PRICE, INCOME, INTEREST IN A TWO-SECTOR MODEL OF AGRICULTURE AND NON-AGRICULTURE

A Theoretical and Empirical Analysis for the Indian Economy

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Chapter 1

THE PRESENT STUDY : AN OUTLINE

1.1 The Purpose of the Study

A macroeconomic model seeks to portray the functioning of an economy at an aggregative level, i.e., in terms of important macrovariables and their interrelationships. The empirical counterpart of such a model is what is called a macroeconometric model when the macrorelations are posited statistically, employing probabilistic methods of estimation and/or hypothesis testing.

The present study covers both aspects of a macromodel. On the theoretical side, it builds up a macroeconomic model which may be relevant for a country like India. On the empirical-statistical side, it goes on to formulate a macroeconometric model. There is a clear interdependence between these two parts of the study, since not only has the macroeconometric model been constructed on the basis of the macroeconomic model, but the formulation of the macroeconomic model has also been influenced by the various empirical results obtained in course of the present study. The period of study covers the years from 1950-51 to 1965-66.

At this point we have to recall that there already exist a number of macroeconomic models and also a few macroeconometric models for the

Indian economy. Our indebtedness to this literature will be pointed out in specific contexts. The conceptual background of this study, however, owes as much to this literature of macroeconometric models as to a line of reasoning which is stated most clearly in Kalecki (1954) but which does not quite form a part of contemporary macroeconomic theory. To come to it, we need only mention here that (a) this study is conducted in terms of a two-sector breakdown of the economy, viz., agriculture and non-agriculture, and,(b) its primary focus is on the examination of interactions between prices and outputs in these two sectors. The primary justification for the breakdown is that an underdeveloped economy like India cannot be said to be governed by a single 'law' — whether for price formation or for output and income generation in different sectors. To make room for this basic point is to go beyond the framework of an aggregative one-sector model, a framework in terms of which most of the (short-run) macroeconomic models are developed, and we have taken the minimal step in this regard.1/

Coming now to the 'different laws' in the two sectors we may quote from Kalecki (1954, p.11) :

1/ Going to examine the kind of macroeconometric model suitable for developing economies, Klein (1965, p.324) also remarks, "An aggregative model of the Indian economy must at a minimum be divided into three production sectors — agriculture, private non-agricultural output and the public sector". We may point out in this connection that the so-called "dual economy" models (e.g., Lewis, 1954; Ranis and Fei, 1961; Jorgenson, 1961) adopt a similar breakdown of the economy, viz., traditional and modern sectors. However, the viewpoint, perspective and foci of these models and the model to be proposed in this study are so different that we do not take up any discussion of these models at all.

"Short-term price changes may be classified into two broad groups : those determined mainly by changes in cost of production and those determined mainly by changes in demand. Generally speaking, changes in the prices of finished goods are 'cost-determined' while changes in the prices of raw materials inclusive of primary foodstuffs are 'demand-determined'.

It is clear that these two types of price formation arise out of different conditions of supply. The production of finished goods is elastic as a result of existing reserves of productive capacity ..... (while) the increase in the supply of agricultural products requires a relatively considerable time".[2/]

This sets out the basic principle of price (and implicit output) determination in a capitalist economy. It is, however, submitted that the principle is equally, if not more, valid in the case of an underdeveloped economy like India. First, the elasticity of supply of agricultural produce is likely to be even smaller here than in the case of advanced countries. In fact, agricultural production here depends more on such exogenous factors as weather than on any economic variable. Secondly, considerable

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2/ For a more recent and elaborate exposition of this basic dichotomy the reader is referred to the recent textbook by Robinson and Eatwell (1974, pp. 146-57) where they trace the doctrine even to the classical economists. A few lines may be quoted from their book (pp. 148, 149, 153) : "There are two broad categories of markets in which the relations of supply and demand for particular commodities operate differently .... In the first type, the producer offers his goods ... (at) whatever price they will fetch; in the second, the producer sets his price and sells as much as the market will take..... The first type of market is found among primary production ..... (whose) supply is governed, at any moment, by natural conditions which set a more or less rigid limit to production ..... (The second type of market is found among products of industries where) underutilized capacity normally exists for almost every commodity .... so that supply can respond readily to changes in demand".

excess capacities are usually present in the industrial sector of such economies, as also are imperfect and oligopolistic market structures, open urban unemployment etc. Thirdly, as we shall see in the next chapter, a number of econometric studies in India point to the importance of demand and cost of production in the determination, respectively, of agricultural and manufacturing prices.

It may be further pointed out that the two sectors distinguished have a coordinate importance in the structure of an underdeveloped country which is very much lacking in the case of an advanced industrial economy. For, not only does agriculture account for most of the domestic product in such economies (e.g., almost half in India), but presumably it is the prices of agricultural products which, influencing the costs of raw materials and wages, shape the course of behaviour of other prices. As a basis for developing an 'economic system', therefore, the two-sector breakdown suggested above holds a more promising line of application in these countries.3/

We may take this opportunity to point out a few further general limitations of the usual macroeconomic models — limitations which we shall try to overcome in our work. First, many of these models are aggregative and tread on the pure Keynesian line of demand determining outputs. However,

3/ It is interesting to note in this context that Kalecki concerned himself exclusively with 'cost-determined prices', i.e., prices of manufactures. In an advanced industrial economy these may be taken to be the overwhelmingly major component of the general price level. It is perhaps for this reason that the aggregative studies on price behaviour in industrial economies have been concerned mostly with the wage-price relationships, paying little attention to the 'structure' of prices.

as we have argued just now, in an economy like India the supply of many commodities (particularly in the agricultural sector) is inelastic and hence any fiscal or monetary policy would be rather ineffective in raising production.[4/] Thus an injection of fresh government expenditures into such an economy is likely to raise mainly prices and not production.

Secondly, most of these models pay only a scanty attention to the role of prices in the economy.[5/] The present day experience reveals that inflation or 'stagflation' is very much a problem in underdeveloped countries. This requires special attention to be drawn to the behaviour of prices as well as to their effects on the different parts of the economy. And this is where usual macroeconomic models are really unsatisfactory; a rigorous theoretical model analysing the interaction of prices and outputs in different sectors is most often lacking. As we shall see below, such interaction may be so important that an increase in the autonomous demand (for the product of one sector) may reduce production (in the other sector) — a result contradicting the familiar conclusion of a Keynes-type model.

A final problem is encountered when attempts are made to overcome the aforesaid limitations. Such models are bound to be big in size. For instance, the product sectors of the economy need to be classified into at least two — one in which production is inelastic and the other in which it may be assumed to be elastic. Explanations of the behaviour of prices

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4/ See Rao (1952).

5/ One reason is that these are of the one-sector variety. But even when these contain several prices, the role which prices play in affecting demands, outputs etc. is not, in general, placed on a proper perspective.

of individual products as well as of their interactions are called for. All these variables are further to be integrated with the monetary variables of the economy. Once models become large to this extent, a fresh problem crops up. That is, one gets lost in the maze of various structural relations and variables, so that a simple picture of the working of the economy is very difficult to perceive.[6/]

Many of these shortcomings usually persist even in the empirical counterparts of macroeconomic models. This is particularly true of most of the macroeconometric models which have so far been constructed for India. These models neither attempt at a rigorous examination of the interrelationship between prices and outputs of various sectors, nor do they help in having an integrated and overall view of the economic mechanism operating in India.

As already stated, the present study may be viewed as one attempt at removing these limitations from the usual macroeconomic and macroeconometric models. Also, as it will be clear later on, the present model can be viewed as a two-sector extension of Keynesian theory to the case of an underdeveloped economy. The study consists of two parts. In Part I a theoretical model has been constructed for the short-run determination of prices, incomes and rate of interest; the major implications of the model are then examined. Results of our empirical investigations have been reported in Part II. The plan of the study is described in detail in the next section.

6/ The model of Harris (1970) is a case in point.

1.2 The Plan of the Study

Part I consists of three chapters — Chapters 2 to 4. Since the study talks much about prices, two chapters are devoted to review the materials. Chapter 2 surveys a number of quantitative studies on price behaviour in India. A major part of this chapter is devoted to a critical examination of a number of macroeconometric models of India and notes the major limitations of these models. Chapter 3 then presents and analyses the history of movement of prices and outputs in various sectors in India during the period from 1950-51 to 1967-68. The primary purpose of this chapter is to identify some of the factors which might explain the behaviour of prices and productions as observed in India. In this context, the arguments of the "structuralist" school[7/] (regarding the Latin American inflation) have been examined and it is shown that many of the factors emphasised by the structuralists are also relevant for India.

The basic theoretical structure of the present study has been spelt out in Chapter 4. As already stated, a two-sector breakdown of the real part of the economy has been considered — agriculture and non-agriculture (inclusive of services), each characterised by its specific demand and supply elements. The main elements in the demand for the agricultural good (i.e., the product of the agricultural sector) are private consumption, export and 'intermediate' use of agricultural raw materials in the non-agricultural sector. The important components of demand for

7/ For arguments of the structuralist school, see, e.g., Felix (1961) and Seers (1962).

the non-agricultural good (i.e., the product of the non-agricultural sector) are private consumption, private investment, export, public consumption and public investment. The supply of each good comes from domestic production and import. While the supply of agricultural good is assumed to be given exogenously, excess capacity is assumed to prevail in the non-agricultural sector so that here 'demand creates its own supply'.

The model postulates that the price of the non-agricultural good is governed partly by the price of the agricultural good and partly by the demand for the non-agricultural good. The private consumption demand for each good depends upon aggregate (real) income and relative price, i.e., the so-called intersectoral terms of trade. This relative price also affects the private investment in the non-agricultural sector; the latter is influenced also by two additional variables — the (real) income originating in the non-agricultural sector and the rate of interest.

The monetary sector has been introduced in a, more or less, Keynesian fashion. On the one hand, there is the demand for money varying positively with the aggregate money income, but inversely with the rate of interest. However, the supply of money has not been treated as an exogenous variable, but is assumed to be governed by the rate of interest and the (unborrowed) base money; the latter is defined as the sum of currency with the public and required-cum-excess reserves of banks net of their borrowings from the central bank.

On the assumption that some of the variables (e.g., government demands of all kinds, base money etc.) are given exogenously, the model is then shown to yield a determinate system in terms of the endogenous variables. Next, all the relations in the model are shown to be reducible to only two simultaneous equations in two variables, viz., (real) income in the non-agricultural sector and relative price of agricultural good. Such a derivation has been motivated by the need to have a simple view of the determination of the values of key variables of the model., viz., income in the non-agricultural sector, relative price of agricultural good, absolute prices of two goods and rate of interest. The results have been obtained algebraically, but a graphical exposition has also been added.

Finally, the section on comparative statics establishes four propositions with the help of a few additional assumptions. It is shown that an increase in the (net) autonomous demand for non-agricultural good or an increase in the base money raises income in the non-agricultural sector and relative price of agricultural good (and also absolute prices of two goods). An increase in the autonomous demand for agricultural good increases its relative price, but reduces income in the non-agricultural sector. Finally, an increase in the(real) income in the agricultural sector raises income in the non-agricultural sector.

Part II of the study consists of Chapters 5 to 8 and is devoted to the empirical investigation of various structural relations of the model. Chapters 5 to 7 report these results. A novelty of the theoretical model as well as of the macroeconometric model lies in the disaggregation of total private consumption expenditure into two separate parts — one on the agricultural good and the other on the non-agricultural good. So far no macroeconometric study on the Indian economy has such a breakdown.

The final chapter (Chapter 8) presents the complete macroeconometric model and discusses its properties (e.g., the time path of endogenous variables, stability of the model etc.). Comparative static results are also presented and it is shown that all the four propositions stipulated in the theoretical model also hold good empirically.

1.3 Some Limitation of the Model

The model is cast in terms of a two-sector division of the product markets — agriculture and non-agriculture (inclusive of services). For a more rigorous investigation into interactions between prices and incomes, a more disaggregative schema of the following type may be suggested. First, the agricultural sector may be divided into at least two subsectors, viz., food, and raw materials for industry. Similarly, the non-agricultural sector may be divided into manufacturing and services, in the first instance. The latter may be further disaggregated into services related to production (e.g., trade, transport, communication and banking) and services mainly of the nature of final use (e.g., professional, personal and government administrative services)[8]. The last breakdown would be warranted by the fact that a major part of the services turned out by the former group enters commodity production in the agricultural and manufacturing sectors as inputs, so that prices of these services have obvious bearings on prices of these products; such relationships are, however, negligible for the latter group of services.

It may not be very difficult to make an extension of our theoretical model, incorporating the kind of disaggregation suggested above. However, the construction of the empirical counterpart of such a model will pose almost insurmountable difficulties, especially in respect of the availability of the requisite data. This is the primary reason for which we have refrained from building such a large system. However, even our limited disaggregation serves our basic purpose, namely, that of demonstrating the interaction between prices and outputs of two sectors as well as their interactions with monetary variables.

Another unsatisfactory feature of our model is that the monetary and banking sectors of the economy are treated at a highly aggregative level. Here too, a detailed disaggregation is desirable.

8/ See Kuznets (1959, p.44) and Mukherjee (1969, pp. 147, 153-60).

Fourthly, we have kept a few balancing equations of the overall system in the background of the formal model. For example, the model brings in exports and imports, but not the balance in the foreign sector taken as a whole. Also, no discussion is made about the balance of the government budget. All this means that it is being implicitly assumed that the net inflow of foreign loans, changes in foreign exchange reserves, government instruments like deficit financing, open market operations etc. will take care of these balance relations.

Finally, it should be recognised that the model offered is of the 'descriptive' variety and not a 'policy' model. Of course, by interpreting any exogenous variable of the model as a 'policy' or 'instrument' variable, one may derive the corresponding policy implication from our comparative static analysis. However, we have not explicitly dealt with such interpretations.

PART I

A Glossary of Notations Used in the Study 1/

The superscript 'i' to a letter refers to the sector in question — 'a' for agriculture and 'n' for non-agriculture.

P^i : price of the good of sector i.

P : relative price of agricultural good $(= \frac{P^a}{P^n})$.

measured in terms of P^i

Y^i : (real) income originating in sector i (at factor cost).

X^i : output of sector i (net of its own-input use).

C^i : private consumption demand for the good of sector i.

T^i : (real) indirect taxes less subsidies in sector i.

E^i : export of the good of sector i.

F^i : import of the good of sector i.

X^{ij} : intermediate use of the good of sector i in sector j, $(i \neq j, \; i, j = a, n)$.

D^i : aggregate demand for the good of sector i.

measured in terms of P^a

ΔSA : change in the total (private and government) stock of agricultural good.

Q^a : (net) autonomous demand for the agricultural good $(= \Delta SA + E^a - F^a)$.

1/ These notations are used in both Part I and Part II. Some additional notations are used in Part II only which are explained there. Further, a few other notations are used here and there, which are explained in specific contexts.

measured in terms of P^n:

GC : government consumption demand for the non-agricultural good.

GI : government investment demand for the non-agricultural good.

I^i : private investment demand for the non-agricultural good (inclusive of inventory change) by sector i.

Q^n : (net) autonomous demand for the non-agricultural good ($= I^a + GC + GI + E^n - F^n$).

Y : aggregate (real) income ($= PY^a + Y^n$).

Y' : aggregate money income ($= P^a Y^a + P^n Y^n$).

M : (unborrowed) base money (currency with the public + required and excess reserves of commercial banks — borrowings of commercial banks from the central bank).

r : rate of interest.

β : amount of non-agricultural good required as intermediate input per unit of agricultural income ($= X^{na}/Y^a$).

M^s : supply of money.

M^d : demand for money.

Apart from these, we shall use some standard notations for partial derivatives of a function. Thus, for example,

G_x, G^k_x ; $G_{x_i}, G^k_{x_i}$; G_r, G^k_r : partial derivatives of a function G or G^k with respect to its arguments X, X^i and r, respectively.

Chapter 2

QUANTITATIVE STUDIES ON PRICE BEHAVIOUR IN INDIA : A SURVEY

2.1 Introduction

The studies on the behaviour of prices in the Indian economy are quite large in number, although many are not 'purely' econometric in nature. The present survey intends to discuss not merely studies of 'purely' econometric nature, but also a few important quantitative works.

The various studies on the behaviour of prices in India can be classified broadly into three groups. One group deals with only the general price level, i.e., the average level of prices of all goods (and services) taken together. The basic explanatory variables in these models are some global magnitudes like money supply, aggregate demand, aggregate output etc. A second group of studies, on the other hand, takes up some crucial component of the price structure for detailed analysis. A number of such studies concern the price of foodgrains. Such studies merit attention. For, as we shall see later, prices of foodgrains or, generally speaking, of all agricultural crops (both foodgrains and industrial raw materials like oilseeds, cotton and jute fibres etc.) are supposed to be an important determinant of the inflationary pressures in an underleveloped country like India. In fact, nearly half of the national income here originates in agriculture; (the weight assigned to foodgrains in the official index number of wholesale general price with base 1952-53=100 is as much as 23.3 per cent). In contrast to the above two groups there are works which analyse prices of different goods separately and also study the interrelationship among them. Some of the macroeconometric models which have been developed for India come under this category.

Before entering into a discussion of these studies we shall first refer to some important controversy on the theories of the price level determination.

2.2 Theoretical Controversy : Demand-Pull vs. Cost-Push and Keynesian vs. Quantity Theories[1/]

Upto the late forties economists generally agreed that inflation was typically a manifestation of the phenomenon of excess demand. That is, prices rose because demands for goods and services outpaced their supplies. However, the co-existence of inflation and unemployment in many countries, particularly since the Second World War, gave a jolt to the earlier belief as this meant the persistence of inflationary pressures even in the situation of deficient demand. The experience ultimately led to the birth of a rival theory — the so-called cost-push theory of inflation. The theory asserts that, in practice, prices are rather administered and are liable to increase whenever there is any increase in costs of production, even when excess demand is absent.

1/ A survey of various theories of inflation can be found in Bronfenbrenner and Holzman (1963) and Johnson (1963).

Within the demand-pull theory itself there is a further debate as to the relative appropriateness of the Keynesian theory and the quantity theory. Starting with the proposition that the aggregate income is equal to the aggregate consumption and aggregate investment, the Keynesian income analysis postulates that it is investments (and other autonomous outlays like government expenditures) which are the principal determinants of aggregate income and hence that excess demand emerges whenever real investment exceeds real saving at the existing price level. The quantity theory, on the other hand, focusses its attention on the quantity of money which is supposed to determine money income and hence aggregate monetary demand. This theory then holds that whenever the quantity of money increases, prices of goods and services will be pushed up if their supplies do not increase sufficiently.

With this brief introduction to the rival theories 2/ of price determination we shall go to examine how these theories, developed generally in the context of developed countries, have influenced the studies on Indian inflation.

2/ There are other theories of inflation, e.g., the 'sectoral demand shift' theory of Schultze (1959). According to this theory, in a dynamic economy demand keeps shifting from sector to sector and hence prices rise in the sectors toward which demand shifts. However, since prices do not decline in the declining sectors owing to the downward rigidity of such prices and wages, an upward trend in the price level is observed even when a general excess demand is absent. See Bronfenbrenner and Holzman (1963) for comments on this theory as well as discussion of other theories.

2.3 Models of the General Price Level

We shall first consider a few writings which take the quantity theory as their basic theoretical framework. Let M^S be the quantity of money, p , some index of the general price level, y, real national income and V, the income velocity of money. Then from the definition it follows that

$$(2.1) \qquad M^S V = py$$

A version[3/] of the quantity theory holds that changes in y are rather independent of those in M^S and that V is a constant, being determined by such institutional factors as payment practices and the like which change only in the long run. In this case, an increase in M^S raises total expenditures on goods and services and hence the money income. It then pushes up p, if y remains constant or at least does not increase in the same proportion as M^S.

The idea that some form of the quantity theory is applicable to the Indian economy is rather popular. As for example, to quote Ball (1965, p. 146), "Monetary adjustment in India may be of the quantity theory type". Chandavarkar (1963, p. 1402) also writes, "The comparative stability of the ratios of gross and net money supply to national income in India (or its reciprocal, the income velocity) is noteworthy". Similarly Shah (1962) observes that over the period from 1948-49 to 1958-59 a simple relationship between the stock of money (inclusive of time deposits) and income

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3/ For a summary of the different versions of the quantity theory, see Friedman (1970).

is stronger than that between the autonomous expenditure (defined as the sum of private investment, government deficit and the balance of trade) and income. Iyengar (1969), covering a few more years and following the methodology of Friedman and Meiselman (1963), arrives at a similar result that the stock of money explains consumption better than autonomous expenditure.

Friedman (1963, pp.2-4), the chief exponent of the quantity theory, in fact comments that the inflationary pressure over the Second Plan period in India has to be explained in terms of a higher increase in the stock of money relative to real income while a lower rate of increase in the stock of money relatively to output accounts for the downward movement of all prices during the First Plan period.

However, the quantity theory is too simple to give a full picture of the course of price movements. For one thing, this theory does not portray the actual process of price determination. In a recent empirical study Bhattacharya (1971, Ch. 3), following the methodology of Friedman and Meiselman (1963) with a few modifications, concludes that no clear-cut judgement can be passed regarding the relative stability of the two theories — the quantity theory and income-expenditure theory — as both money and autonomous expenditure are seen to explain consumption very closely. Thirdly, as Chakrabarti (1970) argues, the increase in domestic product cannot be said to be, in general, independent of the increase in the stock of money, especially in the present Indian context where the increase in the latter has been due primarily to the government's inability to finance the total Plan outlay by non-inflationary methods. Finally, as our relation (2.1) implies, whether changes in money supply will predict faithfully the changes in price and/or those in money income will depend very much on whether the income velocity can be regarded as stable in the Indian economy. Now, as Agarwala (1970, pp. 88-91) observes, over the period from 1901-02 to 1961-62 the income velocity of money (defined as the ratio of national income to money supply) showed a downward trend. He attributes this declining trend in velocity to the increasing degree of monetisation in the economy. As the non-monetised income flows are being drawn into the monetised sector, Agarwala arguee, money has to cover a wide area of economic transactions for the same level of income and consequently, the income velocity goes down. In his own macro-model Agarwala however takes the stock of money as the principal determinant of money income. The study of Prasad (1969, pp.53-4), on the other hand, seems to contradict the arguments of Agarwala. Prasad observes that even when the monetised component of national income is considered as the relevant income figure, the income velocity over the period 1951-66 showed no less fluctuation than the money supply itself. In fact, the coefficient of variation of the annual percentage change in the ratio of monetised income to money supply is much larger (218 per cent) than that in money supply (74 per cent). In a later study Marwah (1972) also observes that the income velocity is not a constant, but is significantly affected by interest rates, thus corroborating the Keynesian theory.

