S. Public Law 480.

In Chapter 2, we spent some time elaborating on the foregoing issues. The notions of saving and foreign exchange constraints were discussed with the help of a simplified theoretical model, to be followed by a discussion of various aspects of foreign capital, and the issue of PL 480 assistance to India. In Chapter 3, some important economic and institutional features of the Indian economy were outlined, and this was supplemented with a discussion of the economic trends in the economy since the early 1950's. Chapters 4, 5 and 6 were devoted to the construction and estimation of various parts of the econometric model. The simultaneous block of equations in the model was estimated using a modified two-stage least squares procedure in which the first stage involved regressing each endogenous variable on a set of principal components constructed from the set of predetermined variables in the model. Further, wherever considered necessary, the second-stage regressions were adjusted for auto-correlation using the Cochrane-Orcutt iterative technique. With some exceptions, most of the equations performed reasonably. Some of the salient features of our results are: (i) we were unable to capture the effects of improved farming technology - viz., fertilizer use and the use of high-yielding seed varieties - on agricultural and foodgrains output, primarily due to collinearity problems, though weather conditions were found to be important in this context; (ii) imported inputs as well as infrastructural inputs such as industrial power were found to have significant effects on industrial output, the effects of the latter being stronger; (iii) the simple Keynesian function explains private saving behaviour quite satisfactorily although a simple version of Friedman's "permanent" income model augmented by an income distribution variable, also gives reasonable results, a shift in the distribution of income in favour of the non-agricultural sector leading to an increase in private saving; (iv) foreign capital is found to have adverse effects on government saving for a given level of revenue, though these effects are weak; (v) there is little evidence to suggest that there are adverse effects on the government's tax effort due to increased capital inflows; and (vi) PL 480 foodgrain imports are not a one-for-one substitute for commercial imports; in particular, a unit decrease in the former leads to less than a unit increase in commercial imports, which indicates that there is some foreign exchange saving implicit in a unit of PL 480 imports, given that they do not involve a foreign exchange cost while commercial imports do.

In Chapter 7 we first evaluated the forecasting ability of the model through historical simulation. Evaluated in terms of forecast error and of its ability to forecast correctly the year-to-year changes in major endogenous variables, the model performed reasonably well. However, its performance was less satisfactory in the case of sectoral investment and inventory change variables. In the second part of Chapter 7 we used the model in a set of experiments designed to evaluate the effects of changes in various important exogenous variables. The major findings are summarized below:

(1) An increase in the foreign capital inflow over a short period alters the time-path of national income in the short as well as long run. Further, the rate of growth of output is affected in the short run, though the long-run growth path of national output is virtually left unchanged. These effects are stronger the sharper the change in foreign capital. Thus, a sharp increase in the foreign capital inflow over the period 1967-1971 is found to permanently lift the time-path of national income, which tends to stabilize at a level of 3.5% above its actual path at the end of the simulation. There is an acceleration in the growth rate from an average of 3.9% to an average of 5.1% in the short run, but the long-run growth rate of output is affected only very slightly. In constrast to sharp, short-period increases in foreign capital, a small but even and sustained increase in foreign capital over a longer period, raises the time-path of output in both the short and long run. However, the growth rate of output is virtually unaffected in the short as well as long run. These results suggest that for an

for an acceleration in the growth rate, that is sustained over the long period, the increase in foreign capital has to be both large and sustained over a long period. The latter could lead to problems of debt service, an issue that has been dealt with only at a simple level in the model.

(2) An easing of the foreign exchange constraint due to a permanent increase in export earnings has favourable effects on national income, particularly in the longer term. Output in the industrial sector is mostly favourably affected, but given its relatively small share in national income, the effects on the latter are moderate.

(3) An increase in the average direct tax rate raises government saving since government revenues rise. But the increase lowers private income and hence lowers private saving. The net effect is to leave aggregate real saving unchanged. Thus, increased direct taxation merely changes the composition of saving, leaving, *ceteris paribus*, aggregate investment in the economy unchanged. The implied changes in the institutional and sectoral composition of investment, however, have mild expansionary effects on output.

(4) Increased government spending based on money creation results mainly in increased prices, with only weak effects on national income. On average, over

a ten-year period, a close to proportional relation between the money supply and <u>nominal</u> national income is implied. That real income rises at all, to begin with, given the volume of aggregate saving and foreign capital, is because of the changes in the institutional and sectoral composition of investment, and hence their differential impact upon sectoral output.

(5) Reduced PL 480 imports, compensated for by an increase in foreign exchange aid, have favourable effects on foodgrains and agricultural output. In fact, national income rises as well largely because of an easing of the foreign exchange constraint due to the increase in foreign exchange aid. However, since reduced PL 480 imports induce a smaller increase in commercial imports and domestic production of foodgrains does not rise sufficiently, the total supply of foodgrains in the economy is adversely affected. In general, these effects do not persist over the longer term. On the other hand, if the PL 480 reduction is associated with a reduction in capital transfers to the Indian government, foodgrains and agricultural output are adversely affected. Since there is no compensating increase in foreign exchange aid, and commercial food imports rise, there are adverse effects on industrial output *via* a worsening of the foreign exchange situation. Consequently, national

income declines even in the longer term. Further, the supply of foodgrains is also adversely affected over the long period.

As is the case with all empirical studies, this study is subject to the limitations of the data. We have attempted to use the latest available data wherever possible. Even though the new, revised data for many variables (e.g., output and capital formation) are likely to be of better quality since they incorporate improvements, are based on a wider body of information, etc., this is no guarantee of their quality. Further, the adjustments that we were required to make to the available data in order to arrive at various series used in the model, may have compounded errors that already exist. In the case of adjustments to some of the data (e.g., capital formation), it would be interesting to experiment with alternative adjustment procedures to check on the sensitivity of the results. Clearly, revisions based on improved data and alternative structures would be useful and desirable. This is not pursued here, because of limitations of time. There are some additional issues that warrant attention.

Our model is supply-oriented and built around the notion of resource constraints. These features provide a framework that appears to be relevant for models of developing economies such as India. Indeed, as the 1980 World Development Report of the United Nations notes, saving, foreign exchange and foreign capital inflows will continue to be important determinants of the growth of developing economies in the decade that lies ahead. Our model represents one approach to these problems, and concentrates on a few specific issues. The capsuling of an extremely complex economy such as India in the form of an econometric model is beset with difficulties, and cannot be achieved without much simplification. Further simplification is generally necessitated in order to concentrate on specific issues. Thus, for instance, the monetary side of our model is highly simplified. The absence of monetary sector relationships and the exogeneity of the money supply not only underplay the role of the bank sector in the money supply process, but also obscure other monetary policy options. As a result, the monetary policy content of the model is limited. Further, the important role of government budget deficits in the money supply process is not explicitly modelled. Labour is also ignored in the model, the implicit assumption being that it is not a limiting factor of production. While the assumption that capital is the prior constraint on output appears to be reasonable in the context of widespread, structural unemployment, this is a simplification. However, we have been constrained by the lack of continuous employment data on a sectoral basis. Employment and unemployment are important matters in a country such as India and a growth-oriented model should, at least, examine the employment implications of growth. Given the nature of unemployment in the country, a model with labour requires an approach that lies outside the realm of the theory of cyclical fluctuations and in which attention is paid to the qualitative aspect of labour.