We thus see that some of the basic assumptions of the quantity theory are not tenable on the empirical ground 4/. On the other extreme within the demand-pull theory lies the Keynes-type model where demand and income are determined by autonomous expenditures. Usually, the Keynesian multiplier theory is supposed to be applicable in an economy operating below full employment. In such an economy an increase in, say, investments raise mainly the output, (some increase in prices may occur, of course). However, once full employment is reached, any increase in expenditure will raise only prices and money income.5/

The model of Raj (1966) follows the Keynesian approach upto a certain extent. Raj assumes that both sources of supply of output, i. e., domestic production and imports, are exogenously determined every year and that prices adjust so as to equate demand with supply. Raj develops two models, one for the (relative) price of foodgrains and the other for the general price level. In the latter model changes in aggregate money demand (D') are assumed to be determined by changes in 'autonomous' money outlay (Q') which are taken to be the sum of government expenditure,

4/ At this point we may point out the study of Prasad (1969) which suggests that the impact of money supply on an underdeveloped economy can be traced only when one considers two other additional assets, namely, bond and the stock of commodities. Thus in a multiple regression equation he finds that the general price level is related positively to the stock of money and inversely to the stock of commodities. The argument for the latter result seems to be that a cet. par. increase in the stock of commodities alters the asset structure and hence requires a fall in its price so as to induce the people to absorb this extra stock.

5/ See Keynes (1936, pp.118-19, 295). A formal model along this line is developed in Goodwin (1947). In a later work Keynes (1940, pp.61-70) himself set out a model of inflation, although with verbal arguments. See Maiti (1972) for a formalised version of the last model.

export earnings, expenditures on domestic capital goods and the 'active inventory accumulation[6]. It is further assumed that the marginal propensity to consume (c) is 0.75 and that there are time lags in the working of the multiplier, only three or four rounds of expenditures being completed in a year[7].

Let $\Delta Q'$ be the change in autonomous outlay in the current year (over the previous year). If now r rounds of expenditures are completed in a year, the total change in money outlay in the current year (over the previous year) will be given by

$$(2.2)\quad \Delta D' = (1 + c + c^2 + \ldots + c^{r-1})\,\Delta Q' + c^r\,\Delta D'_{-1}$$

where $\Delta D'_{-1}$ represents the corresponding figure for the previous year and the last term in (2.2) represents the changes on account of the lagged multiplier effects. It is now assumed that D' in the year 1949-50 equals the value of the aggregate supply at current prices (S') in that year. For each succeeding year the aggregate demand (D') is then computed from the equation (2.2) given the time series observations on $\Delta Q'$. The supply of goods and services (S) in any year is evaluated at the price of the previous year (p_{-1}) and is obtained from the data on domestic production

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6/ In the model of the price of foodgrains Raj estimates the change in the per capita demand for foodgrains by applying an income elasticity of 0.45 to the observed change in per capita income.

7/ Raj does not formalise his model. The formalisation presented here is made on the basis of his calculations of demands, supplies and market clearing prices each year.

and imports. Since p is assumed to alter to the extent required to equate real demand with real supply, i.e., $D'/p = S/p_{-1}$, the estimated change in p is given by

$$(2.3) \qquad \frac{p - p_{-1}}{p_{-1}} = \frac{D' - S}{S}$$

Raj derives two series of predicted prices corresponding to the alternative specifications of $r = 3$ and $r = 4$ and observes that each series moves closely to the actual series, the series corresponding to $r = 3$ moving somewhat closer.

Raj's model provides a major alternative to the quantity theoretic explanation of the general price level. However, the model itself is not free from limitations. Apart from some basic inconsistencies between his stated assumptions and his final model as has been pointed out by Harris (1969), a few other shortcomings can be mentioned. As for example, the model does not explain what determines the supply of goods and services or how the equation for estimated price will change if the autonomous outlay influences not merely money income but the output as well. Further, all prices need not be subject to forces of demand and supply in an identical manner. As we shall see later, there are studies which assert that cost elements are no less important in determining some sectoral price and Raj pays no attention to this aspect.

The last point brings us to the 'wage-cost mark-up theory' of Weintraub (1965, Ch. 4) which may be classified in the group of cost-push theory. Weintraub postulates that sales proceeds (py) can be expressed as a multiple k of wage payments :

$$(2.4) \quad py = k\, w\, N$$

where w is the average wage per employee and N is the number of such employees. Since y/N is the average output per employee, k is easily identified as the average mark-up over unit labour costs while 1/k is the share of wages in national income. Now as long as k remains stable, a rise in unit wage costs will lead to an equiproportionate rise in p. Weintraub (1965, p. 62) observes a very mildly rising trend in k in India during the period 1949-63, its value varying within a narrow range between 2.52 and 2.59. In view of this stability in k, Weintraub argues that the rise in labour costs by some 23 per cent between 1955 and 1963 provides the major explanation of the inflationary pressures during this period.

However, Weintraub's theory is too simple minded. Further, many of his figures are obtained with the help of arbitrary assumptions and statistical calculations are mostly of an elementary nature. Finally, as Chakrabarti (1970) comments, a mark-up pricing hypothesis appears to be highly implausible for the agricultural sector in India where prices are known to be highly sensitive to forces of demand and supply.

2.4 Models of Price of Foodgrains

Two broad points emerge from a survey of the various models on the the behaviour of price of foodgrains[8]. First, all of the models assume,

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8/ There are some differences among the models themselves. As for example, some models discuss only the price of cereals or those of selected crops within cereals group while a few others consider the price of foodgrains as a whole. Again, a few models (e.g., Raj, 1966 ; Chakrabarti, 1970) attempt to explain the relative price of foodgrains in terms of either the general price level or the price of manufactures while other models study only the absolute price of foodgrains.

explicitly or implicitly, that the price of foodgrains is determined by the forces of both demand and supply[9]. Secondly, only Raj (1966) and Mellor and Dhar (1967) derive independent estimates of demand for foodgrains. Thus, given the price elasticity of the demand and the estimate of per capita supply, Raj estimates the price change required to equate the per capita demand with supply. Other models, on the other hand, work with reduced forms in which the price of foodgrains is shown to vary positively with its demand and inversely with its supply (in a multiple regression equation). In the latter group of models the influence of demand has been measured either by real national income (Thamarajakshi, 1970a, 1970b), or by real income in the non-agricultural sector (Chakrabarti, 1970; Divatia and Pani, 1968) and/or by financial variables like money supply and other liquid assets (Divatia and Pani, 1968; Herrman, 1964; Mellor and Dhar, 1967; Ray, 1972).

2.5 Price Relations Embedded in Macroeconometric Models

The models we have reviewed so far are really inadequate for a proper understanding of the inflationary process in an underdeveloped country like India. As for example, regarding the models discussed in Section 2.3 one may point out that a single theory — either the cost-push or the demand-pull — need not be valid for prices of different sectors and hence for the general price level. It is usually argued that prices in some (e.g., agricultural) markets respond rather easily

9/ Velayudhan (1967, pp. 752-55) observes that the substantial rise in prices of foodgrains in the Second and Third Plans is only a reflection of the persistent gap between the supply of and demand for foodgrains, the latter being generated by the growth of population, the rise in per capita income and the increase in urbanisation.

to disturbances in the conditions of demand and supply while other prices (e.g., those of manufactures) are usually cost-determined[10]. Thus even an explanation of the general price level calls for separate analyses of prices of different sectors. The sectoral disaggregation of the economy is warranted on another ground too.[11] As the income and price elasticities of demand for various goods and services differ considerably, the general price level will be determined not so much by such global magnitudes as aggregate demand, aggregate output or the money supply, but by the actual composition of demand and supply. In fact, an analysis of the 'micro' aspects of price formation and of changes in the structure of relative prices might be more relevant in understanding the inflationary process than emphasising only the macro variables. From this stand point the models dealing with the price of foodgrains are pointed to a right direction, but they are only partial and studies in at least two other directions are required before one can have a full picture of the inflationary situation. The first involves the examination of the interrelation between price of foodgrains and other prices. It is usually argued that once price rises in some sector, there operate in any economy certain forces which propagate these pressures throughout the economy. We have so often heard of the mechanism of 'wage-price spiral'. Such propagation elements need not be less important in an underdeveloped economy. In fact, here prices of agricultural goods — foodgrains and industrial raw materials — may initiate the process, the former

10/ See, e.g., Duesenberry (1950), Ackley (1959).

11/ We may also recall the discussion in Chapter 1.

indirectly (through their effects on wages) and the latter directly affecting costs of production, and hence prices, of industrial goods. Secondly, an analysis of the interaction between prices and outputs of different sectors is also important. It is sometimes argued that higher the price of foodgrains higher will be the proportion of consumers' income which will be spent on such products (as the demand for these products are usually price-inelastic) and hence lower will be the expenditure on the other products[12/]. An interesting study by Krishnan (1964) seems to support this argument. On the basis of quarterly as well as annual data Krishnan finds a strong inverse relation between cloth sales by the organised textile mills and the price of foodgrains. In a double-log multiple regression equation in which the price of cloth and national income are introduced as additional explanatory variables, he finds that a 10 per cent rise in the price of foodgrains reduces the cloth sales by almost the same percentage. Krishnan rationalises such a result by arguing that the income effect of a rise in the price of foodgrains on the demand for cloth is presumably higher than its substitution effect and hence that as the non-agricultural sector experiences a fall in real income owing to a rise in the price of foodgrains, the demand for cloth goes down.

The aforesaid discussion suggests that an analysis of price behaviour in India has to be made in a framework which not only allows for the separate treatment of important prices and for the endogenous

12/ See Sovani (1961, pp.304-05).

determination of such variables as outputs, demands etc., but also makes the investigation of interrelation between different prices and outputs an integral part of it. Thus macroeconometric model disaggregated into at least a few sectors is the basic framework in which the inflationary mechanism is to be studied.

A number of macro-econometric models has already been built up for India. However, some of these models (e.g., Krishnamurty, 1964b; Bhattacharya, 1971) do not consider any price variable and hence remain outside the purview of the present survey. On the other hand, the treatment of prices in some other models (e.g., Choudhry, 1963; Choudhry and Krishnamurty, 1968; Mammen, 1967) is very unsatisfactory, never going beyond the explanation of the general price level and that too in a simple fashion[13/]. Our discussion will therefore be confined to only four models — those of Agarwala (1970), Chakrabarti (1970), Marwah (1972) and Narasimhan (1956).

A survey of these four models reveals that despite some similarities they display considerable differences with respect to both the structure as well as the degree of disaggregation. As for example, models of Narasimhan and Marwah are built around, roughly speaking, a Keynesian framework. However, Marwah considers a detailed disaggregation of imports and prices but deals with only the aggregate exports, aggregate (private) consumption and aggregate (private) investment. Narasimhan, on the other hand, considers a two sector division of the economy into consumer

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13/ A survey of these models can be found in Desai (1973).

good and investment good. He also separates out the individual impacts of different classes of income (e.g., non-farm labour income, farm income, profits of both corporate and non-corporate enterprises) on the aggregate consumption and investment expenditures.

Agarwala's model, on the other hand, provides one alternative to the Keynesian theory of 'demand determining output'. He has taken the model of Arthur Lewis (1954) with unlimited supplies of labour as his framework. His disaggregation is according to the agriculture-non-agriculture subdivision. The agricultural output is determined jointly by the capital stock in this sector and an exogenous variable, rainfall. Agricultural output then determines the surplus of food which gives employment in the non-agricultural sector. Combining this employment with the capital stock in the non-agricultural sector a Cobb-Douglas type production function then determines the output in this sector. The impact of demand elements works only through investment functions in the two sectors which depend on disposable income and prices and which give the capital stock in the respective sectors in the next period.

In contrast to the above three models, the model of Chakrabarti takes all other variables apart from prices to be exogenously determined. In this sense it cannot be called a full-fledged macroeconometric model. Its only motivation is to explain the behaviour of several sectoral prices and their interrelation. The cereal has been taken to represent the agricultural food item while manufacture is the representative item in the non-agricultural sector.

The models display one similarity regarding the theory of non-agricultural price. They imply that the price of manufacture follows certain 'mark-up' rule. Such price is supposed to be set either on the basis of only costs as in the model of Agarwala or on the basis of both costs and demand. The labour cost is the cost element common in all works. However, Chakrabarti and Narasimhan include also the costs of raw materials while Marwah brings in price indices of imports and foodgrains, in addition. The proxy variables for measuring demand are however different in different models. Marwah takes for this purpose the capacity utilisation rate in the manufacturing sector while Narasimhan uses the level of output. Chakrabarti, on the contrary, employs per capita money supply to account for the observed rising trend in the ratio of mark-up over cost.

The similarity in these models can be ascertained also in respect of the mechanism by which food prices affect other prices. First, the cost of living is shown to depend either on the agricultural price alone as in the model of Agarwala or on food prices and prices of other goods as in models of Chakrabarti and Marwah. The money wage rate in industries is then shown to be governed by the cost of living. Narasimhan, however, relates the wage rate directly to the price of consumer good. The money wage rate then provides the labour costs of industrial production.

The theory of the determination of agricultural prices is however dissimilar in these models. Chakrabarti and Marwah both assume that prices of agricultural crops (the price of foodgrains as well as the price of industrial raw materials) are determined in a competitive market, being subject to the forces of both demand and supply. There is a difference between them, of course. Chakrabarti holds that the production ~~(both current and lagged)~~ of cereals and the relative price of cereals (in terms of price of manufactures) in the preceding period determines its marketable surplus while non-agricultural output generates the demand for this surplus Thus the relative price of cereals is shown to be determined by its production, non-agricultural output and a lagged relative price[14/]. This relative price, in conjunction with the price of manufacture obtained separately, then helps to determine the price of cereals. Marwah, on the other hand, deals with the absolute price of foodgrains which is determined by its one year lagged value and the excess demand for foodgrains (as measured by foodgrains import). On the other hand, Narasimham does not consider any internal demand variable and explains the farm price by farm production and the foreign price level.

Before going to discuss the determination of agricultural price in Agarwala's model we have to say something about the treatment of the general price level in these models. Chakrabarti and Narasimham explain sectoral prices separately and then obtain the general price level from these sectoral prices. On the contrary, Agarwala adopts a quantity theoretic framework in which the behaviour of money income follows that of money supply. Given the outputs of the two sectors determined by their respective

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14/ Chakrabarti also includes a fourth explanatory variable, the percentage of output of cereals procured by the government, to capture the impact of government distribution of cereals at subsidised prices.

production functions, the role of money income is then to determine the general price level. Next, the definitional equation expressing the general price level as a weighted average of agricultural and non-agricultural prices determines the agricultural price, as the non-agricultural price is obtained from a separate equation.[15] The general price level in the model of Marwah is however shown to be the resultant of three sets of forces — general demand and supply conditions (as measured by the difference between the actual and 'safe'[16] changes in money supply), the pressure in the food sector as reflected in the price of foodgrains, and external forces as indicated by the import price level. The strongest impact is however seen to be exerted by the price of foodgrains. The role of the definitional equation giving the general price level as a weighted average of sectoral prices is here to determine the prices of miscellaneous items.

Whatever be the merits of these models, none of them can be said to be above limitations. To take up the model of Marwah first, the initial

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15/ We emphasise that various relations in each model are simultaneous and hence any one equation cannot be said to determine a specific variable. Still a partial analysis of the kind pursued here is not misleading since the primary motivation of considering a particular equation in a model is to determine a particular variable.

16/ The 'safe' change in money supply (ΔM^S) is defined to be that change which preserves a stable price level in the face of changing output and income velocity, i.e.,

$$\Delta M^S = \left(\frac{\Delta Y}{Y_o} + \frac{\Delta (\frac{1}{v})}{(\frac{1}{v})_o} \right) M_o$$

where the subscript 0 refers to the value in the base period and the symbol Δ to the change over the base period.

condition with respect to the inventory stocks in manufactures and credit availability determines the utilisation rate of the aggregate productive capacity (the equation (24) in her model). Adjusting the level of the existing capital with the capacity utilisation rate, aggregate output is next computed from the production function (the equation (1)). This is shown to determine agricultural output, on the one hand, and, in conjunction with the general price level, the value of the aggregate output, on the other. The total demand is however generated by aggregate expenditure flows such as consumption, investment and merchandise transactions in the foreign sector which are assumed to depend on variables like aggregate output, population, domestic prices relative to foreign prices etc. The national income identity in this model however is used to measure the disequilibrium gap between the value of aggregate demand thus generated and the value of aggregate supply. This gap is denoted by H which is shown to be the sum of government current expenditures, net exports of services, net foreign income and investment in inventories. The real value of H is then fed back into the system as an explanatory variable in the equation (no.(36) in the model) determining the end of period inventory level in the manufacturing sector. An unintended depletion or replenishment of inventory stocks thus observed together with money market conditions determines the capacity utilisation rate in the following period as shown in her equation (24). The latter now generates a new level of supply and the whole system starts moving once again.

Several questions may be raised against this basic structure. First, in view of the fact that H represents mainly the expenditures on services[17/], it is difficult to argue how the real value of H will directly affect the stocks of manufactures. This may be one of the reasons why H is not significant in her equation (36) which has a very poor fit in general: (its $\bar{R}^2$, i.e., the coefficient of multiple determination adjusted for degrees of freedom, is only 0.45). The equation (24) in her model determining the capacity utilisation rate has also a very low $\bar{R}^2$ (0.41 only). Secondly, in view of the fact that agricultural output here depends primarily on weather conditions, it will be stretching the imagination to argue that the capital stock and demand in the preceding period affecting current capacity utilisation rate would be the only force guiding current agricultural output. Further, one may also question whether demand for foodgrains should be taken as a function of its absolute price as Marwah has done (her equation (26)) or the relevant variable, on theoretical grounds, should be its relative price. One may also object to the method of measuring excess demand for foodgrains by its imports on the ground that severe foreign exchange shortages (as India has been experiencing since the Second Plan period) may limit imports and yet this does not necessarily mean lower excess demand and hence lower price of foodgrains.

Considering the model of Narasimham one may note that the model has been fitted to a period (1919 to 1952) during which most of the data

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17/ It is to be pointed out that most of the government current expenditures are on wages and salaries.

are not available in organised form. Further, as Chakrabarti (1970) has well noted, his equation for the farm price does not include any internal demand variable like real income or industrial output. The point is pertinent since his farm price includes also the price of industrial raw materials which are very much influenced by the domestic industrial production. Finally, he completely neglects any impact of the money supply on the economy.

If Narasimham has neglected any possible influence of monetary variables on the prices, Agarwala attaches too much importance to money supply. In a two sector model in which the non-agricultural price is determined by cost conditions, the determination of the general price level through a quantity theoretic framework then leads Agarwala to determine the agricultural price as a residual item from the definitional equation expressing the general price level as a weighted average of two sectoral prices. However, one feels that as agricultural prices play a crucial role in the inflationary mechanism, it should be analysed rather directly and not indirectly as has been done by Agarwala. Further, one may argue that logically speaking, sectoral prices should be determined separately and that the general price level will then be obtained as an average of them. This order has been reversed in Agarwala. The argument, carried a bit far, may even cast doubt on the appropriateness of the quantity theory in determining the general price level in a model involving more than one sector, particularly such heterogenous sectors as agriculture and industry. Finally, the quantity theory is generally supposed to be applicable in an excess demand situation. In view of the fact that Agarwala's model does not contain any demand variable except investments (which are again not directly related to monetary variables) and that his non-agricultural price is determined by cost conditions only, the quantity theory will be difficult to justify in such a case[18].

So far as the explanation of the price behaviour in the Indian economy is concerned, Chakrabarti's model appears to be the most satisfactory one. Still a major limitation of this model is that it does not allow for the endogenous determination of demands, outputs and income in various sectors. To this extent, the interaction between prices and outputs and their implication in a study of inflationary process have not been given proper attention. Further, the assumption of complete price inelasticity of domestic production of cereals is not wholly convincing as Chakrabarti himself refers to several studies which have found such price elasticity in respect of several crops. Finally, although the impact of money supply on different prices is considered in the model, the mechanism is not explicitly stated. In fact, he has not gone to see whether money can affect the economy through some other orthodox route (e.g., the Keynesian route in which money supply influences primarily the rate of interest which in turn affects investment and hence output[19]).

18/ Chakrabarti (1970) notes some other unsatisfactory features of Agarwala's model.

19/ The work of Bhattacharya (1971) suggests that such a Keynesian theory yields satisfactory results for the Indian economy.

To conclude this survey, we mention that there are several interesting points in the models developed in the context of the Indian economy[20/]. But many of them are subject to several limitations. We feel that a satisfactory analysis of the price behaviour in India can be carried out even without considering such a large number of relations as in Marwah (1972). On the other hand, gaps are to be filled up in such models as those of Raj (1966) or Chakrabarti (1970) by say bringing in demand and income or output as endogenous variables. Thus there is room for yet another macroeconometric model for India whose primary motivation will be to analyse sectoral prices in course of interaction among prices, outputs and monetary variables. And this is what is proposed to be done in the present study.

20/ Another macroeconometric model has come up of late (Pandit, 1973). To comment briefly on this model many a point of limitations noted in Chapter 1 is also applicable to this model. For instance, so far as the demand aspects of the economy are concerned (e.g., consumption, investment etc.) the model is aggregative, being of the one-sector variety. Moreover, although the model contains some price variable, these are shown to affect no demand variables except imports. Further, variables (like factory employment, prices of raw materials, index of industrial profits etc.) which are influenced by endogenous variables like industrial output, have been assumed to be exogenously determined.

Chapter 3

AN ANALYSIS OF MOVEMENTS OF PRICES AND OUTPUTS IN INDIA

3.1 Introduction

In the preceding chapter we have referred to some debates which centre around the possible causes of inflation, e.g., the so-called demand-pull and cost-push controversy. These debates have been prevalent mostly in the developed countries. Since the middle of this century a controversy of a different nature has, however, been raging in some of the underdeveloped countries of the world, particularly in Latin America. In fact, the Latin American inflation arguments seem to have polarised economists into two broad schools of thought — the so-called "monetarists" and "structuralists". We shall not, however, discuss this controversy[1/] here. Rather, we shall summarise only the structuralist thesis here. This is motivated by the fact that some of the structuralist factors appear

1/ The literature on these two schools of thought is quite extensive. One of the best analytical syntheses of the structuralist school is supposed to be Seers (1962) which also contains a bibliography of the earliest structuralist writings. Other writings in this school are Seers (1964) and Felix (1961). Several structural characteristics of inflation have been noted in Maynard (1962, Chs. 3, 9), although he does not seem to be quoted as a structuralist. The economic growth in several countries has been viewed critically through the structuralist eyes in several writings like Grunwald (1961, 1964), Mueller (1965) and Sunkel (1958); the last mentioned article is supposed to be the first systematic exposition of the structuralist school. The monetarist arguments are presented in the following writings : Campos (1961a, 1961b), Dorrance (1964). Baer (1967) provides a survey of the monetarist-structuralist controversy in Latin America.

relevant when one looks for possible explanations of inflation in the Indian economy. That this is so is sought to be pointed out in our subsequent discussion of price movements in India.

3.2 The Structuralist Thesis

The nucleus of the structuralist argument is that the Latin American countries have entered the era of industrialisation burdened with so many structural rigidities. As the development effort proceeds, a part of these rigidities is manifested in inflationary situation all around.

The process of industrialisation leads to increases and changes in the structure of demand. The set of factors inducing these changes comprises, first, an expanding population, second, the process of urbanisation, third, increased per capita consumption due to rising incomes, and, finally, changes in tastes. These changes will put pressure on the structure of production. If now the structure of supply is not sufficiently flexible to adopt itself readily to these changes in demand, the economy will be exposed to inflationary pressures.

The supply bottleneck which receives a large attention of the structuralists is the inelasticity of the supply of agricultural goods. The growing demand for food generated in wake of industrialisation, urbanisation and expanding population will lead to rising relative price of domestically consumed food products. But unlike what is expected to happen in a market responsive sector, the rise in food prices will not provoke a strong response from food supply. The trouble lies in the agrarian structure of the Latin American countries — a structure in which land holdings are highly unequally distributed, being characterised predominantly by a very small number of latifundios (very large farms) and a very large number of minifundios (very small farms)2/. None of these farms will however respond to increased demand in the manner of profit maximisation. The large farms lack the initiative to do so, most of them being run by hired managers and the small farms lack both capital and other inputs to raise agricultural productivity as they are often too small to earn even an acceptable minimum level of living. Thus with a lack of supply response from agriculture, the food shortage will result in increasing food prices.

Of course, inelasticities of domestic production will not pose any problem provided there are ample foreign exchange reserves and imports can be obtained in unlimited amounts. However, underdeveloped countries usually suffer from acute balance of payments difficulties. This stems from the tendency of their demand for imports to exceed the demand for their exports. The Latin American exports consist overwhelmingly of raw materials and foodstuffs. The demand for those goods is usually inelastic. An additional contributory factor is the technological improvement in developed countries (e.g., secondary recovery of metals, use of synthetic

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2/ An account of the agrarian structure in Latin American countries can be found in Carroll (1961).

substitutes etc.) which help to economise on the use of primary inputs per unit of output. On the other hand, the income elasticity of the Latin American demand for imports is generally very high. This is particularly true of the demand for capital goods, since domestic capital goods industry is usually small. It is also true, however, of imports of such luxury consumer items as nylon, wristwatches and cosmetics. All this results in considerable deficits in the balance of payments on current accounts.

The tendency for continued balance of payments difficulties will ultimately exhaust foreign exchange reserves and force these countries to undertake import and exchange controls and/or devaluation. These policies are inherently inflationary.

A third line of structuralist arguments centres around government budget. The sphere of necessary government activities has been growing in most countries, due partly to the increased needs for such public utilities as better road, port and transport facilities, power projects, schools etc. and partly to the urgency of taking initiative in the industrialisation process owing to the absence of an experienced and active entrepreneurial class. Consequently, government expenditures will be growing. Yet, institutional factors make it difficult to expand public revenues. First, public revenues are subject to very considerable fluctuations as they are highly dependent on external receipts (i.e., customs duties and taxes on profits of exporting companies[3/]) which themselves fluctuate sharply. Secondly, the tax structure is rather regressive and most Latin American societies are saddled with antiquated, inefficient and sometimes corrupt tax collecting bureaucracies. The governments rely rather heavily on indirect taxation[4/]. All this leads to large deficit financing of the government budget which is obviously inflationary.

The presence of these structural rigidities, the structuralists argue, will thus expose underdeveloped countries to inflationary pressures once they set out on the path of industrialisation. At this point the other set of forces cited by the structuralists as contributing to inflation comes into play, amplifying the original price increases. These "propagation mechanisms" work through conflicts over, first, the distribution of income within the private sector, and, second, the allocation of resources between the private and the public sectors.

As the prices of essential goods begin to go up, the cost of living of workers will rise. The workers will try to maintain their real income by pressing for higher wages. To the extent these demands will be acceeded to, industrial costs will rise. Monopolistic practices in manufactures will have hardly any difficulty in transferring higher costs

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3/ As Maynard (1962, p. 252) reports, during the fifties out of total government revenue, taxes on the external sector yielded nearly 75 per cent in Venezuela, 45 per cent in Chile, 38 per cent in Ecuador, 29 per cent in Peru and 28 per cent in Mexico.

4/ Grunwald (1961, p. 114, f.n. 42) states that in 1956 indirect taxes accounted for 35 per cent of total tax revenues of the Chilean government while the share of income taxes was only 18 per cent.

of production to higher prices. Thus a food price-wage-price spiral will set in.

The contest over the allocation of resources between the public and the private sectors occurs because rising prices tend to divert resources away from the public sector. Since public revenues are relatively inelastic, the attempt by the government to maintain or raise its share in national expenditure then causes budgetary deficits which add to the inflationary pressures.

To summarise the structuralist position, industrialisation brings about increasing demand for goods and services. Since the structure of production and imports does not respond easily, inflationary pressures are generated. The propagation elements then generalise these pressures throughout the economy.

We now turn to a discussion of movements of prices and outputs in the Indian economy during the period from 1950-51 to 1967-68.

3.3 Movements of Prices and Outputs During the Period, 1950-51 to 1967-68[5/]

A glance into the history of the Indian economy reveals that, generally speaking, all prices have been increasing since the middle of the fifties[6/]. However, there have been considerable fluctuations in the

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5/ For a detailed analytical study of price behaviour during the three Plan periods, see Velayudham (1967).

6/ See Table 3.8, given at the end of this chapter. Figures of different variables to be quoted in the present discussion are all taken from Tables 3.1-3.4, added at the end of the present chapter.

Price of all agricultural goods (P^a) <u>relative</u> to that of all non-agricultural goods (P^n). This is obvious from the column (5) of Table 3.2. The relative price apart, we shall discuss movements in the absolute prices of all agricultural goods (P^a) and all non-agricultural goods (P^n), and also the movement in the absolute price of an important component of P^a, namely, the foodgrains price (P^{fg}). However, on the basis of the direction of movements in the <u>relative price</u> of all agricultural goods (P^a/P^n), the entire period starting from 1950-51 can be divided into a few sub-periods as follows :

(I) <u>1951-52 to 1952-53</u> : Relative price moved in favour of the agricultural sector at an average annual rate[7/] of 2.6 per cent. However, the behaviour of two absolute prices — P^a and P^n — was dissimilar in the two years covered in this period. They rose in 1951-52, but declined sharply in the next year (see Table 3.2).

(II) <u>1953-54 to 1955-56</u> : Relative price moved against the agricultural sector and this had been accompanied by downward movement of all prices. The annual rate of decline averaged out to be 2.6 per cent for the relative price of agricultural goods (P^a/P^n) and 9.5, 3.6 and 1.1 per cent respectively for absolute values of foodgrains price (P^{fg}), agricultural price (P^a) and non-agricultural price (P^n) (see Table 3.1).

7/ The average annual rate of change of a variable within a given period will mean, in the present context, the <u>arithmetic average</u> of the rates of change in that variable in the different years covered within the period.

(III) 1956-57 to 1958-59 : Relative price moved in favour of the agricultural sector at an average annual rate of 2.7 per cent, and this was accompanied by a rising trend in all prices. Thus while the foodgrains price and agricultural price rose at average annual rates of 13.7 and 8.3 per cent respectively, the non-agricultural price increased at a slower rate (5.4 per cent).

(IV) 1959-60 to 1962-63 : All individual prices were on the rising trend with the exception in the year 1961-62 when P^a declined and in the year 1959-60 when only P^{fg} fell. However, non-agricultural price increased at a faster rate (4.2 per cent per annum, on average) than the agricultural price (2.3 per cent per annum). As a result, the relative price of agricultural goods declined at an average rate of 1.9 per cent per annum.

The period from 1963-64 to 1967-68 witnessed one of the highest rates of inflation in the Indian economy. The foodgrains price, agricultural price and non-agricultural price moved up at average annual rates of 16.4, 12.3 and 8.8 per cent respectively and the relative price of agricultural goods increased at the rate of 3.2 per cent per annum.

However, from the point of view of economic growth this period should be classified into two — one from 1963-64 to 1964-65 and the other from 1965-66 to 1967-68. This distinction is warranted by the fact that the first subperiod was characterised by substantial growth of domestic production, the real net domestic product (NDP, in short) increasing at an average rate of 6.6 per cent per annum. Despite this growth in production, prices rose rather sharply in this period, the average annual rates of increase of foodgrains price, agricultural price and non-agricultural price recording high figures of 17.1, 11.8 and 11.8 per cent respectively. This growth involving inflation had however been followed in the next few years by recession with inflation[8/]. The recession had been caused primarily by the severe drought situation which plagued the economy for the period from the end of 1965-66 towards the first part of 1967-68. Agricultural production in the two agricultural years 1965-66 and 1966-67 went down by 16.5 and 1.1 per cent respectively while in each of the two calendar years 1966 and 1967 the industrial production declined at a rate of 0.8 per cent. As a result, all prices continued to rise substantially, the rise had been severe particularly in the two years 1966-67 and 1967-68. Thus whereas in 1965-66 the agricultural price rose by 9.1 per cent, its rates of increase reached high figures of 16.8 and 12.3 per cent in the next two years. In these three years non-agricultural price increased by 6.1, 14.4 and 10.7 per cent respectively.

Towards the end of 1968 the economy started recovering from the grip of recession. Industrial production in this year rose by 6.4 per cent. The growth in agricultural production had been very substantial, exceeding the peak level reached before recession. The bumper crop during this year brought about a decline in prices of all agricultural goods. As

8/ For a discussion of recession and inflation during this period, see Khusro (1967), Sethi (1967), Bhatt (1970, 1971), Shetty (1971). Regarding inflation in the '70's see, e.g., Bose (1974), Chakrabarti (1974), Chakrabarti and Maiti (1974), ERU (1975), Maiti (1975).

for example, foodgrains price fell by as much as 9.7 per cent in 1968-69. The price of manufactures, however, did not show any decline. It rather registered a small increase of 1.9 per cent. The result was that the relative price now moved against the agricultural sector. Thus the five years' rising trend in the relative price of agricultural goods had been checked and reversed in 1968-69.

Since our empirical study will cover the period from 1950-51 to 1965-66, we shall here limit our investigation to this period only and hence group together the three years from 1963-64 to 1965-66 :

(V) <u>1963-64 to 1965-66</u> : Relative price had been moving in favour of the agricultural sector and three prices — foodgrains price, agricultural price and non-agricultural price — increased at average rates of 12.9, 10.9 and 6.3 per cent per annum respectively.

The question now is : what factors can be held responsible for such a kind of price behaviour as has been observed in India during the period under consideration ? The price rise in 1951-52 was due partly to the boom conditions of the Korean war and partly to the shortfall in domestic agricultural production. The production of all agricultural crops[9/] declined by some 4.4 per cent over the year 1950-51 (see Table 3.2). Subsequently, war conditions tended to die down. Agricultural production also recovered. Prices declined as a result in the next year.

9/ This includes both foodgrains and non-foodgrains items like oilseeds, fibres, plantations etc.

The second period from 1953-54 to 1955-56 witnessed one of the highest rates of growth in agriculture. The production of foodgrains and the production of all agricultural crops increased at average annual rates of 8.5 and 6.4 per cent respectively. The industrial production did not rise so much, registering an annual average rate of growth of 5.8 per cent. The high growth of agricultural production is the main factor responsible for the fall in prices of agricultural goods during this period. Per capita wage earnings in factors also declined in two years within this period (see Table 3.4) and prices of agro-based and other raw materials were on the declining trend. As a result, non-agricultural price also declined, but at a slower rate than the agricultural price. One particular feature of this period deserves mentioning. The supply of money increased at an average rate of 5.2 per cent per annum during this period. A quantity theoretic argument[10/] therefore fails to account for the extent of fall in all prices as observed during this period. This underlies the need for looking into some structural factors, particularly the behaviour of agricultural production, for a proper understanding of price movement in India[11/].

The third period from 1956-57 to 1958-59 witnessed a reversal of the trend observed in the preceding period. The relative price started moving in favour of the agricultural sector while all prices began to

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10/ This is supposed to be the main argument of the "monetarist" school.

11/ Analysing production, prices and money supply during this period, Ray (1962) comes to a similar conclusion.

soar up. A few features of this period are worth mentioning. First, agriculture suffered a set back. The production of all agricultural crops declined by 0.2 and 6.8 per cent in 1956-57 and 1958-59 respectively (see Table 3.2). The bad performance of the agricultural sector seems to explain not only a major part of the price rise, but also a part of the slower rate of growth in industrial production during this period (4.5 per cent per annum, on average) compared to that achieved in the earlier period. Secondly, government expenditures increased substantially on account of the developmental activities undertaken during the Second Plan. The share of total (consumption plus investment) public expenditures in NDP at market prices grew upto an average value of 13.5 per cent during this period from a corresponding figure of 10.5 per cent in the earlier period (see Table 3.1). The government budget incurred large deficits, its defici expenditures totalling Rs.890 crores during this period (see Table 3.4). Thirdly, there had been considerable rise in imports during this period. One part went to augment the domestic availability of foodgrains, but more important was the rise in imports of capital goods and industrial raw materials which were needed to support the industrialisation program embarked upon during the Second Plan. Total imports as a ratio of NDP rose to an average value of 10 per cent during this period from a corresponding figure of 7 per cent in the earlier period. The share of total exports in NDP however remained stationary at 7.2 per cent, a figure reached in the preceding period (see Table 3.1). All this resulted in large <u>deficits</u>

in balance of payments on current account which totalled 1146 crores of rupees over the entire period as against a total surplus of 60 crores of rupees in the preceding period. These deficits were met partly by foreign loans and assistance and partly by running down reserves of foreign exchanges. The latter declined by Rs. 446 crores over this period (see Table 3.4). Again, it is to be pointed out that the average annual rate of growth in money supply during this period was almost the same (5.5 per cent) as achieved in the preceding period.

The fourth period from 1959-60 to 1962-63 presented an interesting picture. Agricultural production recorded substantial growth, particularly in 1959-60 and 1961-62. The agricultural price experienced a small rising trend, although foodgrain price declined in 1959-60 and 1961-62. On the front of industrial production the rate of growth was substantial, reaching an average value of almost 10 per cent per annum. However, the non-agricultural price increased at a faster rate (4.2 per cent per year, on average) than the agricultural price and the relative price moved in favour of the non-agricultural sector. It seems, therefore, that non-agricultural prices increase not only when costs of production increase, but also when demand conditions are favourable[12]. The current period in fact witnessed a growing demand for non-agricultural goods and services. Investment expenditures had been on the increase from the beginning of the Second Plan. The average share of real gross domestic capital

12/ Studies mentioned in Section 2.5 of the previous chapter imply a similar conclusion.

formation in real gross domestic product (GIP, in short) increased to 16.4 per cent during this period from corresponding figures of 12.0 and 15.4 per cent in the earlier two periods (see Table 3.1). On top of it was the continuous increase in government expenditures, this time partly caused by the need of huge defence expenditures in 1962-63 (and also in 1963-64) when the country was engaged in war with China. The average share of total public expenditures in NDP at market prices increased further to 15.3 per cent during this period. The government continued to have deficit budgets. The pressure on domestic production intensified further as imports could not be raised owing to foreign exchange shortages which the country had been experiencing from the beginning of the Second Plan. During this period the shares of exports and imports in NDP declined to 6.2 and 8.6 per cent respectively, and foreign exchange reserves dwindled further by Rs. 84 crores.

The pressure of demand continued in the following few years. Over the period from 1963-64 to 1965-66 the average government share in national expenditures rose to 18.3 per cent while government deficit expenditures grew upto a total of Rs. 712 crores. This period also witnessed an 11 per cent annual rate of growth in money supply, on average. On the front of domestic production, the average annual growth rate of production of agricultural crops slackened to 3.4 per cent. Industrial production, more or less, maintained its growth rate (8.7 per cent per annum, on average). In the field of foreign trade, no appreciable improvement was noticed in shares of exports and imports in NDP which averaged out to be just 6.5 and 9 per cent respectively. The insufficient growth in agriculture in face of growing demand all around and an inadequate flow of imports all but resulted in considerable increases in all prices, the relative price moving in favour of the agricultural sector.

3.4 Concluding Remarks

Our study of the history of the Indian economy over the ~~three~~ two decades starting from the fifties has been motivated by our desire to identify some of the major forces contributing to inflation and the discussion in the preceding section reveals that many of these factors are rather structural in nature[13].

For one thing, the fluctuations in agricultural production seem to be a major factor determining agricultural price, more particularly, the relative price of agricultural goods. This is clear from columns (2) and (3) of Table 3.1. Of course, demand conditions are also important and for this purpose one should take account of government expenditures and industrial production, or the whole of the non-agricultural income. The point to be stressed is that despite favourable movements in prices, agriculture did not show sufficient growth. The reason seems to lie in the fact that at least during the period under study irrigation facilities were rather

13/ Let us add that we do not want to assert here that whatever price rise India has been experiencing has to be explained by structural arguments alone. In fact, such a rigorous empirical investigation to measure the relative importance of structural and monetary factors remains outside the scope of the present study.

scarce and agricultural production depended more on weather than on any economic variable[14/]. Secondly, there seems to be a close association between the agricultural price and non-agricultural price. This observation lends support to our arguments (and findings of various studies) presented in the previous chapter that in the Indian economy the movement in prices of agricultural goods is a crucial determinant of the course of behaviour of all important prices. In fact, the propagation elements were also present here. The column (2) of Table 3.4 shows that except for the years 1954-55, 1955-56 and 1959-60 (when foodgrains price also declined), the per capita wage earnings in factories had been rising, its average annual rate of growth reaching almost 8 per cent during the first half of the sixties. Thirdly, exports did not show sufficient growth and strains on balance of payments had been persisting which forced the country, first, to limit imports since the late fifties and, finally, to devalue the Indian rupee in June, 1966. Fourthly, throughout the period under study the public sector had been claiming a continuously rising share of national expenditure (see column (13) of Table 3.1 and column (5) of Table 3.3)[15/]. Whatever increment had been taking place in public revenues was clearly insufficient and the government had to take

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14/ See also Sovani (1961, pp. 296, 306-7). The existing agrarian structure may be an important factor accounting for agricultural bottleneck. An interesting article by Bhaduri (1973) illustrates how the land-tenure and share-cropping systems existing in some parts of the eastern region of this country might have given landlords sufficient disincentive, on political as well as on economic grounds, to raise agricultural productivity.

15/ See also Velayudham (1967, pp. 750-51).

recourse to substantial deficit financing most of the time (see column (5) of Table 3.4). Further, a feature in the composition of public revenues was that the share of indirect taxes was not only much larger than that of direct taxes, but it showed a tendency to rise over time while the latter had been falling (see columns (6) and (7) of Table 3.3). Finally, factors mentioned above seem to be more important than money supply in explaining the movement of prices in this country. We have already argued that during 1953-54 to 1955-56 the quantity theory would be of little use for explaining the observed downward movement of all prices. Again, during 1959-60—1962-63 money supply increased at an average rate of 6.6 per cent per annum only. However, industrial production rose almost at the rate of 10 per cent and yet non-agricultural price increased at the rate of 4.2 per cent per annum (see Table 3.1).

We may thus conclude that agricultural production, import bottlenecks, volume of government expenditures etc., are important factors in determining the behaviour of prices in the Indian economy. These observations then provide the main building block on which our basic theoretical model will be constructed in the next chapter — the model which, as we have pointed out in the first chapter, seeks to study the interaction between prices and outputs of different sectors. A final point remains to be added. We have seen that it is important to study not merely the behaviour of absolute prices, but also that of the relative prices. Our model seeks also to take account of this particular point.

Table 3.1. Average annual figures[a] of several variables during different periods

period	average annual percentage rate of change								average annual percentage share in total output[b]			
	relative price of agricultural goods (P^a/P^n)	production of agricultural crops	agricultural price (P^a)	foodgrains price (P^{fg})	non-agricultural price (P^n)	foodgrains production	industrial production	money supply	gross investment	exports	imports	public expenditures
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
I 1951-52 to 1952-53	2.6	-1.2	-3.7	3.0	-6.0	-4.4	3.6[c]	-2.9	11.0	6.8	7.5	8.6
II 1953-54 to 1955-56	-2.6	6.4	-3.6	-9.5	-1.1	8.5	5.8	5.2	12.0	7.2	7.0	10.5
III 1956-57 to 1958-59	2.7	-0.2	8.3	13.7	5.4	-1.5	4.5	5.5	15.4	7.2	10.0	13.5
IV 1959-60 to 1962-63	-1.9	6.0	2.3	-0.1	4.2	6.8	9.9	6.6	16.4	6.2	8.6	15.3
V 1963-64 to 1965-66	4.2	3.4	10.9	12.9	6.3	2.6	8.7	11.0	19.9	6.5	9.0	18.3

Notes : a : average annual figure of a variable within a given period means the arithmetic average of annul figures of that variable in different years covered within the period; all columns have been calculated in this way from the relevant columns given in Tables 3.2 and 3.3.

b : share of gross domestic capital formation has been calculated out of GDP at 1960-61 prices, shares of exports and imports, out of NDP at 1960-61 prices and the share of public expenditures, out of NDP at market prices.

c : figure for only one year, 1952-53.

Table 3.2 : Percentage change in some variables over the preceding year

year	foodgrains price (P^{fg})	agricultural price (P^{a})	non-agricultural price (P^{n})	relative price of agricultural goods (P^{a}/P^{n})	production of foodgrains	production of agricultural crops	industrial production	money supply
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1951-52	7.6	6.2	4.3	1.7	-9.5	-4.4	N.C.	1.0
1952-53	-1.7	-13.5	-16.3	3.5	0.7	2.0	3.6	-6.8
1953-54	-3.4	4.4	4.6	-0.3	11.0	4.6	2.0	0.5
1954-55	-21.2	-9.2	-3.7	-5.7	17.8	12.1	6.9	4.7
1955-56	-4.0	-5.9	-4.2	-1.8	-3.4	2.4	8.4	10.5
1956-57	27.8	16.1	11.0	4.6	0.3	-0.2	8.3	8.7
1957-58	4.3	3.1	2.9	0.2	4.8	6.4	3.5	5.2
1958-59	9.0	5.8	2.4	3.4	-9.6	-6.8	1.7	2.5
1959-60	-3.9	2.9	4.6	-1.8	20.0	15.4	8.8	6.4
1960-61	0.2	4.8	8.1	-3.1	-3.2	-4.0	12.1	6.9
1961-62	-1.9	-0.1	0.8	-0.9	8.1	10.7	9.2	4.4
1962-63	5.1	1.7	3.4	-1.6	2.3	1.8	9.5	8.8
1963-64	10.1	6.0	5.7	0.2	-4.8	-3.6	8.4	12.0
1964-65	24.1	17.5	7.0	9.6	2.2	2.5	8.6	10.3
1965-66	4.5	9.1	6.1	2.8	10.5	11.4	9.2	10.6

Notes : Columns (3)-(5) and (9) are calculated from cols.(1)-(3),(27) of Table B.1 of Appendix B. Columns (2), (6)-(8) have been calculated from various issues of "Monthly Bulletin of Reserve Bank of India" and of its annual publication "Report on Currency and Finance". Production of agricultural crops includes foodgrains (cereals and pulses) and non-foodgrains (oilseeds, fibres, plantations, sugarcane etc.). Productions of foodgrains and agricultural crops relate to previous agricultural year while industrial production relates to current calendar year.