The question of labour is part and parcel of a more general issue - viz., human capital development, whose importance in economic development is being increasingly realized. (See, for instance, the aforementioned United Nations report.) This issue has been ignored in our study. Our emphasis on resource constraints, which are undoubtedly important, should not be taken to mean that they are the only constraints to growth. Obviously, the problem of growth and development straddles a wide range of issues. Of these, human capital and the related problem of income distribution are relevant. These have been ignored in the present model. In fact, even though capital accumulation is given emphasis in our study, a case can be made for the favourable growth effects of increased consumption.

In particular, the latter could lead to increased labour productivity through improved nutritional standards, particularly in a context where these are low.

The examination of the issues raised above would involve a larger model than the one considered here. Finally, the massive upsurge in energy costs since the mid-seventies has set in motion forces of structural change, as import-dependent economies adjust to the new situation. Future econometric models of the Indian economy and extensions of the present one would have to address the issues raised by this phenomenon.

DATA APPENDIX

In this appendix, we list the major sources of our data, and outline the methods adopted in the construction of the various series used in the study. We confine ourselves only to those variables which require independent measurement. The variables which do not require independent measurement (such as those which can be measured from definitions) are, with some exceptions, not discussed. We have found it convenient to draw a distinction between variables for which data have been taken from the national accounts, and those for which data have been taken from other sources. The former set of variables are discussed in Section A.1, while the latter set is taken up in Section A.2.

(A.1) NATIONAL ACCOUNTS DATA.

The sources for the data in this section are the following:

(1) National Accounts Statistics, C.S.O., Government of India, February 1976 and January 1978.

(2) National Accounts Statistics: Disaggregated Tables, C.S.O., Government of India, March 1975.

(3) Estimates of National Product (Revised Series),

C.S.O., Government of India, August 1970.

(4) Estimates of National Income, C.S.O., Government of India, February 1964.

(5) Economic Survey, Ministry of Finance, Government of India, (Annual).

(6) Statistical Abstract, C.S.O, Government of India, (Annual).

Data for some of the variables were taken directly from these sources and required no adjustment. These variables are direct tax revenues (DTS), measured net of land revenue (LRS); indirect tax revenues (IDTS); other current revenues of the government (ORS), which comprise primarily the earnings of government departmental enterprises; interest on national debt (NDRS); net capital inflow (FKS), measured (inclusive of net foreign capital transfers KTRS), as the current account deficit; net factor payments abroad (NFPS). All these data are in nominal values. The data for other series, while based on these sources, required varying degrees of adjustment.

(A.1.1) Sectoral and National Income.

Output in each of the four sectors of the economy - agriculture, industry, infrastructure and services - refers to net value-added in each sector in

1960-61 rupees. These data have been obtained from the sources listed above. These sources provide two real series for sectoral output (YA, YM, YINF and YSV) and national income (NY) - one, in 1960-61 prices, for the period 1956-57 to 1973-74, and the second, in 1970-71 prices, for the period 1970-71 to 1975-76. The sectoral price deflators were adjusted to a common base 1960-61 (this is discussed below) to obtain a continuous series for YA, YM, YINF, YSV and NY for the period 1956-57 to 1975-76 in 1960-61 prices. Since the sum of YA, YM, YINF and YSV equals net domestic product (NDP), the difference (NY - NDP) gives us a series for net factor payments abroad in 1960-61 prices.

Output (value-added) in non-traditional manufacturing industries (YNTM) was constructed on the basis of disaggregated data published in (1) and (2) above. YNTM was defined as: Value-added in total manufacturing less value added in each of food, beverage and tobacco, and textile industries. Once again, the data for the period 1970-71 to 1975-76 were in 1970-71 prices and had to be expressed in 1960-61 prices by converting the implicit price deflator for this period (1970-71 = 1.0) to 1960-61 = 1.0.

(A.1.2) Deflators for Sectoral and National Income, and Net Factor Payments.

The deflator for net factor payments (NFPS) was obtained by dividing the current value series by the series expressed in 1960-61 prices (as obtained above).

There are four sectors in the model, but only three sectoral price deflators are used - viz., the deflators for agricultural income (PAD), industrial income (PMD) and infrastructural and services income combined (PSD). These are obtained by dividing the appropriately aggregated sectoral incomes in current values by the corresponding constant rupee-value incomes. These conversions yield two sets of series - one based on 1960-61 = 1.0 for the period 1960-61/1970-71, and another based on 1970-71 = 1.0 for the period 1970-71/1975-76. Both are combined and brought to 1960-61 = 1.0. For the period 1956-57/1959-60, the revised national and sector product data are available only in 1960-61 prices but not in current prices. Consequently, the aforementioned deflators for this period had to be obtained first by using the old national accounts series to obtain each deflator with 1948-49 = 1.0, and then linking it to the series with 1960-61 = 1.0. The national income deflator (P) was obtained using similar procedures.

(A.1.3) Saving.

The available data for saving is in nominal terms, is on a net basis, and is broken down as follows: (a) household saving (SHS) (b) corporate saving (SCS), which we express net of retained earnings of foreign companies in India, and (c) government saving (SGS). The sum of SHS and SCS gives nominal private saving in the economy (SPS). Government saving is disaggregated into: (i) saving of government administration and departmental enterprises (SG1S), and (ii) of non-departmental enterprises. SPS and SG1S were defalted by the national income deflator (P) to give real private saving (SP) and real government saving (SG1), both in 1960-61 prices. SP, SG1 and SG2S are the three saving series used in the model.

(A.1.4) Capital Formation by Production and Institutional Sector.

Sources (1) and (2) publish data (in real and nominal terms) for capital formation by (a) industry-of-use, and (b) by type-of-assets by government and private sector. These data were used to construct our sectoral as well as private and government capital formation estimates. This required a number of adjustments to the available data, and these are discussed below.

1) Sectoral Capital Formation.

The industry-of-use data were first aggregated to conform to the definitions of our four sectors - agriculture, industry, infrastructure and services. Then on the basis of the available capital consumption data, the gross capital formation estimates by sector were put on a net basis. Our next task was to estimate the fixed component of net capital formation in each sector, data for which are not available. In the absence of any precise information, we adopted the following simple procedure to estimate fixed sectoral capital formation. We first dealt with the period 1950-51 to 1970-71, for which the constant rupee data are in 1960-61 prices.

(1.1) $X_i = F_i + V_i$

(1.2) $X = \Sigma X_i = \Sigma F_i + \Sigma V_i$,

$F = \Sigma F_i$, $V = \Sigma V_i$

where

X_i = net capital formation in the i^{th} sector.

F_i = net fixed capital formation in the i^{th} sector.

V_i = inventory investment in the i^{th} sector.

F = aggregate fixed capital formation (NFIT in the model).

V = aggregate inventory investment (INV in the model).

F_i and V_i are the unknowns. We assumed that fixed capital formation in the i^{th} sector (F_i) is proportional to aggregate fixed capital formation in the economy.

(1.3) $F_i = \alpha F$

The factor of proportionality α was assumed to be the share of the i^{th} sector in aggregate net capital formation. That is,

(1.4) $\alpha = (\frac{X_i}{X})$, which implies

(1.5) $F_i = (\frac{X_i}{X})F = (\frac{X_i}{X})(\frac{F}{X}) \cdot X$

where $(\frac{X_i}{X})(\frac{F}{X})$ = net fixed capital formation in the i^{th} sector as a proprotion of aggregate net capital formation.