N. C. : Not calculated, owing to the noncomparability of the series.

Table 3.3 : Percentage share of some variables

year	share in GDP[a] of gross investment[a]	share in NDP[a] of		share in NDP[b] of public expenditures[c]	share in total public revenue[c] of	
		exports[a]	imports[a]		direct taxes[d]	indirect taxes[c]
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1951-52	12.6	6.1	8.6	8.3	26.6	58.0
1952-53	9.4	7.4	6.4	8.9	29.8	55.3
1953-54	10.0	6.8	6.1	8.9	28.8	56.9
1954-55	11.1	6.9	7.0	10.6	26.5	58.6
1955-56	15.0	8.0	7.8	11.9	26.1	57.2
1956-57	16.8	7.3	10.2	12.0	26.0	57.2
1957-58	15.3	7.8	11.1	15.3	25.1	61.2
1958-59	14.2	6.5	8.6	13.3	24.8	60.3
1959-60	14.2	6.9	8.4	14.4	25.0	61.7
1960-61	17.0	5.9	9.3	14.9	24.6	60.9
1961-62	16.4	5.8	7.7	14.8	24.0	61.0
1962-63	17.8	6.2	8.8	17.1	24.8	60.9
1963-64	19.1	6.9	9.0	18.3	24.7	59.9
1964-65	19.2	6.5	9.2	17.3	24.6	62.1
1965-66	21.3	6.1	8.7	19.2	22.3	65.4

Notes : a at 1960-61 prices; b at market prices; c at current prices

Exports (imports) represent total exports (imports) of agricultural and non-agricultural goods at 1960-61 prices. These four variables ~~and NDP at 1960-61 prices~~ are given in Table B.1 in the Appendix B . Public expenditures include both consumption and investment expenditures. Columns (6) and (7), the series of NDP and that of public consumption expenditures are all taken from Government of India (1964a, 1971). Column (2) and the series of public investment expenditures are taken from Lal (1970).

Table 3.4 : Annual figures of some variables

(Column (2) with base 1952-53 = 100 and other columns in crores of rupees)

year	index of per capita wage earnings in factories[a]	balance of payments on current account[b]	changes[c] in foreign exchange reserves	overall deficits[d] of government budgets
(1)	(2)	(3)	(4)	(5)
1951-52	94.4	-163	-165	- 7
1952-53	99.3	+ 60	+ 17	- 28
1953-54	102.3	+ 47	+ 29	- 45
1954-55	101.5	+ 6	- 18	- 97
1955-56	100.3	+ 7	+ 10	-155
1956-57	104.4	-313	-144	-253
1957-58	108.2	-506	-260	-497
1958-59	110.9	-327	- 42	-140
1959-60	108.9	-186	- 16	-135
1960-61	120.7	-392	- 59	+ 56
1961-62	128.5	-358	- 6	-103
1962-63	139.4	-354	- 2	-141
1963-64	146.3	-458	+ 11	-187
1964-65	153.2	-655	- 56	-194
1965-66	169.4	-649	+ 48	-331

Notes : a : the series is taken from Chakrabarti (1970); figure for a given financial year (say, 1951-52) represents that in the corresponding calendar year (say, 1951); in Chakrabarti (1970) per capita wage earnings in factories are calculated from CMI and ASI data on total wages paid and total number of workers employed in factories.

b : deficit (-), surplus (+); for years upto 1960-61, the series is taken from Government of India (1968, 1969b) and afterwards, from various issues of Economic Survey published annually by the Government of India.

c : decline (-), increase (+).

d : deficits (-), surplus (+).

Columns (4) and (5) are taken from Govt. of India (1968, 1969b).

Chapter 4

THE BASIC MODEL

4.1 Introduction

Our main interest, as we have stated in the introductory chapter, is to study the implications of price-output interaction on the course of inflationary process in an underdeveloped economy like India. From this standpoint, a purely aggregative model is clearly inadequate, as we have argued in the first two chapters. The basic argument is that the entire economy cannot be said to be governed by a single economic law; rather different sectors of the economy display different kinds of behaviour. This calls for a suitable disaggregation of the economy into a few strategic sectors. However, any disaggregation relevant for the Indian economy should allow separate room for the agricultural sector. Not only does this sector alone account for almost half of national income, but it is the prices of agricultural products which play the most crucial role in shaping the course of behaviour of other prices. In fact this is what is suggested by various studies surveyed in Chapter 2 as well as by the history of Indian price movements analysed in Chapter 3. Further, as we have argued in Chapter 1, the basic mechanism of demand-supply adjustment is quite dissimilar in agriculture and other sectors. On all these grounds we shall consider a two-fold division of the product sectors of the economy — agriculture and the rest, and the model to be developed in this chapter will be cast in terms of this basic division[1/].

4.2 The Framework

About the real sector of the economy we assume that there are two types of products — one is the product of the agricultural sector, to be called the agricultural good and the other is the product of the non-agricultural sector, to be called the non-agricultural good. The latter includes the outputs of the so-called services sector.

The demand for the agricultural good is made up of final demand (consumption, export and inventory accumulation[2/]) and intermediate demand (raw material use in the production of non-agricultural good). The demand for non-agricultural good is similarly made up of consumption, investment (both fixed investment and inventory accumulation) separately by the agricultural and non-agricultural sectors, export and intermediate

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1/ Going to examine the kind of macro-econometric model suitable for developing economies, Klein (1965) also holds a similar view, namely, that an aggregative model of the Indian economy must at a minimum be divided into agricultural and non-agricultural sectors.

2/ There is no agricultural component in the commodity composition of gross fixed investment. Therefore, the total investment use of the agricultural good consists only of inventory accumulation.

demand for using it as inputs in the agricultural sector[3/]. The consumption as well as investment of either good may be both private and public. We, however, assume that the government consumption expenditure is spent wholly on the non-agricultural good[4/]. The supply of either good comes from its import and domestic production. The demand-supply equality for the two goods can, therefore, be written as :

$$(4.1) \quad X^a + F^a = C^a + X^{an} + \Delta SA + E^a$$

$$(4.2) \quad X^n + F^n = C^n + X^{na} + I^n + I^a + GC + GI + E^n$$

where

X^i = output of good i (net of its own-input use),

F^i = import of good i,

E^i = export of good i,

C^i = private consumption of good i,

X^{ij} = intermediate use of good i in sector j,

I^i = private investment of non-agricultural good in sector i,

ΔSA = change in the total (private and government) stock of agricultural good,

GC = government consumption of non-agricultural good,

GI = government investment of non-agricultural good,

and the superscript i or j stands for both 'a' (agriculture) and 'n' (non-agriculture).

3/ Since output of any sector will be measured net of its own-input requirement, we consider neither the intermediate use of agricultural good in the agricultural sector, nor that of non-agricultural good in the non-agricultural sector.

4/ The items which predominate in government consumption expenditures are wages and salaries of its employees and other services, all of which are considered here as products of the non-agricultural sector. On the

contd/----

At this point let us introduce a few accounting or definitional relations. We shall take the price of the non-agricultural good (P^n) — subsequently to be referred to as simply the non-agricultural price — as the numeraire and measure real national income and relative price of agricultural good in terms of this price. Thus if Y^a and Y^n are real incomes[5/] (in the sense of value added) in the agricultural and non-agricultural sectors, respectively and P^a is the price of the agricultural good (subsequently to be called the agricultural price), the relative price of agricultural good (P) is, by definition,

$$(4.3) \qquad P = \frac{P^a}{P^n}$$

and the aggregate real income (Y) is given by

$$(4.4) \qquad Y = PY^a + Y^n$$

while the aggregate money income (Y') is given by

$$(4.5) \qquad Y' = P^a Y^a + P^n Y^n$$

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footnote 4/ (contd.)
empirical side also, there is the further problem of isolating government consumption expenditure on agricultural good, if any, from total such expenditure, since no separate data are available. Possibly, these are the reasons why the input-output table of Manne and Rudra (1965) keeps the cells corresponding to the government consumption of agricultural products blank. Let us point out that since government consumption will be assumed to be given exogenously, its two-fold breakdown into agricultural and non-agricultural goods can easily be incorporated into our theoretical model.

5/ Incomes measured in terms of prices of respective sectors.

Henceforth we shall write income to mean real income. Thus Y^a and Y^n will be referred to as simply income in the agricultural and non-agricultural sectors, respectively while Y will be called aggregate income.

Finally, the relation between income and output of each sector is to be spelt out. We need such a relation not only as an accounting relation in our theoretical model, but in our empirical model as a method of estimating figures of outputs of different sectors, since official statistics, as published in, say, Govt. of India (1971), furnish only incomes (i.e., value added) originating in different sectors and not their outputs. Now, income (at current prices) in the two sectors will be given by

$$(4.6) \quad \begin{aligned} P^a Y^a &= P^a X^a - P^n X^{na} &&: \text{ agriculture} \\ P^n Y^n &= P^n X^n - P^a X^{an} &&: \text{ non-agriculture} \end{aligned}$$

where Y^i and X^i are measured at some constant prices. Thus the relation between output and income of a sector is easily obtained from (4.6) as follows :

$$\begin{aligned} X^a &= Y^a + \frac{1}{P} X^{na} &&: \text{ agriculture} \\ X^n &= Y^n + P \ X^{an} &&: \text{ non-agriculture} \end{aligned}$$

Since sectoral income figures are usually given at factor cost, we have to add real indirect taxes less subsidies in each sector (measured in terms of its own price) — T^a for agriculture and T^n for non-agriculture — to the two relations to obtain outputs at market prices :

$$(4.7) \quad \begin{aligned} X^a &= Y^a + \frac{1}{P} X^{na} + T^a &&: \text{ agriculture} \\ X^n &= Y^n + P \ X^{an} + T^n &&: \text{ non-agriculture} \end{aligned}$$

Our subsequent analysis will run in terms of Y^a and Y^n and whenever output figures are needed we shall make use of (4.7). It is obvious that henceforth Y^a and Y^n would mean incomes at factor cost in the two sectors.

The monetary sector of the model is characterised by a demand function and a supply function of money. In line with the Keynesian tradition we assume that the demand for money (M^d) varies positively with the aggregate money income (Y'), but inversely with the rate of interest (r)6/:

$$(4.8) \quad M^d = M^d (Y', r) ; \qquad M^d_{y'} > 0, \qquad M^d_r < 0$$

For quite a long time the supply of money has been treated as an exogenous variable in the theoretical literature on macroeconomics. However, works of Polak and White (1955), Brunner (1961), Brunner and Meltzer (1963) etc., suggest that it is influenced, at least partly, by the rate of interest7/. In fact, the variable which may be treated as a policy parameter and which is now supposed to be the main determinant of money supply is what is called the base money (high-powered money) or, specifically, the unborrowed base money; the latter is defined to be the sum of currency with the public, required and excess reserves of commercial

6/ See Keynes (1936, Chs. 13-15). Henceforth notations like G_x, G^k_x, G^k_r, G_{x_i}, $G^k_{x_i}$ etc. will denote respectively the partial derivatives of the functions G and G^k with respect to their arguments X, r, X^i etc.

7/ Recent empirical studies on the Indian money market (e.g., Bhattacharya, 1970; Mammen, 1971; Gupta, 1973) also point to the endogenous nature of the money supply.

banks net of their borrowings from the central bank. However, given the base money, the supply of money will vary in accordance with the variation in the rate of interest. On the assumption that banks try to maximise their profits, the amount of free reserves (the excess reserves of banks net of their borrowings from the central bank) which the banks usually maintain will tend to vary inversely with the rate of interest. For, as the return from lending rises, banks will be willing to supply more deposits by reducing their free reserves and hence, the stock of money will increase[8/]. Thus we may write[9/]

$$(4.9) \qquad M^s = M^s(M, r); \qquad M^s_M > 0, \qquad M^s_r > 0$$

where M^s is the supply of money and M, the (unborrowed) base money.

The demand-supply equality in the monetary sector then requires

$$(4.10) \qquad M^d = M^s$$

Exogenous Variables of the Model

The variables to be considered in the model are now all introduced. Of all these variables we shall assume the following ones to be determined outside the system : Y^a, E^a, E^n, F^a, F^n, I^a, Δ SA, GC, GI and M. A few words should, therefore, be added as a sort of justification for these assumptions.

8/ See Teigen (1965, pp. 92-5).

9/ The supply function of money has been described in detail in Ch. 7, Section 7.3.1.

We assume that the domestic production of agricultural good depends more on such exogenous factors like weather than on any economic varieble. One may argue that it should bear some relationship to the capital stock accumulated in this sector. However, the wide fluctuations in the production of agricultural crops, as has been observed in the Indian economy[10/], cast serious doubt on the validity of this argument. Moreover, ours is a short-run model so that the influence of the changing capital stock may be neglected.

On the other hand, our assumption that the agricultural output is determined exogenously does not necessarily imply that individual crops are insensitive to intra-agricultural price variation. In this context, we may mention that while a few empirical studies point to the positive price elasticity of agricultural production, at least in particular regions and for particular crops (e.g., Krishna, 1963; Mann, 1967), results of other studies are, however, conflicting[11/] (e.g., NCAER, 1962; Narain, 1965). In any case, these results would not be inconsistent with the assumption that the output of the agricultural sector as a whole is

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10/ See the discussion in Section 3.3, Chapter 3.

11/ In fact, a host of arguments have been advanced in support of the thesis that Indian agricultural crops are not responsive to price changes (Neale, 1959; Oslon, 1962; Khatkhate, 1962). A few of these arguments are : (a) the majority of agricultural holdings being small, they are in any case cultivated upto the fullest possible extent, (b) there is little alternative use of agricultural land and other resources, (c) the substitution between crops is limited by the specificity of soil and weather requirements of particular crops. We may refer to Chakrabarti (1970, Ch. 1) for a summary of these arguments and of various empirical studies.

rather independent of changes in the price of agricultural good relative to that of non-agricultural good.[12]

To take foreign trade now, export demand is usually conceived in the theoretical literature as a function of two explanatory variables, viz. , level of economic activity in the rest of the world and relative price, the latter being defined as the ratio either of domestic price to prices of countries to which goods are exported, or, of domestic price to prices of countries which are competitors in the world market. While the relevance of foreign economic activity is generally agreed upon, there is conflicting evidence on the sensitivity of exports to changes in the relative price. Thus while Cohen (1964) & Agarwala (1970) retain relative price as an explanatory variable in the export demand function, Dutta (1964) finds that this variable is not (statistically) significant in explaining world demand for India's exports during the period, 1950-61, except in the case of India's exports to the limited area outside the Sterling, Dollar and OECD countries. It should further be pointed out that the coefficient of relative price in Agarwala's export demand equation is not significant and that the equation itself has a very low coefficient of determination (0.35). Introducing as a possible explanatory variable the domestic absolute price (instead of relative price), Da Costa (1965), on the other hand, observes that this variable is significant in explaining India's

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12/ We shall take Y^a, instead of X^a, as the relevant exogenous variable. The difference between these two figures is negligible since non-agricultural inputs used in agriculture are very small, as our data in the Appendix B would show. Of course, the results of the model could easily be shown to remain unaltered even if the subsequent analysis were carried out by assuming X^a, and not Y^a, as exogenous.

exports of some item but its coefficients in the export demand functions for some other item come up with perverse (positive) signs. With these conflicting empirical results in the background it may not be unreasonable to assume that India's exports depend mainly on such exogenous forces as the level of foregin economic activity, export promotion activities of the home country etc.

Similarly, as regards the import function, most of the studies conclude that it is not, at all, influenced by the relative price, i.e., the ratio of domestic price to import price (e.g., Narasimham, 1956; Dutta, 1964, 1965; Agarwala, 1970). Sometimes imports are also assumed to be determined by national income and/or domestic investment. However, it is the capacity to import which seems to play the most important role in determining actual imports here. For, ever since the beginning of the Second Plan India has been experiencing severe foreign exchange shortages, as we have seen in Section 3.3, Chapter 3. Now such capacity to import is determined by the flow of foreign loans and aids and the volume of exports. The former is guided by exogenous forces and the latter also depends on outside factors, as we have argued in the preceding paragraph. For this reason, we assume that imports are determined by such exogenous factors as government's system of priority imports, import licensing policies etc.

The change in the stock of agricultural good (ΔSA) is really a troublesome item. The method of estimating figures for ΔSA is very limitative and whatever data are available are unlikely to give true figures of changes in <u>private</u> stock of agricultural good (let us denote it by ΔSA^p), a part of ΔSA. This perhaps is the reason why there is no empirical study on ΔSA^p. Since we have to retain ΔSA at least for the purpose of accounting relation for the agricultural sector, an interesting methodological question arises : is it meaningful to introduce a variable with poor or unreliable data as an endogenously determined one or is it better to treat it as an exogenous variable ? Obviously, we do not assert that variables like price, output etc., do not have any effect on ΔSA^p. We only maintain that unless reliable data are available, no satisfactory explanation can be established for ΔSA^p and no conclusion can be obtained regarding how and in what direction variables like price and output influence ΔSA^p. For this reason and also because of the fact that the other part of ΔSA is the change in the <u>government</u> stock of agricultural good which may be taken to be policy-determined, we assume ΔSA to be an exogenous variable.

In regard to private investment demand for the non-agricultural good by the agricultural sector (I^a), one somewhat analogous empirical study may be mentioned. Agarwala (1970) introduces two variables — real disposable income in agriculture and the price of agricultural good relative to that of investment good — to explain private investment in agriculture[13/]. However, the coefficients corresponding to the relative

13/ Agarwala's investment variable includes both agricultural and non-agricultural goods and hence is not strictly comparable to our variable I^a.

price variable is found to be significantly negative, contrary to what one would expect on a priori ground. In our own investigation (reported in the Appendix A) we find that none of the seemingly relevant variables — agricultural output, agricultural price relative to non-agricultural price, rate of interest — is seen to exert any significant influence on I^a. We, therefore, assume I^a to be independent of current endogenous forces.

Finally, we assume that both the government consumption demand (GC) and the government investment demand (GI) for non-agricultural good are given exogenously and that the (unborrowed) base money (M) is exogenously determined by the monetary policy of the central bank[14].

Having completed the list of variables to be considered exogenous we may now lump together some of these variables. Thus in the equation (4.1) we write a new exogenous variable — to be called the (net) autonomous demand for agricultural good — which is denoted by Q^a and is defined by

$$(4.11) \qquad Q^a \equiv \Delta SA + E^a - F^a$$

Similarly, exogenous variables in the equation (4.2) are taken together to give us the (net) autonomous demand for non-agricultural good (Q^n) which is defined by

$$(4.12) \qquad Q^n \equiv I^a + GC + GI + E^n - F^n$$

14/ (Unborrowed) base money has been taken as a policy variable in several studies (e.g., Bhattacharya, 1970; Mammen, 1971). Indeed, it is influenced by such factors as the deficit financing of the government, the amounts of gold and foreign exchange reserves held by the central bank etc.

Before concluding this subsection, a general remark has to be added. So far as our theoretical model is concerned, most of the variables which are treated here as exogenous could have been considered as determined within the system and still the analysis and the conclusion of the model (to be presented subsequently in this chapter) would have remained valid. This would only require minor modifications of the analysis that follows. An illustration, given in footnote 26, p. 86, in this chapter, is expected to drive home the point.

4.3 Relations for Endogenous Variables

We now state the various relations for the endogenous variables of the model. To start with, the private consumption demand for agricultural good (C^a) is assumed to vary positively with national income (Y) and inversely with the relative price of agricultural good (P) :

$$(4.13) \qquad C^a = C^a (Y, P); \qquad C^a_y > 0, \quad C^a_p < 0$$

Likewise, the private consumption demand for non-agricultural good (C^n) is assumed to be an increasing function of Y. However, the influence of P on C^n is ambiguous and a discussion on this point is deferred to Section 4.4 (p.85) of the present chapter :

$$(4.14) \qquad C^n = C^n(Y, P); \qquad C^n_y > 0, \qquad C^n_p \gtreqless 0$$

The intermediate use of agricultural good in the non-agricultural sector (X^{an}) is assumed to be an increasing function of non-agricultural income :

$$(4.15) \qquad X^{an} = X^{an}(Y^n); \qquad X^{an}_{Y_n} > 0$$

while that of the non-agricultural good in the agricultural sector (X^{na}) is assumed to be proportional to the latter's income 15/ :

$$(4.16) \qquad X^{na} = \beta Y^a; \quad \beta > 0$$

β being the factor of proportionality.

The private investment demand for the non-agricultural good by the non-agricultural sector (I^n) is assumed to vary positively with the income in this sector (Y^n), but inversely with the rate of interest (r) and the relative price of agricultural good (P). While the influence of the first two variables on an investment function is theoretically well known, the introduction of the third variable needs some explanation. A rise in P means that the price of industrial raw materials of agricultural origin increases relatively to the price of the good which is made out of these materials. Further, though we do not explicitly bring employment and wages in our model, we have in mind a view that changes in per capita wage earnings follow the course of changes in the cost of living, the most important determinant of the latter being the agricultural price 16/.

15/ Why X^{na} is taken proportional to Y^a while X^{an} is considered to be a function of Y^n will be clear when we state the method of estimation of these inter-sectoral flows in Section 5.1 of the next chapter.

16/ Studies surveyed in Section 2.5, Chapter 2 may be recalled at this point.

Therefore, a rise in P means a rise in the labour cost of production relatively to the price of the non-agricultural good. On all these grounds, therefore, given Y^n and r, a rise in P will tend to reduce profits in the non-agricultural sector and hence the investment in this sector. Thus we may write :

$$(4.17) \quad I^n = I^n (Y^n; P, r); \qquad I^n_{y_n} > 0, \quad I^n_p < 0, \quad I^n_r < 0$$

We now come to the price formation relation in the non-agricultural sector. It is assumed that the price of the non-agricultural good is affected both by (net) prime costs of its production and by its demand[17]. On the former side, the netting is of the intra-industrial price relations, which leaves basically the price of agricultural raw materials used in the non-agricultural sector and the money wage rate as the determinants of its unit prime cost. Both of these variables will be affected by the agricultural price, as we have argued in the previous paragraph. In order to find a measure of the demand for non-agricultural good we consider output in this sector. Since the movement in the non-agricultural income will reflect the movement of output in this sector, we stipulate that the non-agricultural price (P^n) varies <u>positively</u> with both agricultural price (P^a) and non-agricultural income (Y^n) :

$$(4.18) \quad P^n = F(P^a, Y^n); \qquad F_{p_a} > 0, \quad F_{y_n} > 0$$

17/ Reference may be made to the discussion in Chapter 1 and the empirical studies surveyed in Chapter 2.

However, the elasticity of the F-function with respect to P^a is likely to be less than unity. Several reasons may be pointed out to support this hypothesis. First, the unit cost of labour and agro-based raw materials is only a part of total unit cost of production. Secondly, wage payments are not fully adjusted to changes in the cost of living. Thirdly, some of the products in the non-agricultural sector do not use agro-based raw materials. Finally, some of the prices may be controlled by the government so that these will not be fully adjusted to the changes in their cost of production. On all these counts, we postulate that a one per cent change in P^a changes P^n by less than one per cent[18]:

(4.18a) $$PF_{P^a} < 1$$

The F-function corresponding to a particular value of Y^n, say Y^n_o, is drawn[19] in Figure 1 which satisfies the restriction (4.18a).