The available data for X_i, X and F required to make this calculation, however, are not on a consistent basis. The estimates of X actually used in the calculation are adjusted for "errors and omissions" because the estimates of net capital formation arrived at by aggregation over fixed and inventory investment and over institutional sectors consistently overestimate actual capital formation in the economy. Adjustment for these errors, however, is only made at the level of X but not at the level of F and V, nor at the institutional sector sector level, in the official data. In other words

(1.6) $X = F^{*} + V^{*} - R$

where R = "errors and omissions".

F^{*} = published estimates of net fixed capital formation.

V^{*} = published estimates of inventory investment.

Consequently,

(1.7) $F = F^{*} - RF$ and $V = V^{*} - RV$

(1.8) $RF + RV = R$

where RF and RV, and hence F and V are not known. In other words, while the errors R are known, their distribution between F^{*} and V^{*} are not. However, F^{*} cannot be used to obtain F_i in equation (1.5), because the available data for sectoral net capital formation are presented adjusted for "errors and omissions". That is,

(1.9) $\Sigma X_i = X = \Sigma F_i + \Sigma V_i$

Consequently, F^{*} for which data are available, has to be adjusted by the amount RF to obtain F.RF was approximated by

(1.10) $RF = (\frac{F^{*}}{X^{*}}) \cdot R$

where X^{*} = unadjusted aggregate net capital formation.

Thus, (1.10) was used to obtain RF which enables us to adjust F^* in (1.7) to obtain F, which in turn was used in (1.5) to obtain a set of estimates for net fixed capital formation for each of our sectors - viz., NFIA, NFIM, NFINF and NFISV in terms of the symbols used in the model. Similarly, an adjusted aggregate inventory investment series V (= INV in the model) was obtained by subtracting F from X.

The calculation in (1.10) was repeated using current value data. This enabled us to obtain the current value counterparts of F and V using (1.7) and (1.8). From this, we were consequently able to estimate the implicit deflators for net fixed investment (PINV) and inventory investment (PVD).

For the period 1970-71 to 1975-76, the available constant rupee data are in 1970-71 prices. To obtain the sectoral fixed investment estimates for this period, the same procedure (as outlined above) was followed. However, to estimate all the required series in 1960-61 prices, we first obtained estimates of the deflators required in the calculation, with 1970-71 = 100. These series were then linked to the corresponding series based on 1960-61 = 100, using the common overlapping year 1970-71, thereby enabling us to convert all the deflators to the base year 1960-61, and thus to obtain all the required series in 1960-61 prices.

2) Government and Private Investment.

Above we derived an aggregate net fixed capital formation series F (= NFIT), adjusting the available series F^*, using (1.10) and (1.8). Similarly, an inventory investment series V (= INV) was derived by adjusting the published series V^*. But having done that, we have to adjust the private and government conponents of F^* and V^* as well. However, we need to adjust only one of the components in each case, given that the adjustments to F^* and V^* are known. Using current value data, we assumed:

$$(1.11) \qquad RFG = \left(\frac{FG^*}{F^*}\right) \cdot RF$$

where RFG = "errors and omissions" allocated to government fixed capital formation.

FG^* = government net fixed capital formation (unadjusted).

Obtaining RFG from (1.11), we can obtain our adjusted nominal government fixed capital formation series (FG) from

$$(1.12) \qquad FG = FG^* - RFG$$

Deflating this series by PINV, we get our real government net fixed investment series. Consequently, the real (adjusted) net fixed private investment series FP, is obtained residually from

(1.13) $FP = F - FG$

In our model, we also have a nominal government inventory investment variable. This was obtained by assuming

(1.14) $RVG = (\frac{VG^*}{V^*}) . RV$

where RVG = "errors and omissions" in aggregate inventory investment allocated to government inventory investment.

VG^* = government inventory investment (unadjusted).

Calculating RVG from (1.14), our adjusted (nominal) government investment series (VG) is obtained from

(1.15) $VG = VG^* - RVG.$

In terms of the symbols used in the model, the set of computations involved in (1.11) to 1.15), give us the NFIG, NFIP and INVGS series.

(A.1.5) Sectoral Capital Stock.

To compute estimates of sectoral capital stock, bench-mark estimates were required. These were obtained from a study by Mukherjee and Sastry (see Mukherjee (1969), pp. 49-50) in which estimates of (reproducible) tangible wealth by broad sectors at the beginning of the fiscal year 1950-51 are presented.

These estimates were used to construct bench-mark estimates of capital stock in each of the four sectors in our model. The sectoral capital stock series (KA, KM, KINF, KSV) were then constructed by adding the cumulative sum of net fixed capital formation in each sector for each year to the corresponding bench-mark estimates.

(A.2) OTHER DATA.

The data for variables discussed here were taken from a number of sources, and these are listed along with the series with whose construction they were involved. All the variables listed in the foregoing section are measured on a fiscal year basis (April-March). The variables discussed here were constructed on the basis of data which were available on a fiscal year basis for some variables, a crop year (July-June) basis for others, and a calendar year basis for yet some others. Wherever conversion from one time reference to another was required to get the needed series, we took weighted averages of each pair of adjacent years, the weights being the proportions of each of these years which fall in the required year. Thus, letting the superscripts C, F and L stand for crop, fiscal and calendar years respectively, we have:

(i) $X_t^c = .5X_{t-1}^L + .5X_t^L$ → calendar to crop year.

(ii) $X_t^c = .75X_t^F + .25X_{t+1}^F$ → fiscal to crop year.

(iii) $X_t^F = .75X_t^c + .25X_{t-1}^c$ → crop to fiscal year.

(A.2.1) Prices.

Data for the prices of agricultural goods (PAF) and foodgrains (PFF) are available on a fiscal year basis. These were taken from various issues of Economic Survey and of Report on Currency and Finance, Reserve Bank of India (Bombay). Since the available series are based on different base years, a continuous series for each of PAF and PFF was derived with 1960-61 = 1.0 PAF includes prices of foodgrains, fruits, vegetables, raw jute and cotton, and other non-food cash crops. PAF and PFF have a weight of 332 and 148 respectively, in the 1961-62 = 1.0 wholesale price index series. PAF is viewed as a weighted average of PFF and other non-foodgrain agricultural prices (PNFF), with the weights being (148/332) and {332-(148/332)} respectively. A series for PNFF was derived from a knowledge of these weights and the PFF and PAF series. The PNFF series, as well as the PFF series were then put on a crop year basis (PF, PNF) with 1960 = 1.0. The corresponding crop year series for the price of agricultural goods, PA, was derived as a weighted average of PF and PNF.

The index of manufactured goods prices (PM) used in the study is measured as a weighted average of (a) an index of prices of chemical products and chemicals (b) an index of prices of machinery and transport equipment, and (c) an index of prices of manufactures - finished and intermediate. The requisite data are taken from various issues of Economic Survey and Report on Currency and Finance. The weights were calculated on the basis of the weight assigned to each of the indices (a), (b) and (c), and hence to their sum, in the general wholesale price index series with 1961-62 = 1.0, which runs from 1961-62 to 1975-76. For the period prior to 1961-62, the index of prices of manufactured goods - i.e., (c) above, based on 1952-53 = 1.0, is inclusive of (a) and (b). Both series were combined and put on the common base year 1960-61 to yield the PM index used in the model.

(A.2.2) Acreage, Rainfall and Related Variables.

1. Acreage and Related Variables.

Data for gross area under all crops (A) and gross area under foodgrains (AF) are taken from various annual issues of Economic Survey, Report on Currency and Finance, and from Area and Production of Principal

Crops in India, Directorate of Economics and Statistics, Ministry of Agriculture, Government of India (New-Delhi). The series for area under non-foodgrain crops was derived residually by subtracting AF from A. The data for area under high-yielding seeds (AHYV) was also taken from various issues of Economic Survey. All these data are on a crop year basis. The data for fertilizer consumption (FC) was taken primarily from the 1974-75 issue of Fertilizer Statistics, Government of India. These data are on a fiscal year basis and were adjusted to conform approximately to the crop year.

2. The Rainfall Index.

The weather index (WI) was constructed primarily from data published in the Statistical Abstract. More detailed data published by the Meteorological Office were not available to us. Our index is quite rough and concentrates only on the rainfall aspect of the weather. However, given that fluctuations in agricultural output are greatly influenced by weather conditions, it was felt that some measure of weather conditions should be constructed. Our measure deals with rainfall only during the south-west monsoon season (June-September) since the bulk of the country receives 75% or more of its annual rainfall in this period. {See Koteswaram (1970)}. The measure is a weighted average of actual to normal rainfall during June-September in 13 major producing provinces in the country.

$$WI = \sum_{i=1}^{13} W_i \left(\frac{R_i^a}{R_i^n}\right)$$

where R_i^a = actual rainfall during June-September in the i^{th} province.

R_i^n = normal rainfall during June-September in the i^{th} province.

W_i = weight assigned to the i^{th} province.

Data for R_i^a were taken from various issues of Statistical Abstract, and Estimates of Area and Production of Principal Crops in India, while those for R_i^n were calculated on the basis of estimates over a fifty-year period of annual rainfall and its distribution over regions, made by Koteswaram (1970). These data are on a meteorological-division basis, rather than a strictly provincial basis. However, we have grouped together meteorological divisions to correspond approximately to the province, wherever necessary. The weights correspond to the share of each province in foodgrains production in the year 1967.

(A.2.3) Foodgrains Production, Imports and Change-in-Stocks.

1. Production and Change-in-Stocks.

The foodgrains production series (YF) was obtained from various issues of the Economic Survey. The data are on a crop year basis.

Change-in-stocks (DSF) data are available only for the government sector and are on a calendar year basis. The following procedure was followed to arrive at a DSF series inclusive of the change in stocks in the private sector, and to express the series on a crop year basis.

Following R.N. Lal (1977, p. 64), we formulate the problem as follows:

(2.1) $SF = SFP + SFG = .25(\alpha YF - PG) + SFG$

where SF, SFP and SFG stand for end-of-crop-year aggregate, private and government foodgrain stocks respectively, PG for foodgrains procured by the government, and α for the proportion of foodgrains disposed off by farmers. It is assumed that 25% of total disposal less government procurement is held as private stock. We can re-write (2.1) in terms of changes as

(2.2) $$DSF_t = \Delta SF_t = .25\{\alpha(YF_t - YF_{t-1}) - (PG_t - PG_{t-1})\} + (SFG_t - SFG_{t-1}).$$

To use this for obtaining our DSF series two adjustments were necessary - one, the value of α was not known, and second, PG and SFG are on a calendar year basis and consequently required conversion to a crop year basis.

a) Estimation of α.

P.K. Bardhan and K. Bardhan (1969) have calculated the proportion of cereals marketed for the period 1952-53/1964-65. Using their estimates, we derived a marketed surplus series for the same period assuming that the proportions are the same for foodgrains production (YF) as a whole (i.e., cereals + pulses). The proportion α was then estimated in a regression of the marketed surplus series so derived (MS) on YF. Extrapolation beyond 1964-65 then yielded a marketed surplus series for our sample period: 1956-57/1975-76.

b) Adjustment of PG and SFG to crop year basis.

Let SFG^* and PG^* stand for government foodgrain stocks and procurement in the calendar year. Since SFG^* refers to stocks held at the end of the calendar year (December), and the calendar year leads the crop year by 6 months, it is evident that the average stock held in calendar year t, given by $(SFG^*_{t-1} + SFG^*_t)/2$, centres on June, which corresponds to the end of the crop year t. We denote this end-of-crop-year stock as SFG_t. In other words

(2.3) $SFG_t = (SFG_t^* + SFG_{t-1}^*)/2$

From a study by Khetan (1973, p. 66), we estimated that approximately 55% of output is normally harvested in the third and fourth quarters of the calendar year, the rest being harvested in the first and second quarters. Assuming that the government's procurement of foodgrains is distributed over the calendar year in these proportions, we can approximate the government's crop year procurement PG by

(2.4) $PG_t = .55PG_{t-1}^* + .45\ PG_t^*$

noting that the third and fourth quarters correspond to the first six months in the crop year.

Substituting (2.3) and (2.4) into (2.2) we get

$$DSF_t = .25\{(MS_t - MS_{t-1}) + .55\Delta PG_{t-1}^* + .45\Delta PG_t^*\}$$
$$+ \{(\Delta SFG_t + \Delta SFG_{t-1})/2\}$$

This equation was used to generate our DSF series. We also estimated the MS series using net production of foodgrains which is normally taken 87.5% of YF. The DSF series derived in this manner was very similar to the previous one and our estimation results based on the two DSF series were practically the same, so the results of the latter series are not reported in this study.

2. Foodgrain Imports.

Two series were constructed for foodgrain imports (ZF) - one for aggregate imports and the second for Title 1 PL 480 imports (ZFPB). Commercial foodgrain imports (ZFCOM) were obtained by subtracting the latter series from the former. The two series were obtained in the following manner:

a) Aggregate Foodgrain Imports.

Data for grain imports (in millions of tons) on a crop year basis were obtained from World Grain Trade Statistics (1974), U.S. Department of Agriculture, (Washington, D.C.), World Grain Statistics (1974) F.A.O., United Nations (Rome), and various issues of Monthly Bulletin of Agricultural Economics and Statistics, F.A.O., United Nations, (Rome). These data do not include rice imports, data for which were obtained from Agricultural Data Book for the Far East and Oceania (1969), U.S. Department of Agriculture (Washington, D.C.), and from various issues of Agricultural Statistics, U.S. Department of Agriculture (Washington, D.C.). These data are on a calendar year basis, and were hence adjusted to a crop year basis. Adding together the grain imports and rice imports series gave us our foodgrain imports series (ZF).

b) PL 480 Foodgrain Imports.