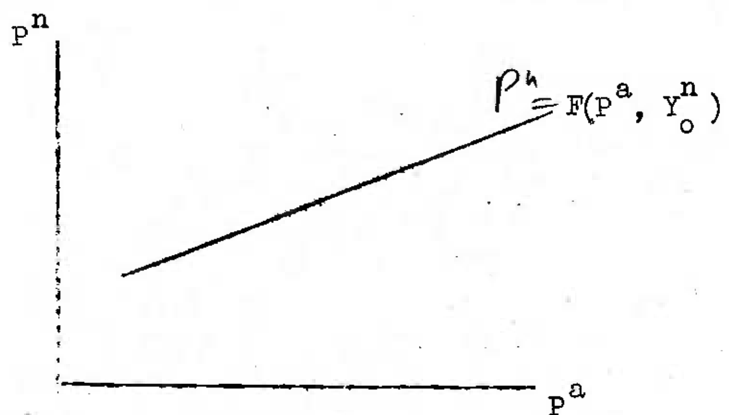

FIGURE 1

18/ See also Kalecki (1954, pp. 24-6).

19/ There can be a number of possible geometrical representations of F-function (e.g., a function concave to the P^a-axis).

At this point we may bring in all the relations introduced in Section 4.2. The three definitional relations (4.3)-(4.5) can be rewritten as :

$$(4.19) \qquad P^a = PP^n$$

$$(4.20) \qquad Y = PY^a + Y^n$$

$$(4.21) \qquad Y' = P^n Y$$

In view of (4.7), (4.11) and (4.12) the equations (4.1) and (4.2) showing the demand-supply equality for the two goods can also be rewritten as follows :

$$(4.22) \qquad Y^a + \frac{1}{P} X^{na} + T^a = C^a + X^{an} + Q^a$$

$$(4.23) \qquad Y^n + PX^{an} + T^n = C^n + X^{na} + I^n + Q^n$$

For the (real) indirect taxes less subsidies for two sectors (T^a and T^n), we assume that each is an increasing function of its income :

$$(4.24) \qquad T^a = T^a(Y^a) \; ; \qquad T^a_{y_a} > 0$$

$$(4.25) \qquad T^n = T^n(Y^n) \; ; \qquad T^n_{y_n} > 0$$

Finally, we like to reduce all the relations for the monetary sector (4.8) - (4.10) into a single one. This is easily obtained once we note that the demand-supply equality condition in this sector, (4.10), yields, in view of (4.8) and (4.9), a relation between r, Y′ and M. Specifically, starting from a situation of equilibrium in the monetary sector a rise in the aggregate money income would raise the demand for money and hence the rate of interest so as to maintain (4.10). Similarly, a rise in the base money would raise the money supply and hence require a fall in the rate of interest in order that (4.10) is satisfied. Thus, we can write[20]

$$(4.26) \quad r = L(Y', M) ; \qquad L_{y'} > 0, \quad L_m < 0$$

Relations (4.13)-(4.26) characterise the equilibrium situation of the model. We have, in total, 14 equations to determine 14 endogenous variables : C^a, C^n, X^{an}, X^{na}, I^n, P^n, P^a, Y, Y', P, Y^n, T^a, T^n and r. There are 4 exogenous variables : Y^a, Q^a, Q^n and M and there is one parameter β.

20/ Let us define a new function H as follows :

$$H(r; Y', M) \equiv M^d(Y', r) - M^s(M, r)$$

The equality (4.10) can now be written as

$$(4.10a) \quad H(r; Y', M) = 0$$

Assuming that both M^d and M^s are continuous and have continuous partial derivatives, H is also a continuous function possessing continuous partial derivatives. An appeal to the implicit function theorem (see Theorem 1 in Appendix A.1) would then enable one to express r (in a neighbourhood around the point at which (4.10a) is satisfied) uniquely in terms of Y' and M, provided $H_r \neq 0$ at this point. Since $H_r = M^d_r - M^s_r < 0$, we can write

$$r = L(Y', M)$$

and the partial derivatives of the L function are given by

$$L_{y'} = - \frac{H_{y'}}{H_r} = - \frac{M^d_{y'}}{M^d_r - M^s_r} > 0$$

$$L_m = - \frac{H_m}{H_r} = \frac{M^s_m}{M^d_r - M^s_r} < 0$$

where signs are obtained with the help of (4.8) and (4.9).

4.4 The Reduced Form of the System

We like to express equilibrium conditions of our model, represented by (4.13)-(4.26), in a fewer number of relations. This will not only help us to have a simple and overall view of the working of the economic system, but facilitate a graphical exposition of the model.

Equilibrium Conditions Cast into Fewer Relations

By making suitable substitutions, the whole system (4.13)-(4.26) can be rewritten as

$$(4.27)\quad Y^a = C^a(Y, P) + X^{an}(Y^n) - \frac{1}{P}\beta Y^a - T^a(Y^a) + Q^a$$

$$(4.28)\quad Y^n = C^n(Y, P) + \beta Y^a + I^n(Y^n, P, r) - PX^{an}(Y^n) - T^n(Y^n) + Q^n$$

$$(4.29)\quad P^n = F(P^a, Y^n); \qquad 0 < PF_{P_a} < 1, \quad F_{Y_n} > 0$$

$$(4.30)\quad r = L(Y', M); \qquad L_{Y'} > 0, \quad L_m < 0$$

and three definitional relations are

$$(4.31)\quad Y = PY^a + Y^n$$

$$(4.32)\quad P^a = PP^n$$

$$(4.33)\quad Y' = P^n Y$$

We now have 7 equations (4.27)-(4.33) to determine 7 endogenous variables — P, Y^n, P^n, r, Y, P^a and Y'. Given the exogenous variables/parameter, Y^a, Q^a, Q^n, M and β, the endogenous variables are determined <u>simultaneously</u> from these equations. However, one can conceptually think of a partial equilibrium analysis of each of the relations. This will also make clear our views regarding the mechanism through which the economic system is being supposed to operate. One basic assumption is that the demand-supply adjustment mechanism is dissimilar in agricultural and non-agricultural markets. As we have argued in Chapter 1, it is the (relative) price, and not production, which is assumed to respond to excess demand (supply) in the agricultural sector. On the other hand, the non-agricultural sector is assumed to operate under excess capacity[21] and, as in a Keynesian income-expenditure model, 'demand creates its own supply' in this sector.

To discuss the various relations presented above, given the value of Y^n and values of relevant exogenous variables (Q^a, Y^a), the demand-supply equality in the agricultural market (the equation (4.27)), in conjunction with the definition of aggregate income (4.31), determines the relative price of agricultural good[22], P. Again, given the values of P and Y^n,

21/ No capacity utilisation figures, or for that matter capacity figures, are available for the Indian manufacturing sector as a whole. Therefore, it is almost impossible to test the hypothesis that the non-agricultural sector operates under excess capacity. However, the series of capacity utilisation index, as constructed by Krishnamurty (1964a, p.69), points to the existence of considerable excess capacity in the manufacturing sector during the period, 1947-60. Even the very crude series of potential utilisation ratio constructed by Divatia and Varma (1970) does indicate that over the years from 1960 to 1968 actual production in the manufacturing sector was far below its potential production, the latter being defined in a crude way as the peak production achieved upto the time in question.

22/ This also conforms to the approaches of various empirical studies surveyed in Chapter 2. These studies suggest that the (relative) prices of agricultural products are determined through a competitive mechanism, being responsive to changes in conditions of both demand and supply.

the price formation relation in the non-agricultural sector (4.29) along with (4.32) determines absolute prices P^a and P^n, and the equation (4.30) determines the rate of interest, with the help of (4.31) and (4.33). The purpose of the condition (4.28) is to determine non-agricultural income, Y^n, by the aggregate demand for non-agricultural good which depends on, among other things, relative price of agricultural good, agricultural income, rate of interest and the non-agricultural income itself.

Let us now suppose that an equilibrium exists so that there is a set of values of the variables — denote it by $(P_o, Y^n_o, P^n_o, r_o, Y_o, P^a_o, Y'_o)$ — for which equations (4.27)-(4.33) are satisfied. We assume further that all functions in the above equations are continuous and have continuous partial derivatives.

Now from (4.29)-(4.33) one can express r around the equilibrium point in terms of the variables Y^n, P, Y^a and M. This can be done by making use of the implicit function theorem (see, Theorem 2 in Appendix A.1), provided $(1 - PF_{p_a})$ is not equal to zero. This is, however, positive by (4.29) so that one can write

$$(4.34) \qquad r = R\,(Y^n, P\ ;\quad Y^a,\ M)$$

where R is a continuous function having continuous partial derivatives given by [23]

23/ The derivation of R function and its partial derivatives is shown in Appendix A.2. The fact that a rise (fall) in Y^n or in P will raise (reduce) r can also be demonstrated graphically by making use of the Figure given towards the end of the present section (p. 91). From Figure 3 it is obvious that a rise in Y^n will shift the contd.../-

$$R_{y_n} = L_{y'} \left(P^n + \frac{YF_{y_n}}{1 - PF_{p_a}}\right) > 0$$

$$(4.35) \quad R_p = L_{y'} P^n \left(Y^a + \frac{YF_{p_a}}{1 - PF_{p_a}} \right) > 0$$

$$R_{y_a} = P^a L_{y'} > 0$$

$$R_n = L_n < 0$$

We are now in a position to reduce the whole system (4.27)-(4.33) into only two simultaneous relations involving only two endogenous variables — Y^n and P. This is done in the next subsection.

Equilibrium Conditions Recast into Two Relations
Involving Only Two Endogenous Variables - Y^n and P

For this purpose we first define two new functions — D^a and D^n — which are really the R.H.S. of relations (4.27) and (4.28), respectively. For want of better names, we shall call these the aggregate demands for agricultural and non-agricultural goods, respectively, although these are net of taxes and intermediate use. Thus for the agricultural good we have

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footnote 23/ contd.

F-curve upwards. Therefore, given the relative price and hence the ray od, both the absolute prices and hence the aggregate money income will rise. This in turn raises r via (4.30). Similarly, a rise in P, given Y^n, shifts the ray od to the right and hence raises both the absolute prices. In this case also aggregate money income and hence the rate of interest rise.

$$D^a = C^a(Y, P) + X^{an}(Y^n) - \beta Y^a/P - T^a(Y^a) + Q^a$$

(4.36)
$$= C^a(PY^a + Y^n, P) + X^{an}(Y^n) - \beta Y^a/P - T^a(Y^a) + Q^a$$

[in view of (4.31)]

$$= D^a(Y^n, P; \quad Y^a, Q^a, \beta)$$

The partial derivatives of this function are given below[24]

(4.37)
$$D^a_{y_n} = C^a_y + X^{an}_{y_n}$$

$$D^a_p = C^a_y . Y^a + C^a_p + \beta Y^a/P^2$$

$$D^a_{y_a} = C^a_y . P - \beta/P - T^a_{y_a}$$

$$D^a_{q_a} = 1$$

An increase in Y^n raises the consumption demand for agrioulcutal good, by C^a_y and the intermediate demand, by $X^{an}_{y_n}$. Thus we have unambiguously,

(4.38) $$D^a_{y_n} > 0$$

However, in the expression for D^a_p the first and last terms are positive while the second term is negative. We shall however assume that

(A1) $$D^a_p < 0$$

The negative sign of D^a_p entails the assumption that the second term dominates the other two. Theoretically, a change in P induces two kinds of effects on consumption — the income effect and the substitution effect.

24/ In the analysis that follows we shall everywhere neglect partial derivatives of functions with respect to β. However, it is very easy to consider such partial derivatives and even a comparative static analysis (presented in the next section) in the case of a change in β.

To discuss the income effect first, an increase in P in the present case has opposite effects on the real incomes of the two sectors. It raises the real income of the agricultural sector, but reduces that of the non-agricultural sector as the latter can afford to buy less agricultural good than was possible earlier. As a result, the income effect of a rise in P is likely to increase the self-consumption of the agricultural sector and to reduce the consumption of the non-agricultural sector. On the other hand, the substitution effect of a rise in P tends to reduce the consumption demand for agricultural good from both sectors. Since we measure real income by $Y = PY^a + Y^n$ and in the consumption function the explanatory variables introduced are both Y and P, the income effect of a relative price change for the agricultural sector is given by $C^a_y \cdot Y^a$. On the other hand, C^a_p measures the income effect (of the relative price change) for the non-agricultural sector as well as the substitution effects for both agricultural and non-agricultural sectors, all of which work in the same (negative) direction. We assume that these three effects taken together are sufficiently large to outweigh the income effect for the agricultural sector (and also the term $\beta Y^a/P^2$), so that D^a_p is negative.

About the partial derivative $D^a_{y_a}$ we assume it to be less than unity :

(A2) $D^a_{y_a} < 1$

The demand function for the non-agricultural good can also be written as follows :

$$D^n = C^n(Y,P) + \beta Y^a - PX^{an}(Y^n) - T^n(Y^n) + I^n(Y^n, P, r) + Q^n$$

(4.39) $$= C^n(PY^a + Y^n, P) + \beta Y^a - PX^{an}(Y^n) - T^n(Y^n) + I^n \left\{ Y^n, P, R(Y^n, P; Y^a, M) \right\} + Q^n \quad \text{[by (4.34)]}$$

$$= D^n(Y^n, P; Q^n, Y^a, M, \beta)$$

The partial derivatives of this function are given below :

(4.40)
$$D^n_{y_n} = C^n_y - PX^{an}_{y_n} - T^n_{y_n} + I^n_{y_n} + (I^n_r \cdot R_{y_n})$$

$$D^n_p = C^n_y \cdot Y^a + C^n_p - X^{an} + I^n_p + (I^n_r \cdot R_p)$$

$$D^n_{q_n} = 1$$

$$D^n_{y_a} = C^n_y \cdot P + \beta + (I^n_r \cdot R_{y_a})$$

$$D^n_m = (I^n_r \cdot R_m)$$

where the bracketed term in each expression is the one which works through the change in the rate of interest induced by the change in the variable in question.

Let us now see what stipulations we can make about the signs of the above partial derivatives.

An increase in Y^n raises directly the consumption and investment demand for the non-agricultural good. However, since it raises the rate of interest via (4.34), its indirect effect is a reduction in investment demand (the last term). Considering also the terms corresponding to indirect taxes and intermediate demand, the net effect is likely to be positive. For our purpose we need only the assumption that

(A3) $D^n_{y_n} < 1$

It is, however, interesting to trace the effect of a rise in P on D^n. It raises agricultural real income and hence this sector's demand for non-agricultural good, by $C^a_y \cdot Y^a$ (the income effect of a relative price change for the agricultural sector). However, the income effect on the demand for non-agricultural good works in a negative direction for the non-agricultural sector while its substitution effects for both sectors work in a positive direction. Since the term C^n_p measures the sum total of the last three effects and since one of them works in a direction opposite to those of the other two, the sign of C^n_p cannot be established a priori. It may be positive, negative or even zero (if the two opposite effects cancel out)[25/]. Apart from these effects on consumption, a rise in P reduces the investment demand in the non-agricultural sector directly via its effect on profitability (since $I^n_p < 0$) and indirectly by raising the interest rate, via (4.34). Considering also the effect on the value of intermediate use of agricultural good we assume that the net effect of a rise (fall) in P is a reduction (increase) in D^n:

(A4) $D^n_p < 0$

25/ It is sometimes argued that for the non-agricultural sector the income effect is considerable so that the sign of C^n_p or even of $(C^n_y . Y^a + C^n_p)$ may be negative. At this point we may recall our discussion on page 28 of Chapter 2 and particularly the study of Krishnan (1964).

A rise in Y^a has two opposite effects on the demand for non-agricultural good. It raises the consumption and intermediate demand of the agricultural sector for the non-agricultural good by $(C^n_y \cdot P + \beta)$. On the other hand, it raises the rate of interest via (4.34) and hence reduces investment demand in the non-agricultural sector. We assume, however, that

(A5) $D^n_{y_a} > 0$

A rise in the base money M has, however, an unambiguously favourable effect on the demand for non-agricultural good. For, it reduces the rate of interest via (4.34) which, in turn, boosts up investment demand in the non-agricultural sector :

(4.41) $D^n_m > 0$

As a final step, we can now rewrite the equilibrium conditions for the agricultural and non-agricultural markets, namely, relations (4.27) and (4.28) in a way so as to get rid of all the other endogenous variables of the model 26/ :

26/ At this point we may show how several variables treated as exogenous in the text could be made endogenous. Let us consider such variables in the equation (4.2), as an illustration and assume that

$$E^n = E^n(P^n, P^{wn}, Y^w); \quad E^n_{p_n} < 0, \quad E^n_{p_{wn}} > 0, \quad E^n_{y_w} > 0$$

$$F^n = F^n(Y, P^n; P^{wn}); \quad F^n_y > 0, \quad F^n_{p_n} > 0, \quad F^n_{p_{wn}} < 0$$

$$I^a = I^a(Y^a, P, r) ; \quad I^a_{y_a} > 0, \quad I^a_p > 0, \quad I^a_r < 0$$

where P^{wn} and Y^w are, respectively, the world price of non-agricultural good and the world income, both given exogenously and where $I^a_p > 0$, since a rise in P implying a rise in the price of agricultural

$$(4.42) \qquad Y^n = D^n \qquad : \text{non-agricultural market}$$

$$(4.43) \qquad Y^a = D^a \qquad : \text{agricultural market}$$

where the functions D^a and D^n and their partial derivatives are given by relations (4.36), (4.37), (4.39) and (4.40). Each of the equations — (4.42) and (4.43) — defines an implicit function of two endogenous variables Y^n and P and other relevant exogenous variables and hence can be solved uniquely for Y^n or for P with the help of the implicit function theorem 27/, provided certain conditions are fulfilled. Such an exercise will facilitate a simple graphical exposition of the equilibrium solution of our system.

Footnote 26/ contd.

good relatively to that of investment good is likely to raise profits in the agricultural sector. The autonomous demand for non-agricultural good (Q^n) now becomes : $Q^n \equiv$ GC + GI. Since it is obvious from (4.29) that P^n is an increasing function of both Y^n and P (see also footnote 23), the demand for non-agricultural good :

$$D^n = C^n + \beta Y^a - PX^{an} - T^n + I^n + (I^a + E^n - F^n) + Q^n$$

can still be shown to be a function of only two endogenous variables Y^n and P. Hence partial derivatives of D^n with respect to Y^n, P, Q^n, Y^a and M can be easily obtained. D^n_m will still be positive and we have only to introduce assumptions (A3)-(A5). The subsequent analysis may then proceed as in the text. Similarly, exogenous variables in the demand for agricultural good (viz., $\triangle SA^p$, E^a and F^a) could also be made endogenous; for that we have only to recall the relevant assumptions.

27/ See Theorem 1 in Appendix A.1.

A Graphical Representation of the Equilibrium Situation

To take up, first, the equation corresponding to the non-agricultural market it can be solved uniquely for Y^n in a neighbourhood around the equilibrium point (Y^n_o, P_o), provided $(1 - D^n_{y_n})$ does not vanish at this point. This is, however, positive by (A3). Thus we can write

$$Y^n = \phi^n (P \; ; \; Q^n, Y^a, M, \beta) \tag{4.44}$$

where ϕ^n is a continuous function having the following continuous partial derivatives :

$$\phi^n_p = \frac{D^n_p}{1 - D^n_{y_n}}$$

$$\phi^n_{q_n} = \frac{D^n_{q_n}}{1 - D^n_{y_n}} = \frac{1}{1 - D^n_{y_n}} \tag{4.45}$$

$$\phi^n_{y_a} = \frac{D^n_{y_a}}{1 - D^n_{y_n}}$$

$$\phi^n_m = \frac{D^n_m}{1 - D^n_{y_n}}$$

It is easily verified that (4.41) and our assumptions (A3) and (A5) guarantee that $\phi^n_{q_n}$, $\phi^n_{y_a}$ and ϕ^n_m are all positive. Again, the assumptions (A3) and (A4) imply that ϕ^n_p is negative. For given values of the exogenous variables the relation (4.44) is drawn as a downward sloping curve, nn, on a P - Y^n plane[28/] in Figure 2.

In a similar way, the equation (4.43) corresponding to the agricultural market can be solved uniquely for P in a neighbourhood around the equilibrium point (Y^n_o, P_o), provided D^a_p does not vanish at this point. Our assumption (A1) says that the value of this partial derivative is negative. Thus we can write

$$(4.46) \qquad P = \phi^a (Y^n; Q^a, Y^a, \beta)$$

where ϕ^a is a continuous function of its arguments having continuous partial derivatives, given below :

$$\phi^a_{y_n} = \frac{D^a_{y_n}}{(-D^a_p)} > 0$$

$$(4.47) \qquad \phi^a_{q_a} = \frac{D^a_{q_a}}{(-D^a_p)} = \frac{1}{(-D^a_p)} > 0$$

$$\phi^a_{y_a} = \frac{1 - D^a_{y_a}}{D^a_p} < 0$$

28/ The shape of the nn curve can be explained quite easily. This curve is the locus of all pairs of Y^n and P for which the non-agricultural market is in equilibrium. If $D^n_p < 0$, then starting from an equilibrium situation, an increase in P reduces aggregate demand for non-agricultural good and hence creates excess supply in this market. Since $D^n_{y_n} < 1$, this excess supply can be eliminated only if non-agricultural income falls. It is also easily seen that in the case $D^n_p > 0$, and $D^n_{y_n} < 1$, the nn curve will be an upward-sloping curve.

The signs of these partial derivatives are obtained with (4.38) and the assumptions (A1) and (A2). For given values of the exogenous variables the relation (4.46) is depicted as an upward-sloping curve[29], aa, on a $P - Y^n$ plane in Figure 2.

The equilibrium values of the two endogenous variables Y^n and P are now obtained at the point of intersection, e_o, of the aa and nn curves

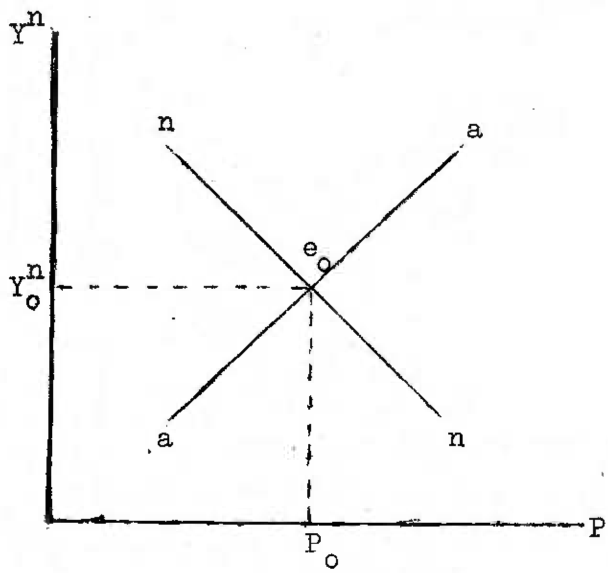

FIGURE 2

and these are shown as Y^n_o and P_o in Figure 2. Again, substituting the values of P_o and Y^n_o in (4.29) and (4.32), the equilibrium values of two absolute prices are easily determined. This is shown in Figure 3 where

29/ The positive slope of the aa curve can be obtained with simple argument. In fact, this curve gives the locus of all pairs of values of Y^n and P which maintain equilibrium in the agricultural market. Starting from an equilibrium situation, an increase in Y^n raises aggregate demand for agricultural good (since $D^a_{y_n} > 0$) and hence creates excess demand in this market. Since $D^a_p < 0$, this excess demand can be eliminated only if the relative price of agricultural good rises.

the slope of the ray od (referred to the P^a-axis) equals $1/P_o$. The equilibrium values of absolute prices are determined at the point of intersection, w_o, between the ray od and the F-curve (adapted from Figure 1). They are denoted by P_o^a and P_o^n in Figure 3.