This series was constructed using data taken from various issues of Agricultural Statistics, and of U.S. Foreign Agricultural Trade Statistical Report (Fiscal Year), U.S. Department of Agriculture (Washington, D.C.). The available PL 480 data were in terms of the dollar value of PL 480 sales (to India) of wheat, rice and foodgrains. On the basis of the dollar value and quantity of total - i.e., commercial plus PL 480 - U.S. exports of wheat, rice and feedgrains to India, we constructed unit-values (U.S. dollars per ton) for each of these exports. These unit-values were then used to deflate the dollar value of PL 480 sales of wheat, rice and feedgrains, to obtain the corresponding quantities in millions of tons. These quantities were added together to yield our PL 480 foodgrain imports series (ZFPB). It may be noted that the data used in this construction were on an Indian crop year (July-June) basis. All the requisite data were not available for the 1959-60 calculation. For this year, we took the estimate presented in F.D. Barlow and Libbins (1969, p. 66), whose estimates for the period 1956-57/1964-65 are in fairly close agreement with ours.

(A.2.4) Trade Data.

The export and import categories in this study have been constructed on the basis of the Indian Trade

Classification (ITC), in which merchandise trade data are classified on a commodity basis by section, division and group. Our series have been constructed primarily from the aggregate section-level data. By section, the ITC classification is:

Section 0 - Food and Live Animals.

Section 1 - Beverages and Tobacco.

Section 2 - Crude Materials, inedible, except fuels.

Section 3 - Minerals, Fuels, Lubricants and Related Materials.

Section 4 - Animal and Vegetable Oils and Fats.

Section 5 - Chemicals.

Section 6 - Manufactured goods classified chiefly by material.

Section 7 - Machinery and Transport Equipment.

Section 8 - Miscellaneous Manufactured Articles.

Section 9 - Commodities and Transactions not classified according to kind.

Our export and import categories have been defined as follows:

1) Exports.

(a) Exports of Manufactures = 5 + 6 + 7 + 8.

(b) Exports of Non-traditional Manufactures = 5 + (6 less jute manufactures less cotton textiles) + 7 + 8.

(c) Exports of other (mainly primary goods) = total exports - (5 + 6 + 7 + 8).

= 0 + 1 + 2 + 3 + 4 + 9.

2) Imports.

(a) Imports of Capital Goods = 7.

(b) Imports of Raw Materials and Intermediate Goods = 2 + 3 + 4 + +(5 less 56) + 6

(c) Imports of Cereals and Cereal Preparations = Division 04.

(d) Imports of fertilizer = Division 56.

(e) "Other" Imports = Total Imports - (04 + 2 + 3 + 4 + 5 + 6).

= (0 less 04) + 1 + 8 + 9.

The major sources for these data, which are in current values and on a fiscal year basis are Monthly Statistics of the Foreign Trade of India, Volumes 1 and 2, Department of Commercial Intelligence and Statistics, Government of India (Calcutta), Monthly Bulletin, Reserve Bank of India (Bombay), Report on Currency and Finance and Statistical Abstract. Since the data were reported on a different basis prior to 1957, data classified in this manner were not available from official sources for the fiscal years 1956-57 and 1957-58. These were taken from a study by Thanawala (1967), who has re-classified the data for the period 1950-51/1959-60 according to the ITC defined above.

The export and import categories were expressed in real terms by deflating the components of each by the relevant unit-value index, data for which were obtained from various issues of Report on Currency and Finance and Monthly Bulletin. The various unit-value indices were constructed by combining series based on different base years, and adjusting them to base year 1960-61. The unit-value data prior to 1960-61 are on a calendar year basis, and hence had to be first put on a fiscal year basis. Further, for the calendar year 1956, no data for most of the unit-values, according to the ITC sections above, are available. Consequently, for the fiscal year 1956-57, the 1957 calendar year unit-values were taken as approximations. In some cases like capital goods imports, jute manufactures and exports of manufactures, where some additional information from non-official sources was available, we were able to construct approximate unit-values for 1956-57. These sources were R.N. Lal (1977, p. 95), for capital goods imports and M. Singh (1964, p. 38) for jute exports. The unit-value index for 1956-57 for manufacturing exports was based on its unit-value according to the old classification.

Deflation of the components of our export categories by their respective unit-values, enabled us to derive real series for each export and import categoty.

The exception was the real primary exports series, which was obtained residually by subtracting real manufacturing exports from real aggregate exports. Having obtained the real counterparts of our export and import categories EM, ENTM, EO, ZCAP, ZRAW, ZCRP, ZFRT defined above, the respective unit-values - PEM, PENTM, PEO, PZCAP, PZRAW, PZCRP and PZFRT - were obtained by dividing the current value data for each category by the appropriate real series.

(A.2.5) Other Balance of Payments Data.

The variable ERS measures the discrepancy between the estimates of merchandise trade as published in the national accounts and those prepared on a disaggregated commodity basis by the Department of Commercial Intelligence and Statistics (DGCI). ERS was measured using the balance of payments identity as follows:

ERS = ZS - ES - NEIS - NFPS - FKS

where ZS = nominal aggregate imports as estimated by the DGCI.

= sum of import categories listed above.

ES = nominal aggregate exports as estimated by the DGCI

= sum of export categories listed above.

Replacing ZS and ES by their national accounts counterparts, and setting ERS to zero, we used this identity to measure net exports of invisibles other than factor payments (NEIS).

The index of the exchange rate EI, was calculated using the folloiwng information:

	Exchange Rate
1956-57 to 1965-66	Rs 4.76 per U.S. dollar.
1966-67 to 1970-71	Rs 7.50 per U.S. dollar.
1971-72 to 1975-76	Not fixed; annual average calculated on the basis of the dollar and rupee value of export / import published in the Economic Survey.

The index was constructed by making the 1960-61 exchange rate of Rs 4.76 per U.S. dollar equal to 1.0.

(A.2.6) World Income and Export Prices.

The 1969, 1972 and 1977 issues of Yearbook of National Accounts Statistics: International Tables, United Nations (New York), provides calendar year data for the index of constant dollar GDP for developing and developed market economies with 1963 = 100.0, as well as with 1970 = 100.0. Both GDP indices were reduced to the base year 1960. The index of world income used in the study (QWI) was derived by taking a weighted average of both indices, the weights being those assigned to each of these groups of countries in the 1970 = 100.0 series. The index was then brought to a fiscal year basis with 1960-61 = 100. Note that the index excludes the GDP of centrally planned economies.

An index of the unit-value of exports of developing countries (excluding oil-exporters) with 1975 = 1.0 is available on a calendar year basis in International Financial Statistics Yearbook, (1979), I.M.F., United Nations, (New York). This was adjusted a fiscal year basis with 1960-61 = 1.0 to yield the index PELDC. The unit-value index of world manufacturing exports (PWM) was taken from various issues of Monthly Bulletin of Statistics, United Nations (New York) and from Handbook of International Trade and Development Statistics (1972), UNCTAD, United Nations (Geneva). The index covers the commodities in SITC sections 5 to 8, and is available for different base years. We adjusted the index to a fiscal year basis and re-constructed it with 1960-61 = 1.0.

(A.2.7) Miscellaneous Variables.

The remaining variables for which series were constructed were the agricultural and manufacturing production indices AGRI and MFGI respectively, and the supply of industrial power INPOW.