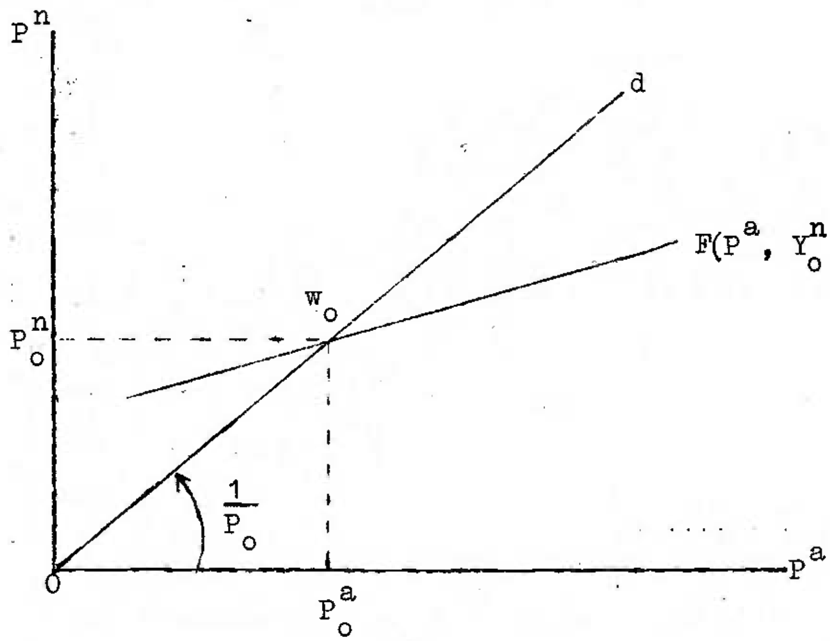

FIGURE 3

The equilibrium value of the rate of interest can be obtained by making use of equations (4.30), (4.31) and (4.33), or equivalently, of the equation (4.34). Equilibrium values of other variables may be obtained similarly with the help of other equations in the model.

To summarise the results demonstrated so far, given the values of the exogenous variables the equilibrium situation of our economy is characterised by those values of the variables — Y^n, P, P^n, P^a, and r — which satisfy the set of equations (4.27)-(4.32) or equivalently, the set of equations (4.42), (4.43), (4.29), (4.32) and (4.34). With a few suitable assumptions, a graphical exposition of the determination of the variables — Y^n, P, P^n, P^a — is also shown in Figures 2 and 3.

We now proceed to derive some comparative static results — results which indicate the way in which the equilibrium values of the endogenous variables will change in response to specified shifts in the exogenous variables. This is discussed in the next section.

4.5 Comparative Static Analysis

We shall consider specified changes in the following exogenous variables — Q^n, Q^a, Y^a and M — and their impact on the equilibrium values of the endogenous variables — Y^n, P, P^n, P^a and r.

First of all, let us take total differentials of the relations (4.42) and (4.43).

$$\begin{aligned} dY^n &= D^n_{y_n}\, dY^n + D^n_p\, dP + D^n_{q_n}\, dQ^n + D^n_{y_a}\, dY^a + D^n_m\, dM \\ dY^a &= D^a_{y_n}\, dY^n + D^a_p\, dP + D^a_{q_a}\, dQ^a + D^a_{y_a}\, dY^a \end{aligned} \tag{4.48}$$

Since $D^n_{q_n} = 1$ and $D^a_{q_a} = 1$ by (4.40) and (4.37), we get from the above two equations :

$$\begin{aligned} (1 - D^n_{y_n})\, dY^n - D^n_p\, dP &= dQ^n + D^n_{y_a}\, dY^a + D^n_m\, dM \\ \frac{D^a_{y_n}}{D^a_p}\, dY^n + dP &= \frac{1}{(-D^a_p)}\, dQ^a + \frac{1 - D^a_{y_a}}{D^a_p}\, dY^a \end{aligned} \tag{4.49}$$

Let us now consider the following determinant :

$$(4.50) \qquad J = \begin{vmatrix} 1 - D^n_{y_n} & - D^n_p \\ \dfrac{D^a_{y_n}}{D^a_p} & 1 \end{vmatrix}$$

$$= 1 - D^n_{y_n} + D^n_p \frac{D^a_{y_n}}{D^a_p}$$

$$= 1 - \left[D^n_{y_n} + D^n_p \frac{D^a_{y_n}}{(-D^a_p)} \right]$$

We shall assume that the above determinant is positive. This assumption has indeed an interesting economic interpretation. A rise in the non-agricultural income has two kinds of effects on the aggregate demand for non-agricultural good — one may be called the income effect and the other, the price effect. A one unit rise in Y^n changes the aggregate demand directly by $D^n_{y_n}$; (of course, $D^n_{y_n}$ incorporates the effect on the demand brought about by the change in r which is induced by the given change in Y^n; see the relevant expression in (4.40)). This may be called the income effect. However, a rise in Y^n creates a disturbance in the agricultural market by raising the aggregate demand for the agricultural good by $D^a_{y_n}$. Consequently, the relative price of agricultural good rises by $D^a_{y_n} / (-D^a_p)$. This rise in P reacts back on the non-agricultural market by changing its aggregate demand by[30/] $(D^n_p \; D^a_{y_n})/(-D^a_p)$. This may be called the price effect, or the effect which works through the change in the relative price of agricultural good. We assume that the sum total of these two effects is less than unity. In other words, the ultimate rise in the aggregate demand for non-agricultural good consequent upon a rise in income in this sector should be less than the latter :

$$\text{(A6)} \qquad J = 1 - \left[D^n_{y_n} + D^n_p \frac{D^a_{y_n}}{(-D^a_p)} \right] > 0$$

We also list below our assumptions and signs of a few partial derivatives which will be needed to derive our comparative static results :

$$\text{(A1)} \qquad D^a_p < 0$$

$$\text{(A2)} \qquad D^a_{y_a} < 1$$

$$\text{(A3)} \qquad D^n_{y_n} < 1$$

$$\text{(A4)} \qquad D^n_p < 0$$

$$\text{(A5)} \qquad D^n_{y_a} > 0$$

and

$$\text{(4.38)} \qquad D^a_{y_n} = C^a_y + X^{an}_{y_n} > 0$$

$$\text{(4.41)} \qquad D^n_m = (I^n_r . R_m) > 0$$

30/ Of course, D^n_p incorporates the effects which work via the change in r brought about by the given change in P; see the expression for D^n_p in (4.40).

One point remains to be mentioned regarding (A6). It is easily seen that if (A1), (A3) and (A4) are satisfied, then (A6) is automatically satisfied. In fact, (A6) can be written as

$$1 - D^{n}_{y_n} > D^{n}_{p} \frac{D^{a}_{y_n}}{(-D^{a}_{p})}$$

With (A1) and (A3), the above can be rewritten as

$$\text{(A6a)} \qquad \frac{(-D^{a}_{p})}{D^{a}_{y_n}} > \frac{D^{n}_{p}}{1 - D^{n}_{y_n}}$$

From (4.45) and (4.47), it is seen that the left hand side of the relation (A6a) gives the slope of the aa-curve (referred to the P-axis) while the right hand side gives the slope of the nn-curve (referred to the P-axis). The relation (A6a) requires the aa-curve to have a slope algebraically greater than that of the nn-curve[31].

31/ The assumption (A6) is thus compatible with the case $D^{n}_{p} > 0$, i.e., the case when the nn-curve has also a positive slope. The assumption (A6) then requires the aa-curve to be steeper than the nn-curve (both being referred to the P-axis).

A Change in Q^n

Let us first consider specified change in Q^n only. In this case, we can solve for $\frac{dY^n}{dQ^n}$ and $\frac{dP}{dQ^n}$ from (4.49) by Cramer's rule.

$$(4.51)\quad \frac{dY^n}{dQ^n} = \frac{1}{J}\begin{vmatrix} 1 & -D^n_p \\ 0 & 1 \end{vmatrix} = \frac{1}{J}$$

$$\frac{dP}{dQ^n} = \frac{1}{J}\begin{vmatrix} 1 - D^n_{y_n} & 1 \\ \frac{D^a_{y_n}}{D^a_p} & 0 \end{vmatrix} = \frac{1}{J}\cdot\frac{D^a_{y_n}}{(-D^a_p)}$$

where J is defined by (4.50). It is easily seen that if our assumption (A6) is satisfied then dY^n/dQ^n is positive. If, however, (A6) and (A1) are satisfied, than dP/dQ^n is also positive.

To find the effects on the absolute prices, we first write (4.29) and (4.32)

$$(4.29)\quad P^n = F(P^a, Y^n)$$

$$(4.32)\quad P^a = PP^n$$

Taking total differentials of the relations (4.29) and (4.32), we get

$$(4.52)\quad dP^n = F_{P_a}\, dP^a + F_{y_n}\, dY^n$$

$$(4.53)\quad dP^a = P\, dP^n + P^n\, dP$$

From (4.52) and (4.53) we get, after simplification :

$$(4.54) \quad dP^n = \frac{F_{y_n}}{1 - PF_{p_a}} dY^n + \frac{P^n F_{p_a}}{1 - PF_{p_a}} dP$$

Since $\frac{dY^n}{dQ^n}$ and $\frac{dP}{dQ^n}$ are both positive, and F_{y_n}, F_{p_a} and $1-PF_{p_a}$ are also positive by (4.29), it is easily seen that $\frac{dP^n}{dQ^n}$ and $\frac{dP^a}{dQ^n}$ are also both positive. Finally, from (4.34) we get

$$(4.55) \quad \frac{dr}{dQ^n} = R_{y_n} \frac{dY^n}{dQ^n} + R_p \frac{dP}{dQ^n}$$

which is also seen to be positive, since R_{y_n} and R_p are both positive by (4.35).

The above results can be obtained by making use of our diagrams developed earlier. As (4.45) shows, $\phi^n_{q_n} > 0$ so that an increase in Q^n shifts the nn-curve to the right say, to n_1n_1 (Figure 4). The new equilibrium point is e_1 where relative price rises from P_o to P_1 and non-agricultural income, from Y^n_o to Y^n_1. The change in absolute prices can also

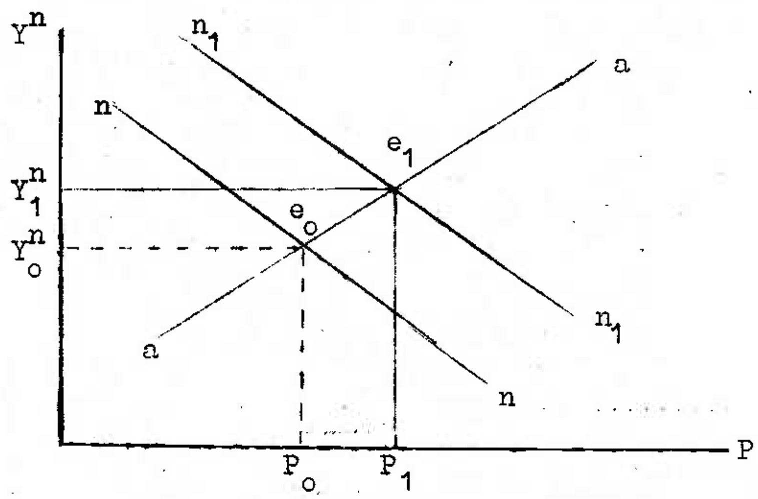

FIGURE 4

be shown on a Figure 3-type diagram. Since Y^n increases to Y_1^n, the F-curve shifts upwards (Figure 5). Further, since relative price has increased to P_1, the ray through the origin (with its slope equal to the reciprocal of relative price) shifts downwards to, say, od_1. Therefore, unambigously two

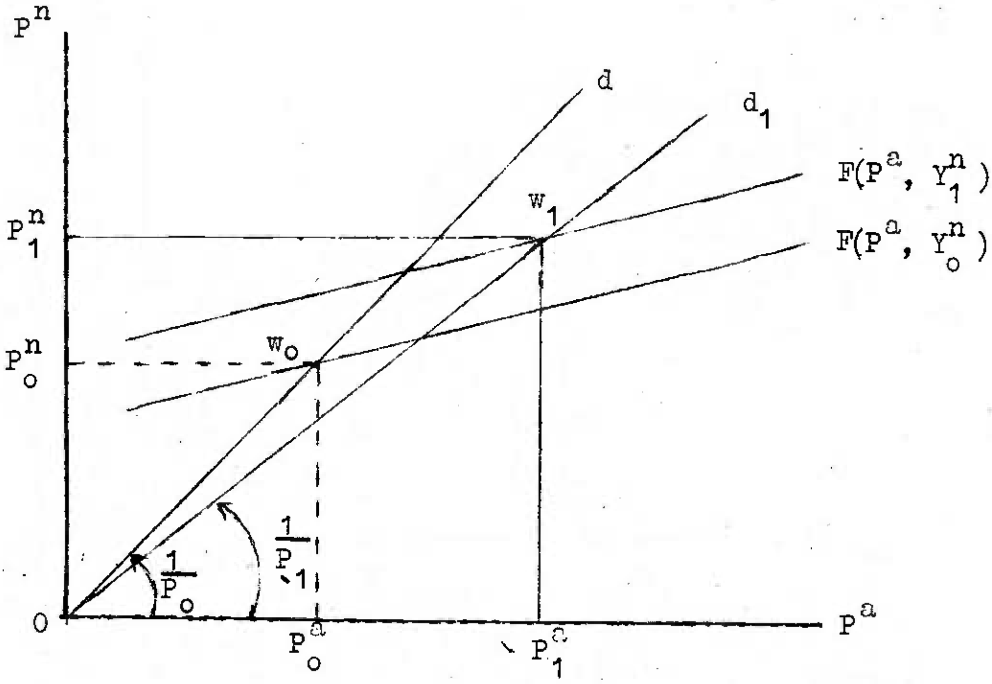

FIGURE 5

absolute prices increase to P_1^a and P_1^n. Finally, it is easily seen that since non-agricultural income and both the absolute prices increase, aggregate money income increases and hence the rate of interest also increases. Thus we have the following result :

PROPOSITION 1 : Under the assumptions (A1) and (A6), a rise (fall) in the autonomous demand for non-agricultural good, Q^n, raises (reduces) Y^n, P, P^n, P^a and r.

A Change in M

Let us now consider a specified change in the base money, M, only. From(4.49) we get

$$\frac{dY^n}{dM} = \frac{1}{J}\begin{vmatrix} D^n_m & -D^n_p \\ 0 & 1 \end{vmatrix} = \frac{D^n_m}{J}$$

(4.56)

$$\frac{dP}{dM} = \frac{1}{J}\begin{vmatrix} 1 - D^n_{y_n} & D^n_m \\ \frac{D^a_{y_n}}{D^a_p} & 0 \end{vmatrix} = \frac{D^n_m}{J} \cdot \frac{D^a_{y_n}}{(-D^a_p)}$$

where J is defined by (4.50).

Since $D^a_{y_n}$ and D^n_m are both positive by (4.38) and (4.41), the assumptions (A1) and (A6) imply that $\frac{dY^n}{dM}$ and $\frac{dP}{dM}$ are both positive. From (4.53) and (4.54), it is easily verified that $\frac{dP^n}{dM}$ and $\frac{dP^a}{dM}$ are also both positive. Finally, from (4.34) we get,

$$(4.57)\quad \frac{dr}{dM} = R_{y_n}\frac{dY^n}{dM} + R_p\frac{dP}{dM} + R_m$$

However, R_{y_n} and R_p are positive by (4.35) while R_m is negative. Therefore, the effect on the rate of interest is ambiguous. $\frac{dr}{dM}$ will be negative, if the last term dominates the first two terms.

The present case can also be shown graphically, exactly in the same way as in the previous case. Since, $D^n_m > 0$, the nn-curve will shift to the right (see Figure 4) and Y^n and P will increase. From Figure 5 it is then seen that P^a and P^n will also increase. We can now state

PROPOSITION 2 : Under the assumptions (A1) and (A6), a rise (fall) in the base money, M, raises (reduces) Y^n, P, P^n and P^a. The effect on the rate of interest is, however, ambiguous.

A Change in Q^a

We now consider a specified change in the autonomous demand for agricultural good, Q^a. From (4.49) we obtain

$$\frac{dY^n}{dQ^a} = \frac{1}{J} \begin{vmatrix} 0 & -D^n_p \\ \frac{1}{(-D^a_p)} & 1 \end{vmatrix} = \frac{1}{J} \cdot \frac{D^n_p}{-D^a_p}$$

(4.58)

$$\frac{dP}{dQ^a} = \frac{1}{J} \begin{vmatrix} 1 - D^n_{y_n} & 0 \\ \frac{D^a_{y_n}}{D^a_p} & \frac{1}{(-D^a_p)} \end{vmatrix} = \frac{1}{J} \cdot \frac{1 - D^n_{y_n}}{(-D^a_p)}$$

where J is defined by the expression (4.50). With assumptions (A1), (A3) and (A6) $\frac{dP}{dQ^a}$ is positive, while $\frac{dY^n}{dQ^a}$ will be negative if (A1),(A4) and

(A6) are satisfied. From (4.53) and (4.54) we obtain

$$\frac{dP^n}{dQ^a} = \frac{F_{y_n}}{1 - PF_{p_a}} \frac{dY^n}{dQ^a} + \frac{P^n F_{p_a}}{1 - PF_{p_a}} \frac{dP}{dQ^a}$$

(4.59)

$$\frac{dP^a}{dQ^a} = P \frac{dP^n}{dQ^a} + P^n \frac{dP}{dQ^a}$$

Since, $\frac{dY^n}{dQ^a} < 0$ and $\frac{dP}{dQ^a} > 0$, the effects on the two absolute prices are ambiguous. One result is, however, obvious, namely that whenever $\frac{dP^n}{dQ^a}$ is positive, $\frac{dP^a}{dQ^a}$ has got to be positive.

The above results can be shown graphically also. Since $\phi^a_{q_a} > 0$ by (4.47), an increase in Q^a shifts the aa curve to the right to say, a_1a_1 (Figure 6). As a result, P increases to P_1 while Y^n falls to Y^n_1.

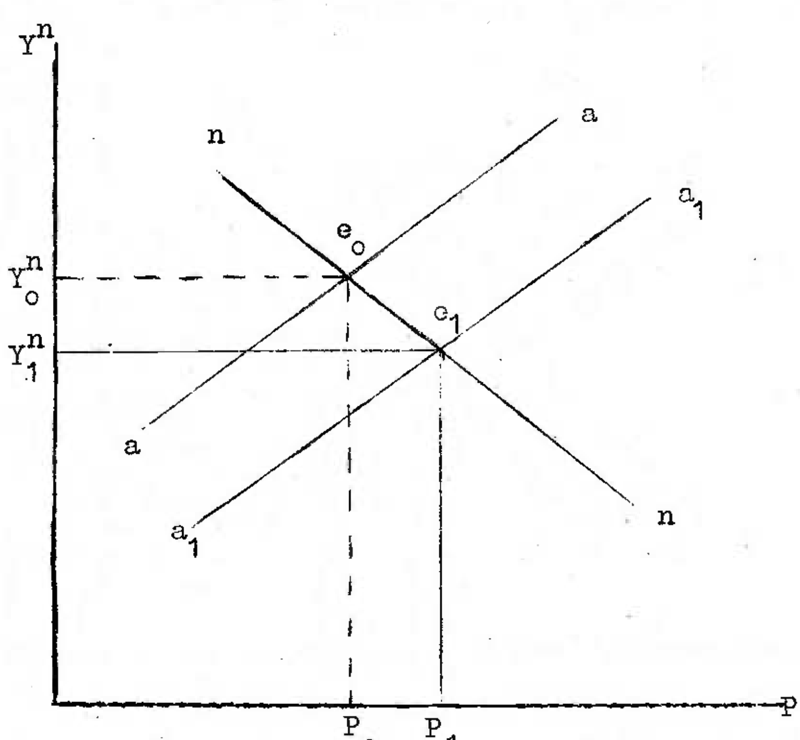

FIGURE 6

The effects on the absolute prices are, however, ambiguous. Since Y^n falls, the F-curve shifts downwards (Figure 7). However, as P also increases to P_1, the od curve also shifts downwards to say, od_1. Therefore, whether

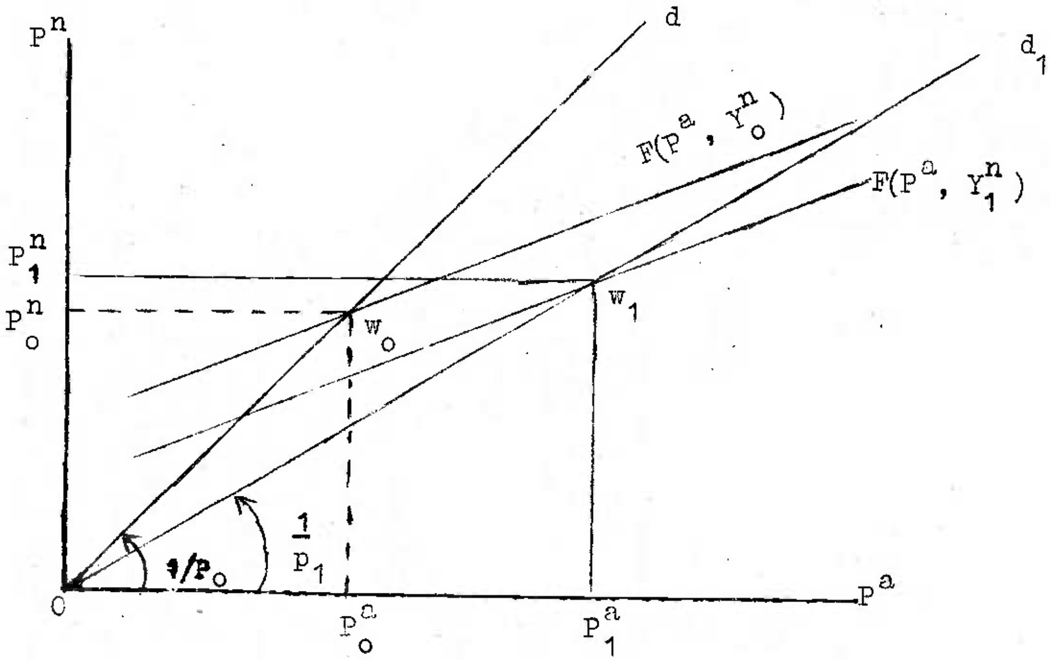

FIGURE 7

P^a and P^n will rise or fall will depend on the relative shifts of the two lines. If the shifts of the two lines are such that they intersect at a point to the left of the vertical line $P^a_o \; w_o$, then both absolute prices will fall. If, however, the new intersection point w_1 is above the horizontal line $P^n_o w_o$ (extended), then both absolute prices will rise. This case is shown in Figure 7. There may be a third situation : P^n falls, but P^a rises. This occurs when the new intersection point w_1 is both below the horizontal line $P^n_o w_o$ and to the right of the vertical line $P^a_o w_o$.