Data for AGRI, available on a crop year basis, was taken from Area and Production of Principal Crops in India and Economic Survey, and adjusted to 1960-61 = 100.0

The index MFGI was constructed such that it conforms approximately to the ITC Sections 5 + 6 + 7 + 8 defined earlier, in terms of commodity coverage. Its construction was based on the index of manufacturing production, data for which were taken from various issues of Economic Survey, Report on Currency and Finance and Yearbook of Industrial Statistics, Volume 1, United Nations (New York). To conform to the ITC sections listed, MFGI excludes the production of food, beverage and petroleum industries, all of which are included in the official index of production of manufacturing industries. The overall index was viewed as a weighted average of MFGI and the index of the group of food, beverage and petroleum industries. The weights were calculated on the basis of weights assigned to manufacturing and its components in the index of industrial production with 1960 = 100.0. In the first stage, the different series for each of manufacturing, food, beverage and petroleum industries were adjusted to 1960 = 100.0. MFGI was then derived in the way the index of non-foodgrains prices (PNF) was derived earlier. The index of production for food, beverage, petroleum and mining industries (MFPI), which was also used in explaining the price of agricultural goods PAF in Chapter 6, was constructed by taking a weighted average of the indices of these industries. Since the index of industrial production and of its components is on a calendar year basis, MFGI and MFPI were adjusted and put on a fiscal year basis.

The series for the supply of industrial power (INPOW) was constructed from data taken from Economic Survey, Basic Statistics Relating to the Indian Economy (1976), C.S.O., Government of India and Economic Survey of Asia and the Far East, United Nations (Bangkok). While data on total electricity generated are available, their breakdown by industrial and other uses are not on a continuous basis. Also not available on a continuous basis is the breakdown industrial power by generating establishments - viz., self-generating units, government and others. The following procedure was followed to estimate INPOW:

$$INPOW = XS + \alpha(XG + XO)$$

where XS = electricity generated by industrial establishments.

XG = electricity generated by public utilities.

XO = electricity generated by other establishments.

α = share of total electricity generated by public utilities and other establishments used in the industrial sector.

$$\beta = \frac{INPOW}{X} = \frac{XS}{X} + \alpha(\frac{XG}{X} + \frac{XO}{X})$$

where X = total electricity generated.

Each of the ratios on the right-hand-side were averaged over the years for which data were available to us - viz., 1955, 1960-61, 1965-66, 1969-70 and 1974-75. We also approximated α in this manner. This yielded an average share of industrial power in total electricity generated over the period of .72 - i.e., $\beta = .72$. The supply of industrial power series (INPOW) was then derived using

$$INPOW = .72X$$

Data for the money supply series was taken from Report on Currency and Finance, (1974-75), and Weekly Statistical Supplement to Monthly Bulletin (March 1976), Reserve Bank of India. The data refer to end-of-fiscal year money stock.

(The data used in the study can be obtained from the Graduate Secretary, Economics Department, McMaster University, Hamilton, Ontario, Canada L8S 4M4.)

SELECT BIBLIOGRAPHY

Agarwala, R.N. (1970), An Econometric Model of India, London, Frank Cass.

Agarwala, A.N., and S.P. Singh, eds. (1968), The Economics of Underdevelopment, New York, Oxford University Press.

Areskoug, K. (1969), External Public Borrowing: Its Role in Economic Development, New York: Praeger.

Artus, J.R. (1977), "Measuring Potential Output in Manufacturing for Eight Industrial Countries, 1955-78", International Monetary Fund Staff Papers, 24 (March), pp. 1-33.

Avramović, D. et. al. (1964), Economic Growth and External Debt, IBRD, Baltimore, Johns Hopkins Press.

Ball, R.J., ed. (1973), The International Linkage of National Economic Models, Amsterdam, North-Holland.

Bardhan, P.K. (1968), "Indian Agriculture: An Analysis of Recent Performance", Current History, 54 (April), pp. 212-218, reprinted in Chen and Uppal, eds. (1971), pp. 6-12.

Bardhan, P.K. (1971), "Recent Developments in Indian and Chinese Agriculture", in Chen and Uppal, eds. (1971), pp. 44-58.

Bardhan, P.K. (1970), Economic Growth, Development and Foreign Trade, New York, Wiley.

Bardhan, P.K. and K. Bardhan (1969), "The Problem of Marketed Surplus of Cereals in India", Economic and Political Weekly, (June 28), Bombay.

Barlow, F.D. and S.A. Libbins (1969), Food Aid and Agriculture Development, U.S. Department of Agriculture, Foreign Agricultural Economic Report, No. 51, June.

Beringer, C. (1963),"Real Effects of Foreign Surplus Disposal in Underdeveloped Economies: Comment", Quarterly Journal of Economics, 46 (May), pp. 317-323.

Behari, B. (1965), Imports in a Developing Economy, Bombay, Vora.

Bhagwati, J.N. et. al., eds. (1971), Trade Balance of Payments and Growth. Papers in International Trade in Honour of Charles P. Kindleberger, Amsterdam, North-Holland.

Bhagwati, J.N., ed. (1969), International Trade: Selected Readings, Hammondsworth,Penguin.

Bhagwati, J.N., (1978), Anatomy and Consequences of Exchange Control Regimes, Cambridge: Mass., NBER, Ballinger.

Bhagwati, J.N. and S. Chakravarty, "Contributions to Indian Economic Analysis: A Survey", American Economic Review, Supplement, 4 (September), pp. 2 - 27.

Bhagwati, J.N., and P. Desai (1970), India: Planning for Industrialization: Industrial and Trade Policies since 1951, London, Oxford University Press.

Bhagwati, J.N., and T.N. Srinivasan (1975), Foreign Trade Regimes and Economic Development: India, New York, NBER, Columbia University Press.

Bhole, L.M., (1972), "Interest Rate and Corporate Investment: An Indian Case Study", Indian Economic Journal, 19 (April-June), pp. 580-593.

Bruton, H.J. (1969), "The Two-Gap Approach to Aid and Development: Comment", American Economic Review, 59 (June), pp. 439-449.

Chaudhuri, P. (1979), The Indian Economy: Poverty and Development, New York, St. Martin's Press.

Choudhury, N.K., et. al. (1972), The TRACE Model of the Canadian Economy, Toronto, University of Toronto Press.

Choudhury, N.K. (1963), An Econometric Model of India, 1930-1955, Ph.D. Dissertation, University of Wisconsin.

Chenery, H.B., ed.,(1971), Studies in Development Planning, Cambridge, Harvard University Press.

Chenery, H.B. and I. Adelman (1966), "Foreign Aid and Economic Development: The Case of Greece", Review of Economics and Statics, 48 (February), pp. 1-19.

Chenery, H.B. and M. Bruno (1962), "Development Alternatives in an Open Economy", Economic Journal, 72 (March, pp. 79-103.

Chenery, H.B. and A. Macewan (1966), "Optimal Patterns of Growth and Aid: The Case of Pakistan", Pakistan Development Review, 6 (Summer), pp. 209-242.

Chenery, H.B. and A.M. Strout (1966), "Foreign Assistance and Economic Development", American Economic Review, 56 (September), pp. 679-733.

Chen, Kua-I.and J.S. Uppal, ed. (1971), Comparative Development of India and China, The Free Press.

Cohen, B. (1966), "Foreign Exchange Constraints and Efficient Aid Allocation: Comment", Economic Journal, 76 (March), pp. 168-169.

Dantwala, M.L., (1957), "Incentives and Disincentives in Indian Agriculture", Indian Journal of Agricultural Economics, 22 (April-June), pp. 1-25.

Desai, M. (1973), "Macro Econometric Models for India, A Survey", Sankhya, Series B, 35, pp. 169-206, reprinted in ICSSR (1978), pp. 307-367.

Dutta, M. (1964), "A Prototype Model of India's Foreign Sector", International Economic Review, 5 (January), pp. 82-102.

Dutta, M. (1965), "Import Structure of India", Review of Economics and Statistics, 47 (August), pp. 295-300.

Enos, J.L. and K.B. Griffin (1971), "Foreign Assistance: Objectives and Consequences: A Reply to Our Critics", Economic Development and Cultural Change, 20 (October), pp. 155-158.

Elridge, P.J. (1970), The Politics of Aid, London, Weidenfield and Nicholson.

Evans, M. (1969), Macroeconomic Activity: Theory, Forecasting and Control; An Econometric Approach, New York, Harper and Row.

Falcon, W.P. (1963), "Real Effects of Foreign Surplus Disposal in Under-Developed Economies: Further Comments", Quarterly Journal of Economics, 79 (May), pp. 323-326.

Findlay, R. (1971), "The Foreign Exchange Gap" and Growth in Developing Countries", in Bhagwati et. al., eds. (1971), pp. 168-182.

Fisher, F.M. (1963),"A Theoretical Analysis of the Impact of Food Surplus Disposal on Agricultural Production in Recipient Countries", Journal of Farm Economics, 45 (November), pp. 863-875.

Griffin, K.B. (1973), "The Effect of Aid and Other Resource Transfers on Savings and Growth in Less-Developed Countries: A Comment", Economic Journal, 83 (September), pp. 863-866.

Griffin, K.B. and J.L. Enos (1970), "Foreign Assistance: Objectives and Consequences", Economic Development and Cultural Change, (April), pp. 313-337.

Gulati, U. (1976), "Foreign Aid, Savings and Growth: Some Further Evidence", Indian Economic Journal, 24 (October-December), pp. 152-160.

Gupta, S.B., (1975), Planning Neutral Money for India, Indian Economic Journal, 23 (April-June), pp. 169-189.

Gupta, K.L. (1970a), "Personal Saving in Developing Nations: Further Evidence", Economic Record, 46 (June), pp. 243-249.

Gupta, K.L. (1970b), "On Some Determinants of Rural and Urban Saving Behaviour", Economic Record, 46 (December, pp. 578-583.

Joshi, V.H. (1970), Saving Behaviour in India, Indian Economic Journal, 17 (April-June), pp. 515-528.

Johnston, J. (1972), Econometric Methods, Tokyo, McGraw Hill.

Kenen, P.B., ed. (1975), International Trade and Finance: Frontiers For Research, New York, Cambridge University Press.

Khang, C. (1968), "A Neoclassical Growth Model of a Resource Poor Open Economy", International Economic Review, 9 (October), pp. 329-338.

Khatkate, D.K. (1962), "Some Notes on the Real Effects of Foreign Surplus Disposal in Underdeveloped Economies", Quarterly Journal of Economics, 76 (May), pp. 186-196.

Khatkate, D.R. (1963) "Real Effects of Foreign Surplus Disposal in Underdeveloped Economies: Reply", Quarterly Journal of Economics, 78 (November), pp. 655-658.

Khetan, C.P. (1973), A Quarterly Econometric Model of the Indian Monetary Sector, Ph.D. dissertation, McMaster University.

Khetan, C.P. and R.R. Waghmare (1971), "Monetary Adjustments in India", Indian Economic Journal, 18 (April-June), pp. 496-513.

Klein, L.R. (1965), "What Kind of Macroeconometric Model for Developing Economies", Econometric Annual of the Indian Economic Journal, 13, pp. 313-324.

Klein, L.R. (1974), A Textbook of Econometrics, Englewood Cliffs, N.J., Prentice Hall.

Kloek, T., and L.B.M. Mennes (1960), "Simultaneous Equations Estimation Based on Principal Components of Predetermined Variables", Econometrica, 28 (January), pp. 45-61.

Koteswaram, P. (1970), "Meteorological and Climatological Aspects of Dryland Farming in India", Paper presented at the ICAR Workshop on Dryland Agricultural Research, Indian Agricultural Research Institute, New-Delhi, (Sept.28-Oct.1).

Krishnamurty, K. (1964), An Econometric Model of India: 1948-1961, Ph.D. dissertation, University of Pennsylvania.

Krishnamurty, K. and N.K. Choudhury (1968), Towards a Post-War Econometric Model of India, Working Paper Series No. 6814, Institute for the Quantitative Analysis of Social and Economic Policy, University of Toronto.

Kuznets, S.S. (1966), Modern Economic Growth: Rate Structure and Spread, New Haven, Yale Unviersity Press.

Lal, D. (1970), "Foreign Exchange Constraints and Economic Development: A Geometric Note", Indian Economic Journal, 18 (April-June), pp. 33-46.

Lal, D. (1972), "The Foreign Exchange Bottleneck Revisited: A Geometric Note", Economic Development and Cultural Change, 20 (July), pp. 722-730.

Lal, R.N. (1977), Capital Formation and its Financing in India, Delhi, Allied Publishers.

Landau, L. (1969), "Differences in Saving Ratios Among Latin American Countries", in Chenery, ed. (1971), pp. 299-321.

Leamer, E.E., and R.M. Stern (1970), Quantitative International Economics, Boston, Allyn and Bacon.

Lewis, A.W., (1954), "Economic Development with Unlimited Supplies of Labour", in Agarwala and Singh, eds. (1968), pp. 400-449.

Linder, S.B. (1967), Trade and Trade Policy for Development, New York, Praeger.

Lotz, J.R. and E.R. Morss (1967), "Measuring Tax Effort in Developing Countries", International Monetary Fund Staff Papers, 14 (November), pp. 478-499.

Mammen, T. (1967), An Econometric Study of the Money Market in India, Ph.D. dissertation, University of Pennsylvania.

Mann, J.S. (1967), "The Impact of P.L. 480 Imports on Prices and Domestic Supply of Cereals in India", Journal of Farm Economics, 49 (February), pp. 131-146.

Marwah, K.K. (1964), An Econometric Model of Price Behaviour in India, Ph.D. dissertation, University of Pennsylvania.

Marwah, K.K. (1972), An Econometric Model of India, Indian Economic Review, 7 (April), pp. 53-91.

Mathur, P.N. (1965), "Real Effects of Foreign Surplus Disposal in Underdeveloped Economies: Comment", Indian Journal of Agricultural Economics, 20 (April-June), pp. 68-72.

McKinnon, R.I. (1964), "Foreign Exchange Constraints in Economic Development and Efficient Aid Allocation", in Bhagwati, ed. (1969), pp. 370-398.

McKinnon, R.I. (1966), "Foreign Exchange Constraints in Economic Development and Efficient Aid Allocation: Rejoinder", Economic Journal, 76 (March), pp. 170-171.

Mellor, J.W. (1976), The New Economics of Growth: A Strategy for India and the Developing World, London, Cornell University Press.

Meier, G.M., ed. (1970), Leading Issues in Economic Development, New York, Oxford Unviersity Press.

Mikesell, R.F. and J.E. Zinser (1973), "The Nature of the Savings Function in Developing Countries: A Survey of the Theoretical and Empirical Literature", Journal of Economic Literature, 11 (March), pp. 1-26.