Finally, from (4.34) we get

$$(4.60)\quad \frac{dr}{dQ^a} = R_{y_n}\frac{dY^n}{dQ^a} + R_p\frac{dP}{dQ^a}$$

so that the effect on the rate of interest is also ambiguous. Thus we have

PROPOSITION 3 : Under the assumptions (A1), (A3) and (A4)[32], a rise(fall) in the autonomous demand for the agricultural good, Q^a, reduces (increases) Y^n, but increases (reduces) P. The effects on the two absolute prices and the rate of interest are, however, ambiguous.

A Change in Y^a

Let us now consider a specified change in the agricultural income, Y^a, only. From (4.49) we get, therefore,

$$\frac{dY^n}{dY^a} = \frac{1}{J}\begin{vmatrix} D^n_{y_a} & -D^n_p \\ \dfrac{1-D^a_{y_a}}{D^a_p} & 1 \end{vmatrix}$$

$$(4.61)\qquad = \frac{1}{J}\left[D^n_{y_a} + D^n_p\,\frac{1-D^a_{y_a}}{D^a_p} \right]$$

$$\frac{dP}{dY^a} = \frac{1}{J}\begin{vmatrix} 1-D^n_{y_n} & D^n_{y_a} \\ \dfrac{D^a_{y_n}}{D^a_p} & \dfrac{1-D^a_{y_a}}{D^a_p} \end{vmatrix}$$

$$= \frac{1}{J}\left[\frac{(1-D^n_{y_n})(1-D^a_{y_a}) - D^a_{y_n}D^n_{y_a}}{D^a_p} \right]$$

32/ As we have already indicated on page 95, (A6) is automatically satisfied in this case.

where J is defined by the expression (4.50). The signs of the above two expressions are seen to be ambiguous. However, if (A1), (A2), (A4), (A5) and (A6) are satisfied, $\frac{dY^n}{dY^a}$ is positive. Similarly, with (A1) and (A6), $\frac{dP}{dY^a}$ will be <u>negative</u>, <u>zero</u>, or <u>positive</u> according as

$$(4.62) \qquad (1 - D^n_{y_n})(1 - D^a_{y_a}) \gtreqless D^a_{y_n} D^n_{y_a}$$

Let us present this case graphically. From (4.45) we see that $\phi^n_{y_a}$ is positive. Therefore, a rise in Y^a shifts the nn-curve upwards to, say, n_1n_1 (Figure 8). From (4.47) we see that $\phi^a_{y_a} \gtrless 0$ so that a rise in Y^a

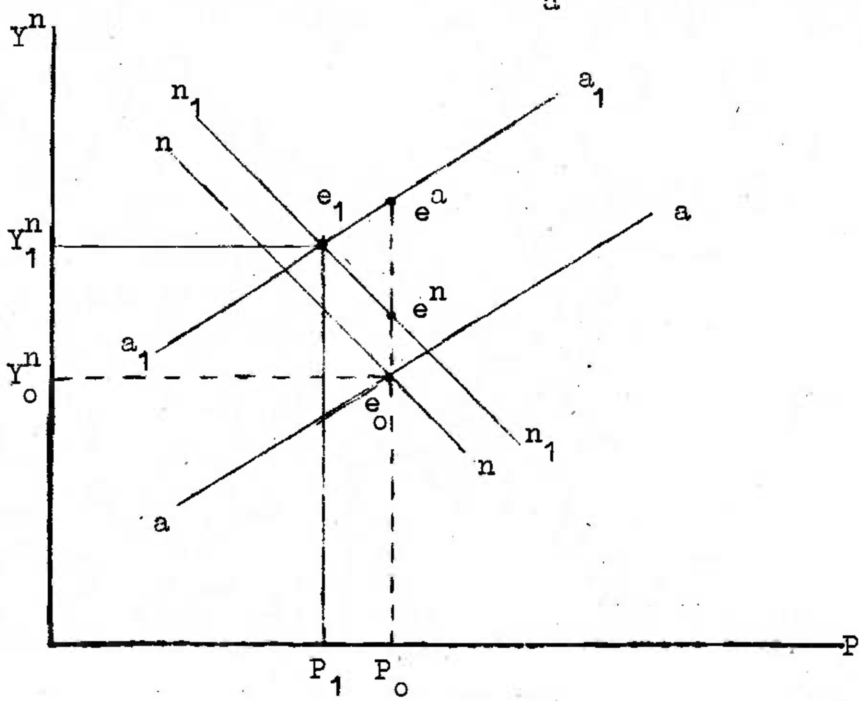

FIGURE 8.

shifts the aa-curve upwards to, say, a_1a_1. One result is obvious. The non-agricultural income will rise. However, whether the relative price of agricultural good will fall or not will depend upon the relative shifts of the two curves. The shift in the aa curve at the old relative price (P_o) is $e_o e^a$ which is given by[33/] $(1 - D^a_{y_a})/D^a_{y_n}$. The shift in the nn curve at the same relative price is $e_o e^n$ which is seen from (4.45) to be equal to $D^n_{y_a}/(1-D^n_{y_n})$. From Figure 8 it is obvious that the relative price of agricultural good will fall, remain unchanged, or rise, according as

$$e_o e^a \gtreqless e_o e^n$$

i.e.,

$$\frac{1 - D^a_{y_a}}{D^a_{y_n}} \gtreqless \frac{D^n_{y_a}}{1 - D^n_{y_n}}$$

i.e.,

$$(1 - D^n_{y_n})(1 - D^a_{y_a}) \gtreqless D^a_{y_n} D^n_{y_a}$$

which is the same as the condition (4.62).

In the present case, the effects on the two absolute prices and the rate of interest are ambiguous. We have from (4.54), (4.53) and (4.34).

$$(4.63) \quad \frac{dP^n}{dY^a} = \frac{F_{y_n}}{1 - PF_{p_a}} \frac{dY^n}{dY^a} + \frac{P^n F_{p_a}}{1 - PF_{p_a}} \frac{dP}{dY^a}$$

33/ Since relative price remains unchanged, we have from (4.46)

$$0 = \phi^a_{y_n} dY^n + \phi^a_{y_a} dY^a$$

and hence

$$\left(\frac{dY^n}{dY^a}\right)_{P\ \text{const.}} = -\frac{\phi^a_{y_a}}{\phi^a_{y_n}} = \frac{1 - D^a_{y_a}}{D^a_{y_n}} \qquad [\text{by } (4.47)]$$

$$(4.64) \quad \frac{dP^a}{dY^a} = P \frac{dP^n}{dY^a} + P^n \frac{dP}{dY^a}$$

$$(4.65) \quad \frac{dr}{dY^a} = R_{y_n} \frac{dY^n}{dY^a} + R_p \frac{dP}{dY^a} + R_{y_a}$$

One result is, however, obvious. Given that $\frac{dY^n}{dY^a}$ is positive, $\frac{dP^n}{dY^a}$ will be negative <u>only if</u> $\frac{dP}{dY^a}$ is negative and thus whenever $\frac{dP^n}{dY^a}$ is negative, $\frac{dP^a}{dY^a}$ is also negative. This is easily verified by (4.63) and (4.64). We can, therefore, state

PROPOSITION 4 : Under the assumptions (A1), (A2), (A4)-(A.6), a rise (fall) in agricultural income, Y^a, raises (reduces) Y^n. A rise (fall) in Y^a reduces (increases) P if we have also

$$(4.66) \quad (1 - D^n_{y_n})\ (1 - D^a_{y_a}) > D^a_{y_n}\ D^n_{y_a}$$

The effects on P^n, P^a and r are, however, ambiguous.

4.6 Summary and Conclusion

As we have argued in the preceding chapters macroeconomic theory developed within a broadly Keynesian (income-expenditure) one-sector framework can not be applicable to the case of an underdeveloped economy like India. To recapitualate, first, the entire part of such an economy can not be said to be governed by a single 'law'. On the one hand, the mechanisms determining prices in different sectors are supposed to be different, as we have seen in the first two chapters. On the other hand, the behaviour of production is also dissimilar in different sectors. While non-agricultural sector may be supposed to operate under excess capacities so that production can respond to demand in this sector, the same is unlikely to be true of the agricultural sector which usually accounts for a major part of domestic product in such an economy. Secondly, the standard macroeconomic models pay only a scanty attention to the role of prices in the economy. Particularly, the interactions between prices and incomes in different sectors are not rigorously examined. However, prices are likely to play a great role in affecting demands and productions in different sectors of an underdeveloped economy.

The theoretical model proposed in this chapter seeks to take account of the above points and considers a two-sector breakdown of the economy, viz., agriculture and non-agriculture. In this sense, it can be viewed as a two-sector extension of the Keynesian model to the case of an underdeveloped economy. A tacit hypothesis is made about the working mechanism of the economy, namely that it is the relative price of agricultural good, and not its production, which adjusts to the condition of excess demand (or supply) in this sector while production in the non-agricultural sector responds to demand in that sector. The model also allows for the determination of absolute prices of the products of the two sectors and the rate of interest, by integrating monetary factors into the working of an overall system.

Next, all the relations of the model are shown to be reducible to two simultaneous equations involving only two key variables — non-agricultural (real) income and relative price of agricultural good. With a few reasonable assumptions, a simple graphical exposition of the determination of these two variables as well as of two absolute prices has been presented in Section 4.4.

Section 4.5 on comparative statics then aims at finding out how the various endogenous variables will change in response to a specified change in some exogenous variable. Such an analysis makes it possible to identify some of the factors which may be held responsible for generating upward pressures on prices in the economy. Let us now summarise the various comparative static results.

An increase in the demand for non-agricultural good brought about either by an increase in its autonomous demand, or by an increase in the base money, raises both the non-agricultural income and the relative price of agricultural good. The absolute prices of two goods also rise.

To talk about the effect of these variables on non-agricultural income (Y^n), let us consider, as an illustration, an increase in the autonomous demand for non-agricultural good (Q^n). We have seen in (4.51) that

$$\frac{dY^n}{dQ^n} = \frac{1}{J} = \frac{1}{1 - D^n_{y_n} + D^n_p \dfrac{D^a_{y_n}}{D^a_p}} \qquad \text{[by (4.50)]}$$

Usually, in a one-sector Keynesian model the value of the multiplier can be shown to be $1/(1 - D^{n}_{y_n})$ which is further <u>greater</u> than unity. In the present case, however, the value of the multiplier has an additional term in the denominator $(D^{n}_{p} D^{a}_{y_n})/D^{a}_{p}$, which clearly brings out the role of prices in the determination of income. In fact, with $D^{n}_{p} < 0$, $D^{a}_{y_n} > 0$ and $D^{a}_{p} < 0$, not only the value of the multiplier would be lower than what one gets in a typically one-sector model, but it might even be <u>less</u> than unity. This then brings out the differences of results in the two types of models.

Again, an increase in the autonomous demand for the agricultural good tends to raise its relative price and, because of the importance of the impact of prices on demands, may even <u>reduce</u> non-agricultural income. This is stated in Proposition 3.

The mechanism by which a fall in agricultural (real) income affects the economy is a little bit complicated. The likely situation is that it will reduce the demand for non-agricultural good and hence the non-agricultural income. The relative price of agricultural good will also rise under an additional assumption. This is spelt out in Proposition 4.

PART II

A Few Additional Notations

This part is devoted to a discussion of various empirical results of the study. Each equation has been estimated by the single equation OLS method. Below each estimated coefficient its t-ratio has been presented in brackets. The coefficient of determination (uncorrected) is denoted by R^2 while that corrected for degrees of freedom is denoted by $\bar{R}^2$; d stands for the Durbin-Watson statistic. The size of the sample is 16 (covering observations for the years from 1950-51 to 1965-66) for each equation except that for investment functions for which it is 15.

Various notations used in the present study have already been described in Part I (pp.14-15). A few additional notations which are used in the empirical model are explained below :

- t : time trend with the year 1950-51 as 1;
- GS : stock of government securities held by the public and other banks except the Reserve Bank of India (in crores of rupees);
- r^l : long-term rate of interest;
- r^s : short-term rate of interest.

A subscript '-1' to a variable denotes its one-year lagged value.

Chapter 5

CONSUMPTION FUNCTIONS FOR AGRICULTURAL AND NON-AGRICULTURAL GOODS

5.1 Introduction : A Problem of Data

The theoretical model as outlined in the previous chapter considers private consumption functions for two goods — agriculture and non-agriculture — separately. We, therefore, need figures of private consumptions of these two goods. The question is how to get these figures.

The problem does not arise in the case of aggregate private consumption of all goods taken together. For, the usual procedure is to estimate this figure from the national income identity, i.e., to estimate it as a residual item after subtracting from national income all other kinds of final demand, namely exports (net of imports), government consumption and investment and private investment. When this procedure is applied to estimate figures of consumption of two or more goods separately, one immediately faces a problem. For, now figures of incomes originating in different sectors would not be sufficient. Rather, figures of outputs of different sectors are needed and time series data on outputs of different sectors are not available. In fact, official national income publication, say, Govt. of India (1971), furnish incomes (i.e., value added) in different sectors and not their outputs.

Let us now see how we can estimate figures of outputs of different sectors. As we have noted in Section 4.2 of previous chapter, there is a relation between income and output in the agricultural sector, as follows :

$$(5.1) \qquad X^a = Y^a + \frac{1}{P} X^{na}$$

where X^a and Y^a are respectively output (net of its own input use) and income in agriculture at constant prices, X^{na} is the amount of non-agricultural good used as intermediate input in agriculture and P is the relative price of agricultural good in terms of non-agriculture i. e., $\frac{P^a}{P^n}$ where P^i is the price of the good of sector i. We now assume that the amount of non-agricultural input used in agriculture is proportional to the agricultural output :

$$(AI) \qquad X^{na} = \beta' X^a$$

where β' is the amount of non-agricultural input needed to produce one unit of agricultural output. From (5.1) we have

$$(5.2) \qquad X^a = \frac{1}{1 - \frac{\beta'}{P}} Y^a$$

and hence

$$(5.3) \qquad X^{na} = \beta Y^a$$

where β is the amount of non-agricultural input needed to generate one unit of agricultural income :

$$(5.4) \qquad \beta = \frac{\beta'}{1 - \frac{\beta'}{P}}$$

If we now know β or, for that matter β', then the time series data on Y^a and P will help us to obtain estimate of X^{na} and hence of X^a.

In order to have some idea about β or β', we may make use of the several input-output tables which have been constructed for the Indian economy for a number of years, (e.g., ISI, 1961; Manne and Rudra, 1965; Saluja, 1968). These tables consider only a part of the non-agricultural sector, i.e., that part which produces material goods. Therefore, the intersectoral flows of intermediate inputs which we shall use in our work will be confined to those sectors only which are covered in these tables.1/

To estimate β' we shall make use of two tables — ISI (1961) and Saluja (1968). The former gives flows for the year 1955-56 and the latter, for the year 1964-65. From these tables the value of β' is estimated to be 0.022 for the year 1955-56 and 0.029 for the year 1964-65. Although, strictly speaking, these two tables are not comparable, yet this rising trend in β' is what is to be expected in a developing economy.2/

Notwithstanding the plausibility of a rising trend in β' we take an average of the above two figures (i.e., 0.026) and assume β' to remain at this level throughout the whole period from 1950-51 to 1965-66. In fact, X^{na} in either 1955-56 or 1964-65 is very small relative to

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1/ This means that we are implicity assuming that if there are any intersectoral flows between agriculture and services, i.e., from agriculture to services and from services to agriculture, then they cancel out.

2/ This rising trend in β' seems to be indicated in official publications. Identifying some of the inputs into agriculture (namely, chemical fertilisers, electricity, pesticides and insecticides and diesel oil) as non-agricultural goods we have calculated such a coefficient for two years - 1960-61 and 1969-70 — from two sources, Govt. of India (1967, 1972). The coefficient is seen to be 0.011 and 0.038 in two years, respectively.

X^a or Y^a. So it will not be a serious mistake if we assume β' to be at a constant level throughout this period. One final observation is to be added. The value of β, as calculated from (5.4) with the help of observations on P and the above value of β', is found to be constant at 0.027 for all the years, the reason again being the small value of β'. This observation simplifies our task as we can now hold that X^{na} bears a proportional relation not only to X^a, but also to Y^a :

$$(5.5) \qquad X^{na} = \beta Y^a$$

where β is estimated to be 0.027. We have made such an assumption in our theoretical model in the previous chapter and we shall use it also in our empirical results.

Apart from X^{na} another important item in the interindustry transaction is X^{an}, the amount of agricultural good used as intermediate inputs in non-agriculture. We have seen in Section 4.2 of the preceding chapter that the relation between value added and output in the non-agricultural sector is given by

$$(5.6) \qquad X^n = Y^n + PX^{an}$$

where X^n and Y^n are, respectively, output (net of its own input use) and income in the non-agricultural sector at constant prices. Now, as in the case of X^{na}, here also we could have assumed that the amount of agricultural input needed per unit of non-agricultural output is a constant, say α^n :

$$(5.7) \qquad X^{an} = \alpha^n X^n$$

But problem is that such an α^n is not observable. For, X^n includes services also which are excluded in the various input-output tables referred to above. One possible suggestion could have been to assume that the amount of agricultural inputs needed to produce one unit of output of the manufacturing sector is a constant, say α^m. Then

$$(5.8)' \quad X^{am} = \alpha^m X^m$$

where X^m is the output (net of its own input use) of the manufacturing sector and X^{am}, the amount of agricultural inputs used in that sector.

However, this only postpones the problem. For, now time series data on X^m are needed which, in turn, need figures of flows of inputs from services to manufacturing (X^{sm}). This is so, because X^m bears the following relation to income (at constant prices) in manufacturing (Y^m) :

$$(5.9) \quad X^m = Y^m + \frac{P^a}{P^m} X^{am} + \frac{P^s}{P^m} X^{sm}$$

where P^m and P^s are prices of goods of manufacturing and service sectors, respectively. Thus, given the observations on Y^m, a knowledge of X^m and X^{am} requires prior information about X^{sm}, the kind of transactions not included in the input-output tables.

In view of the above difficulties we shall try to estimate X^{an} in a different manner. We first estimate X^{an} for a single year, namely for the year 1964-65, from the table of Saluja (1968). The figure is Rs.2084 crores (at 1960-61 prices). To get figures of X^{an} for other years during the period under study we make the following assumption :

(AII) The amount of agricultural good used as intermediate inputs in non-agriculture is proportional to the output of the agro-based industries[3/].

Given now the value of X^{an} in 1964-65, its values for other years are easily obtained from the series of index of production of agro-based industries. This is discussed in Appendix B.

We can now estimate the private consumption of agricultural and non-agricultural goods (denoted respectively by C^a and C^n). As we have indicated earlier, consumption of a particular good will be estimated as a residual, after subtracting from its output all other kinds of demand like exports (net of imports), investment and/or inventory change, government consumption and investment, intermediate demands etc. Now we have seen from (5.1) and (5.6) that output of any sector can be calculated from income of this sector. However, official income figure is given at factor cost. Therefore, we have to add indirect taxes less subsidies in each sector to its output at factor cost. In this way, we have estimated C^a and C^n. The estimation procedure is described in detail in Appendix B.

3/ The assumption seems to be a reasonable one, as is verified by our calculation of the coefficient, the amount of agricultural inputs needed per unit of output of agro-based industries, from the ASI figures as given in Govt. of India (1964b, 1965, 1966). We have considered four important agro-based industry groups — (a) grainmill products, (b) miscellaneous food preparations, (c) tobacco manufactures, and (d) textiles - groups which together have contributed to 40 per cent of total value of industrial output in the factory sector in 1966. From ASI data we have calculated the total use of agro-based materials in, and total value of output of, these industries (at 1960-61 prices) in three years 1964, 1965 and 1966-67, and then calculated per unit use. The coefficient is found to be stable at 0.40 for each of these three years.

5.2 Empirical Results

The theoretical model developed in the preceding chapter considers two explanatory variables for both of the consumption functions — aggregate (real) income of the two sectors (Y) and relative price of agricultural good (P). Corresponding to this formulation we obtain the following estimated equations :

$$(5.10) \quad C^{a} = \underset{(3.694)}{5926.216} + \underset{(6.704)}{0.186\,Y} - \underset{(-2.072)}{3423.28\,P}$$

$$\bar{R}^2 = 0.74, \quad d = 1.98$$

$$(5.11) \quad C^{n} = -\underset{(-1.109)}{1493.774} + \underset{(25.534)}{0.594\,Y} + \underset{(0.237)}{329.17\,P}$$

$$\bar{R}^2 = 0.98, \quad d = 2.26$$

We see that Y has significant coefficients in both of the C^a and C^n functions, that the coefficient of P is negative and has a t-ratio greater than 2 in the C^a function while its coefficient in the C^n function is not at all significant, that $\bar{R}^2$ is very high for the C^n function and is fairly high for the C^a function and that the Durbin-Watson statistic (d) shows the absence of any significant auto-correlation in either of the equations; (see relevant tables in Johnston (1972))[4/].

4/ The log-linear regressions of C^a and C^n on Y and P yield almost identical results as their linear counterparts, in terms of $\bar{R}^2$ and t-ratios for the various coefficients. In the two equations for C^a and C^n, the coefficients of Y are, respectively, 0.48 and 1.21 while those of P are -0.67 and 0.03 (not significant), respectively.

We next examine whether the fit of the equations (5.10)-(5.11) could be improved by bringing in other explanatory variables. We consider time trend (t) or population for this purpose and both yield, more or less, similar results, presumably because of the fact that population is highly correlated with time. We present below the equations corresponding to the time trend :

$$(5.12)\quad C^a = \underset{(3.621)}{5360.069} + \underset{(3.174)}{0.477\,Y} - \underset{(-2.982)}{5253.78\,P} - \underset{(-1.966)}{136.668\,t}$$

$$\bar{R}^2 = 0.79, \qquad d = 0.98$$

$$(5.13)\quad C^n = -\underset{(-0.852)}{714.165} + \underset{(2.263)}{0.193\,Y} + \underset{(2.856)}{2849.85\,P} + \underset{(4.780)}{188.198\,t}$$

$$\bar{R}^2 = 0.99, \qquad d = 1.67$$

Despite the fact that $\bar{R}^2$ has increased (marginally, of course) in each equation, the estimated equations (5.12)-(5.13) suffer from certain unsatisfactory features. First, time has a negative coefficient in C^a and a positive coefficient in C^n. One may try to rationalise such a result by arguing that over time the consumption pattern may be shifting in favour of the non-agricultural good, presumably owing to factors like urbanisation, changing income distribution in favour of the upper income groups etc. However, in view of the fact that over time population is increasing, it is difficult to accept that the total consumption of agricultural good falls over time[5/]. Secondly, the coefficient of Y in C^a

5/ As indicated earlier, replacing t by population in (5.12)-(5.13), yields a negative coefficient for it in (5.12) and a positive coefficient in (5.13).

is high and that in C^n is very low. The corresponding elasticity estimates (at sample means of the variables) are, respectively, 1.24 and 0.39. Such a low income elasticity of C^n is implausible, and also that of C^a seems to be unreasonably high. Thirdly, the d-statistic in C^a is also very low. On all those grounds, we reject the equations (5.12)-(5.13).