Mukherjee, M. (1969), National Income of India: Trends and Structure, Calcutta, Statistical Publishing Society.

Mukherjee, M. and N.S.R. Sastry (1963), "Estimates of Tangible Wealth of India", in the Monthly Bulletin, Reserve Bank of India, January, pp. 8-19.

Myint, H. (1971), Economic Theory and The Underdeveloped Countries, New York, Oxford University Press.

Narasimham, N.V.A. (1956), A Short-Term Planning Model of India, Amsterdam, North-Holland.

Nayyar, D. (1976), India's Exports and Export Policies in the 1960's, New York, Cambridge University Press.

Nerlove, M. (1958), The Dynamics of Supply: Estimation of Farmers' Response, Baltimore, Johns Hopkins Press.

Newlyn, W.T. (1973), "The Effect of Aid and Other Resource Transfers on Savings and Growth in Less-Developed Countries: A Comment", Economic Journal, 83 (September), pp. 867-869.

Nurkse, R. (1953), Problems of Capital Formation in Underdeveloped Countries, Oxford, Basil Blackwell.

Patinkin, D. (1965), Money, Interest and Prices, New York, Harper and Row.

Papanek, G.F. (1973), Aid, Foreign Private Investment, Savings and Growth in Less-Developed Countries, Journal of Political Economy, 81 (February) pp. 120-130.

Papanek, G.F. (1972), "The Effect of Aid and Other Resource Transfers on Savings and Growth in Less-Developed Countries: A Comment", Economic Journal, 82 (September), pp. 934-950.

Papanek, G.F. (1973), "A Reply to Dr. Griffin and Professor Newlyn", Economic Journal, 83 (September), pp. 870-874.

Patel, S.K. (1976), "Relative Prices in Indian Import Functions", Indian Economic Journal, 23 (April-June), pp. 380-386.

Patel, R.H. (1970), "Exports of Engineering Goods: Problems and Prospects" in Monthly Bulletin, Reserve Bank of India (October).

Please, S. (1967), "Savings Through Taxation - Mirage or Reality", Finance and Development, 4 (March) pp. 1-10.

Please, S. (1970), "The Please Effect Revisited", IBRD, Economics Department, Working Paper, No. 82, July.

Prebisch, Raul (1964), Towards a New Trade Policy for Development, Report by the Secretary-General of UNCTAD, United Nations, New York.

Pindyck, R.S. and D.L. Rubenfeld (1976), Econometric Models and Economic Forecasting, New York, McGraw Hill.

Raj, K.N. (1962), "The Marginal Rate of Saving in the Indian Economy, Oxford Economic Papers, 14 (February), pp. 36-50.

Rao, C.R. (1972), Data Base of The Indian Economy, Calcutta, Statistical Publishing Society.

Rao, T.V.S., and G.D. Misra (1976), "Investment Financing in the Corporate Sector", Indian Economic Journal, 23 (April-June), pp. 311-318.

Rahman, M.A. (1967), "The Welfare Economics of Foreign Aid", The Pakistan Development Review, 7 (Summer).

Rahman, M.A. (1968), "Foreign Capital and Domestic Savings: A Test of Haavelmos Hypothesis with Cross-Section Data, Review of Economics and Statistics, 50 (February), pp. 137-138.

Rath, N. and V.S. Patwardhan (1967), Impact of Assistance Under P.L. 480 on Indian Economy, Poona.

Rostow, W.W. (1956), "The Take-Off Into Self-Sustained Growth", in Agarwala and Singh, ed. (1968), pp. 154-186.

Sastry, D.U. (1976), "Investment Behaviour in the Indian Capital Goods Industry", Indian Economic Journal, 23 (July-September), pp. 56-57.

Schiavo-Campo, S. and H.W. Singer (1970), Perspectives of Economic Development, Boston, Houghton Miffin.

Schultz, W.T. (1960), "Value of U.S. Farm Surpluses to Underdeveloped Countries", Journal of Farm Economics, 42 (December), pp. 1019-1030.

Sen, A.K., ed. (1970), Growth Economics, Hammondsworth, Penguin Books.

Sen, S.R. (1960), "Impact and Implications of Foreign Surplus Disposal on Underdeveloped Countries: The Indian Perspective", Journal of Farm Economics, 42 (December), pp. 1030-1042.

Shahi, M.A. (1977), "The Demand for Money: Some Empirical Evidence for Developing Countries", Indian Economic Journal, 29 (April-June), pp. 351-370.

Sharma, O.P. (1975), "Foreign Trade and Relative Prices in an Import Substituting Economy: An Econometric Study of India's Trade Flows, 1951-1970", Indian Economic Journal, 22 (January-March), pp. 201-214.

Shenoy, S.R. (1971), India: Progress or Poverty?: A Review of the Outcome of Central Planning in India, 1951-69, London, Institute of Economic Affairs.

Streeten, P. and R. Hill (1968), "Aid to India", in Streeten and Lipton, eds. (1968), pp. 323-349; reprinted in Chen and Uppal, eds. (1971), pp. 312-327.

Streeten, P. and M. Lipton (1968), The Crisis of Indian Planning, London, Oxford University Press.

Singh, B. (1970), "Price Stability and Money Supply During the Fourth Five Year Plan", Indian Economic Journal, 17 (April-June), pp. 469-477.

Singh, M. (1964), India's Export Trends and The Prospects for Self-Sustained Growth, London, Oxford University Press.

Singh, S.K. (1972), Development Economics: Theory and Findings, Lexington, Massachusets, D.C. Heath.

Thanawala, K.H. (1967), Statistics Relating to India's Foreign Trade: 1948-49 to 1959-60, Bombay, Popular Prakashan.

Theil, H. (1966), Applied Econometric Forecasting, Amsterdam, North-Holland, pp. 26-36.

Thirwall, A.P. (1974), Growth and Development with Special Reference to Developing Economies, London, Macmillan.

UNCTAD (1968), "Trade Projections for India" in Trade Prospects and Capital Needs of Developing Countries, UNCTAD (1968), pp. 3-7, 298-317. New York.

UNCTAD (1973), "An Econometric Model of the Indian Economy: 1950-51 to 1968-69" in Ball ed. (1973), pp. 141-161.

Vasudevan, A. (1975), "Income Velocity of Money and Short-term Rates of Interest - A study of the Indian Experience: 1951-52 to 1973-74", Indian Economic Journal, 23 (October-December), 191-201.

Veit, L.A. (1976), India's Second Revolution: The Dimensions of Development, New York, McGraw-Hill.

Weisskopf, T.E. (1972), "The Impact of Foreign Capital Inflow on Domestic Savings in Underdeveloped Countries", Journal of International Economics, 21 (February), pp. 23-38.

Williamson, J.G. (1968), "Personal Saving in Developing Nations: An Inter-temporal Cross-Section from Asia", Economic Record, 44 (June), pp. 294-210.

Winston, G.C. (1971), "Capital Utilization in Economic Development", Economic Journal, 81 (March), pp. 36-60.

World Bank (1980), World Development Report, New York, Oxford University Press.

Yadev, R.P. (1975), An Econometric Model For the Foreign Trade Sector of India, 1960/61-1971/72, Ph.D. dissertation, Cornell University.

Yotopoulos, P.A. and J.B. Nugent (1976), Economics of Development: Empirical Investigations, New York, Harper and Row.