When attempts are made to separate out the effects of agricultural and non-agricultural incomes on the two consumption functions, we fail to get economically meaningful results. Thus the linear regressions of C^a and C^n on three explanatory variables — agricultural (real) income (Y^a), non-agricultural (real) income (Y^n) and P — yield a <u>negative</u> coefficient for Y^n in the C^a function. Further, the coefficient of Y^a in the C^a and C^n functions becomes, respectively, 0.80 and 0.34, implying that the aggregate marginal propensity to consume of the recipients of agricultural income is greater than unity. Such results are difficult to accept on economic grounds.

We thus see that different modifications of the relations (5.10)-(5.11) attempted (e.g., separating out the total income into agricultural and non-agricultural income, bringing in time or population as a third explanatory variable etc.) do not yield economically meaningful results, and hence are to be rejected in favour of the simple formulation (5.10)-(5.11).

Some general remark remains to be added. The equation (5.11) appears to have an unsatisfactory feature, viz., the coefficient of relative price is not at all significant. Let us, however, point out that there are certain theoretical arguments as to why the coefficient of P may be negligible in the C^n function. As we have argued in Section 4.4 of the preceding chapter, this coefficient measures the sum total of (a) the income effect (of a relative price change) for the non-agricultural sector and (b) its substitution effects for both sectors. Since the effect (a) works in a direction opposite to that of (b), the sign of the coefficient of P as well as its magnitude cannot be ascertained a priori. The estimated equation (5.11) shows that these two effects almost cancel out. It should further be pointed out that for the C^a function all these three effects work in the same (negative) direction, which is also confirmed by the sign of the coefficient of P in (5.10)[6/]. Finally, the income-elasticities of C^a and C^n (calculated from (5.10)-(5.11) at sample means of the variables) are, respectively, 0.48 and 1.19 which conform to our prevalent notion.

5.3 A Comparison with Earlier Works

In this section we shall compare our results with some of the earlier studies on private consumption behaviour in India. Let us, however, point out that our approach is a novel one in the sense that no other

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6/ We should also point out that since Y $(= PY^a + Y^n)$ involves also P, one may think that there may be multicollinearity in our estimated equations. However, the simple correlation coefficient (r_{YP}) between Y and P is small (+ 0.32). Thus r^2_{YP} is only 0.10.

previous works have studied consumption functions for the products of two sectors — agriculture and non-agriculture — separately and hence have not considered relative price as an additional explanatory variables in the consumption functions. In this respect, our result is not strictly comparable to those of earlier works. However, we may say something about the estimate of (aggregate) marginal propensity to consume.

In our model, aggregate consumption of two goods (C), measured in terms of non-agricultural price can be written as

$$(5.14) \qquad C = PC^{a} + C^{n}$$

Hence, the marginal propensity to consume (mpc) for the aggregate consumption will be given by

$$(5.15) \qquad \text{mpc} = PC^{a}_{y} + C^{n}_{y}$$

which, from (5.10)-(5.11) and the sample mean of P, is found to be 0.78. This conforms fairly closely to the estimates of mpc obtained from other studies, as shown in Table 5.1. Let us, however, emphasise that our study considers total income as the relevant variable while other studies take for this purpose either disposable income, or private disposable income, or, monetised disposable income. Also, some of these studies consider all variables (consumption and income) at current prices. Of course, all of these studies consider only aggregate consumption function. For all these reasons, our estimate of mpc may not be strictly comparable to those of others.

Table 5.1 : Estimates of mpc according to different authors

author	estimate of mpc	period
(1)	(2)	(3)
1. Narasimham (1956)	0.90	1919 - 1952
2. Iyengar & Krishnamoorthy (1959)	0.71	1948 - 1955
3. Choudhry (1963)	0.89	1930 - 1955
4. Krishnamurty (1965)	0.81	1948 - 1961
5. Mammen (1967)	0.81	1948 - 1964
6. Bhattacharya (1971)	0.84	1949 - 1968
7. Marwah (1972)	0.84	1939 - 1965
8. Pandit (1973)	0.73	1950 - 1966
9. Present study (1975)	0.78	1950 - 1966

Chapter 6

INVESTMENT FUNCTION

6.1 Theories about Investment Behaviour

The theories of (private) investment behaviour have been dominated by two broad schools of thought. One is the "profit theory" and the other, the "acceleration principle"[1/].

The "profit theory" postulates that the entrepreneur wants to maximise the profits, or the difference between discounted values of future revenues and costs. Two hypotheses have usually been offered that purport to explain investment in terms of measured current profits. The first is the 'expected profits hypothesis'. It is argued that the expected profitability plays a great role in shaping current investment decisions and that since present profits are expected to be a good surrogate for future profits, the entrepreneurs will invest according to the present profits. The second explanation runs in terms of 'residual fund hypothesis'. It is argued that the rate of investment is likely to be constrained by the supply of funds and the current profits provide the internal source of finance. As Kuh (1963a, p.7) puts it, "because of limited availability of funds either from capital market imperfections

1/ There is a third theory which stipulates that investment is basically the result of causal forces which are primarily exogenous to the economic system. See Hammer (1964, ch.2) for a discussion of such "exogenous" theories. Surveys of other theories can be found in Meyer and Kuh (1957, ch. 2) and Kuh (1963a, ch. 2).

or self-imposed restrictions on the business firms designed to avoid external financing, the actual investment rate will be restricted predominantly to gross profit levels"[2].

It may be mentioned that costs (interest expenses, the prices of machinery, etc.) are not explicitly introduced in the framework of profit theory. However, its role is implicitly recognised, since changes in costs will have immediate repercussions on the current and expected profits, and hence on investment.

A second theory of investment behaviour is the acceleration principle. According to the original formulation of Clark (1944), this theory asserts that the change in capital stock, i.e., net investment (I), is strictly proportional to the positive change in output (ΔY)

$$(6.1) \quad I = \beta \Delta Y$$

where β is the capital coefficient. This rigid form of accelerator relationship is based on several restrictive assumptions, two of which may be mentioned : (a) the buyers of plant and capital equipments, prior to an increase in output, must have no excess capacity, and,(b) the suppliers of capital goods have sufficient excess capacity to meet all demands promptly at existing prices. In view of the fact that reality seldom conforms to these specifications, the rigid accelerator theory has been modified into two related directions. The first modification is the

2/ The profit theory of investment was first proposed by Tinbergen (1939) and subsequently developed by Klein (1950, 1951).

replacement of the change in output by the level of output and the second, the introduction of distributed lags.

It is now argued that there will normally be a gap between investment decisions and actual investment and that only a fraction of the discrepancy between a 'desired' capital stock and the actual level can (or will) be acquired in any particular time interval :

$$(6.2) \qquad I = K - K_{-1} = \lambda(K^* - K_{-1})$$

where K and K* are actual and 'desired' capital respectively at the end of the current period, I is the net investment over the current period and λ is an adjustment coefficient equal to the fraction of the 'capacity gap' eliminated per period. The theory is then completed by postulating that $K^* = \beta Y$ where β is the (fixed) capital coefficient[3].

3/ The equation (6.2) can be derived from a different hypothesis, namely that, the actual capital is a weighted average of all past levels of desired capital with weights declining at a geometric rate $(1 - \lambda)$:

$$(6.2.1) \quad K = \lambda K^* + (1 - \lambda)K^*_{-1} + (1 - \lambda)^2 K^*_{-2} + \dots$$

Let us lag the equation (6.2.1) by one period and then multiply that by $(1 - \lambda)$. Finally, subtracting the resulting equation from (6.2.1), we obtain

$$K - (1 - \lambda)K_{-1} = \lambda K^*$$

$$\text{or} \qquad K = \lambda K^* + (1 - \lambda)K_{-1}$$

which is the same as the equation (6.2). Let us mention that this kind of flexible accelerator model has been originated by Chenery (1952) and Koyck (1954).

To summarise the two theories, the profit theory emphasises the role of profits and internal finance and implicitly also the role of the cost of external fiance. The acceleration theory, on the other hand, selects as the most important determinant of investment the level of output or the level of capacity utilisation. Some writers (e.g., Tsiang, 1951), are, however, in favour of a compromise; one possible reason is that profits and the level of output generally move in the same direction (Kuh, 1963b).

To conclude this introductory section, we may briefly refer to other theories of investment behaviour, e.g., the theory of Jorgenson (1963, 1967) or the "adjustment cost" theory (Eisner and Strotz, 1963; Lucas, 1967; Gould, 1968). In these theories the firm's current investment decision is determined by solving an intertemporal optimisation problem. Specifically, the current level of investment is determined by finding the program of capital accumulation which maximises the present discounted value of the firm's net cash flow. The main point to note about these theories is that output, rate of interest etc., are explicitly and rigorously brought in the theoretical framework as factors determining the desired capital stock.

However, all the above competiting theories of investment could be regarded as different members of the same species, the flexible accelerator model as expressed in (6.2), the theories differing only with respect to their emphasis of factors determining the desired capital. On this approach one can then classify the determinants of desired capital into three groups — (a) the level of output, (b) internal finance, represented by the flow of internal funds, the stock of liquid assets etc., and, (c) the cost of external finance, as reflected in interest rates, rates of return, stock prices etc.4/

6.2 Studies on Private Investment in India

All the theories mentioned in the previous section have been discussed more or less in the context of a developed economy. To what extent they are applicable in an underdeveloped economy like India remains to be seen. In this section we shall mention a few important studies on private investment behaviour in India.

In a recent study Bhattacharya (1971) finds that over the period from 1950-51 to 1967-68 total private investment in the Indian economy has been significantly influenced by its own one-year lagged value, national income and rate of interest (as measured by the yield on variable dividend industrial securities). Considering the period from 1939 to 1965 Marwah (1972), however, points to the importance of only income and import of capital goods in investment decisions. Agarwala (1970), on the other hand, considers sectoral investment functions and observes

4/ See Jorgenson (1971, pp. 1112, 1130).

that over the period from 1948 to 1961 private investment in agriculture is significantly influenced by real disposable income of this sector and the price level of agricultural good relative to that of investment good while the disposable income of the non-agricultural sector and the rate of inflation are the two most important factors affecting private investment in non-agriculture.

In an early study Krishnamurty (1964a) observes that over the period 1948-61, one year lagged values of three variables — capacity utilisation, index of industrial profits and a long-term rate of interest — seem to have explained satisfactorily current private gross investment in machinery and other equipments while that in construction seems to have been responsive to lagged capacity utilisation and current disposable income.

In fact, both output and financial variables seem to be important in regulating private investment behaviour in India. As has been observed by Gupta (1969, pp.24-5), the share of internal finance in the gross investment of the private corporate sector has been nearly 63 per cent during the period 1960-61 to 1964-65. The external finance also seems to be important and Gupta estimates that over the period from 1956-57 to 1964-65, while new security issues have financed less than 10 per cent of gross investment of this sector, the contribution of bank credit has been as high as 20 per cent.

The studies of Sarkar (1970) and Krishnamurty and Sastry (1971, 1973) seem to corroborate the observations of Gupta. Sarkar (1970) considers investment activity of large and medium-sized public limited companies in the following industries : cotton textiles, sugar, engineering goods, cement and tea plantations. Her main findings can be summarised as follows : (a) lagged (and in most cases, one-year lagged values) of three explanatory variables — sales change, profit after tax, and the rate of interest as reflected through the variation in the price of variable dividend industrial securities — seem to be more relevant, as compared to their current values, in determining current investment; (b) for the engineering goods industry both the sales change and profit variables appear to be important while investment activity in tea and sugar industries seems to have been responsive to profit variable only. The effect of interest rate on the investment pattern turns out to be significant for cotton and cement industries.

The studies of Krishnamurty and Sastry (1971, 1973) cover the following industries : cotton textiles, sugar, jute, chemicals, engineering goods and cement. They conclude that investment expenditures in the private corporate sector are, by and large, affected by the sales change variable and by financial variables like gross retained earnings and the flow of debt of firms in question.

We thus see that all the three variables emphasised in the Section 6.1 seem to be relevant also in the Indian economy5/. Let us now present our own findings.

6.3 The Present Study

We begin by pointing out that the definition of private investment adopted in the present study is different from those of other studies. The theoretical model, as developed in Chapter 4, considers investment demand for two types of goods — agricultural and non-agricultural goods — separately. The private investment demand for non-agricultural good has further been subdivided into two parts — that by the agricultural sector (I^a) and that by the non-agricultural sector (I^n). Since we have taken the investment demand for agricultural good as given autonomously, our empirical results concern the investment demand for non-agricultural good by two sectors separately. We take up I^n here while findings for I^a are presented in the Appendix A.3.

Private Investment Demand (for the Non-Agricultural Good) by the Non-Agricultural Sector (I^n)

For the investment demand function for the non-agricultural sector the possible explanatory variables considered in this study are : non-agricultural income (Y^n), year-to-year absolute change in this income (ΔY^n),

5/ Of course, exogenous factors like government industrial licensing and controls, scarcity of capital etc., are likely to interfere with the market mechanism. See Sarkar (1970, pp. M-35, M-36), Krishnamurty and Sastry (1973, p.7).

imports of machinery and equipment (F^{me}), amount of capital issues sanctioned by the government(CSG), government investment demand for non-agricultural good (GI), relative price of agricultural good (P), yield on variable dividend industrial securities (r^{vd}), and a few alternative rates of interest, e.g., a medium term rate (as measured by the yield on government securities maturing within five years), a number of long-term rates — the yield on 3 per cent developmental loan of government securities, the yield on 3 per cent conversion loan of government securities. The last mentioned variable will be denoted by r^1. We now summarise a few of our findings below :

(1) In all types of equations, r^1 has yielded better results than any other measure of interest rate.

(2) In most of the equations tried with alternative sets of explanatory variables, the log-linear form has given better fit (in terms of R^2) than its linear counterpart.

(3) Among two income variables Y^n and $\triangle Y^n$, Y^n has given better results.

(4) For any given type of equation, one year lagged values of Y^n, r^1 and P have given better results than their current values. This corroborates the findings of Sarkar (1970) and Krishnamurty (1964a).

Let us present our estimated regression equations. In view of our findings (2), (3) and (4), we report results for the **log-linear** equations involving lagged values of Y^n, r^1 and P.

An examination of the procedure of estimating domestic investment figure indicates[6] that a part of it comprises imports of machinery and equipments from abroad (F^{me}). It is sometimes argued that our investment is constrained by insufficient imports of capital goods. For this reason we introduce F^{me} as one possible regressor for our regression equation. It is interesting to observe that whenever F^{me} and Y^n (either current or lagged values of both) are used together, neither of them comes out to have a significant coefficient and that the coefficient of the income variable comes out to be negative. One such result is given below:

$$(6.3) \quad \log I^n = \underset{(0.913)}{8.566} - \underset{(-0.757)}{1.216} \log Y^n_{-1} + \underset{(1.615)}{1.431} \log F^{me}$$

$$\bar{R}^2 = 0.41, \quad R^2 = 0.50, \quad d = 2.16$$

Since the influence of income upon investment is now commonly accepted and has been widely verified in all contemporary studies on private investment behaviour (e.g., Krishnamurty, 1964a; Agarwala, 1970; Bhattacharya, 1971) we reject F^{me} as a possible explanatory variable for the I^n function.

Next, we proceed to investigate how the rate of interest may have influenced private investment in India. The variable that we first consider for this purpose is the yield on variable dividend industrial securities (to be denoted by r^{vd}). The empirical results yield significant and negative coefficient for r^{vd}. However, r^{vd} cannot strictly

6/ See, as for example, Lal (1970).

be taken as a measure of the rate of interest. For r^{vd} represents the ratio of dividend payments to the price of the security and both the price of a variable dividend industrial security and the dividend on it will be affected by the profits earned in the industry as well as by its expected profitability 7/.

Thus the rate of interest and profitability of industrial investment are mixed up in a complicated manner in r^{vd} and we have to look for other variables to isolate the effects of these two factors on our investment function 8/.

The theoretical model developed in Chapter 4 did not explicitly bring in any variable which provides a direct measure of the level or index of profit in the non-agricultural sector. The main reason is, of course, that no data are available on such a variable so far as the non-agricultural sector (or, even the industrial sector) as a whole is is concerned. The theoretical model did consider a proxy variable for

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7/ Sarkar (1970, p. M-32).

8/ In this sense the investment function in Bhattacharya (1971) seems to involve a mis-specification. He considers r^{vd} as a significant explanatory variable in the equation for the total private investment for the economy as a whole. If the variation in r^{vd} is brought about by the variation in the profitability of industrial investment, it is difficult to see how industrial profitability can influence investment in agriculture unless profitability in both sectors is shown to move in the same direction. Further, he takes r^{vd} as a proxy for the rate of interest. However, as we have already argued, r^{vd} may be a poor measure of the rate of interest. This may be one of the reasons why the current short-term rate of interest does not come out to have a significant coefficient in Bhattacharya's equation (no. (5.6), p.109) explaining the long-term variable, r^{vd}.

this, namely, the relative price of agricultural good in terms of non-agricultural good ($P = P^a/P^n$). To the extent P^a measures the cost of agro-based raw materials used in industries and to the extent wages are governed mainly by prices of agricultural goods, a rise in P would mean a rise in the cost of production in industries relative to their revenue and hence lower profitability in this sector[9/]. As a result, industrial investment would tend to fall. The empirical equation with one year lagged values of Y^n and P as two explanatory variables does yield satisfactory results as we see below :

$$(6.4) \quad \log I^n = \underset{(-1.407)}{-4.551} + \underset{(3.233)}{1.210} \log Y^n_{-1} - \underset{(-2.922)}{8.552} \log P_{-1}$$

$$\bar{R}^2 = 0.56, \quad R^2 = 0.63, \quad d = 1.99$$

Thus both variables are seen to have satistically significant coefficients with proper signs.

To measure the effect of the rate of interest we have tried several alternative rates among which the performance of the yield on 3 per cent conversion loan of government securities (r^1) is the best. The equation involving lagged values of Y^n and r^1 as two explanatory variables is given below :

$$(6.5) \quad \log I^n = \underset{(-2.698)}{-20.446} + \underset{(3.157)}{4.013} \log Y^n_{-1} - \underset{(-2.283)}{6.113} \log r^1_{-1}$$

$$\bar{R}^2 = 0.48, \quad R^2 = 0.55, \quad d = 1.81$$

9/ Thus, as Sarkar (1966) points out, fluctuations in profits in the cotton textile industry during the period, 1950-64, could be explained, to a large extent, by the relatively larger fluctuations in the price of raw cotton as compared to that of cotton manufactures.

We thus see that the long-term rate of interest also has a significant influence on the private investment in the non-agricultural sector.

The equations (6.4) and (6.5) suggest that for the I^n function both relative price and the rate of interest should be included as explanatory variables, along with the income variable. In fact, the equation involving all the three explanatory variables yields higher $\bar{R}^2$ than either of (6.4) and (6.5), as we see below :

$$(6.6)\quad \log I^n = \underset{(-2.092)}{-14.654} + \underset{(2.555)}{3.012} \log Y^n_{-1} - \underset{(-2.278)}{6.765} \log P_{-1} - \underset{(-1.602)}{3.984} \log r^l_{-1}$$

$$\bar{R}^2 = 0.61, \quad R^2 = 0.70, \quad d = 2.03$$

We thus see that income and relative price have statistically significant coefficients and further that the t-ratio for the coefficient of the rate of interest far exceeds unity. Moreover, all the three coefficients have proper signs. The d-statistic also clearly indicates the absence of any significant auto-correlation among the residuals.

Next, we proceed to see whether lagged I^n has any significant influence on current I^n. The estimated equation is reported below :

$$(6.7)\quad \log I^n = \underset{(-2.568)}{-19.086} + \underset{(3.001)}{3.955} \log Y^n_{-1} - \underset{(-2.717)}{8.292} \log P_{-1}$$

$$- \underset{(-2.068)}{5.314} \log r^l_{-1} - \underset{(-1.396)}{0.323} \log I^n_{-1}$$

$$\bar{R}^2 = 0.64, \quad R^2 = 0.74, \quad d = 1.64$$

A comparison of (6.7) with (6.6) reveals that the increase in $\bar{R}^2$ is only marginal and that the lagged I^n does not come out to have a statistically significant coefficient. However, the t-ratios for coefficients of all the other three explanatory variables — income, relative price and the rate of interest — have increased. These results only suggest that although one need not consider lagged I^n, but the other three variables should be considered as important explanatory variables in the I^n function.

Next, we try to see whether the government licensing policy has any appreciable influence on private investment in the non-agricultural sector. The variable chosen to measure the magnitude of government control is the amount (in crores of rupees) of capital issues sanctioned by the government — to be denoted by CSG. The current value, one-year lagged value and two-year lagged value of CSG are tried as possible explanatory variable, but none of them comes out to have a statistically significant coefficient. One such result is given below :

$$(6.8) \quad \log I^n = \underset{(-0.552)}{-7.147} + \underset{(0.862)}{1.835} \log Y^n_{-1} - \underset{(-1.456)}{5.423} \log P_{-1}$$

$$- \underset{(-0.897)}{3.171} \log r^1_{-1} + \underset{(0.725)}{0.331} \log (CSG)_{-1}$$

$$\bar{R}^2 = 0.59, \quad R^2 = 0.71, \quad d = 2.06$$

Not only the $\bar{R}^2$ in (6.8) is lower than that in (6.6), but none of the variables in (6.8) has a statistically significant coefficient. Therefore, we have to reject (6.8). However, we do not want to imply that government control does not have any influence whatsoever on private investment. The negative result may rather point to the difficulty of finding a good measure of government control.

As a last exercise, we examine whether public investment has an appreciable influence on private investment. For this purpose, we consider current, one-year lagged and two-year lagged values of total public investment in the form of non-agricultural good in both sectors. This variable will be denoted by GI. We find that none of the values of GI comes out to have a significant coefficient and further that some of their coefficients turn out to be negative, which is difficult to accept. We report below a result in which the government investment has a positive coefficient :

$$\text{(6.9)} \quad \log I^n = \underset{(-1.065)}{-9.034} + \underset{(1.435)}{2.056} \log Y^n_{-1} - \underset{(-1.550)}{5.081} \log P_{-1} - \underset{(-1.984)}{5.775} \log r^1_{-1} + \underset{(1.143)}{0.780} \log GI_{-1}$$

$$\bar{R}^2 = 0.62, \quad R^2 = 0.73, \quad d = 1.72$$

We thus see that one-year lagged value of GI does not have a statistically significant coefficient. Further, a comparison with (6.6) reveals that the coefficients of income and relative price also now turn out to be non-significant. In fact, none of the coefficients in (6.9) has a t-ratio greater than two. We, therefore, reject GI as a possible regressor for I^n.

All of the above exercises indicate that the improvements attempted upon the equation (6.6), by bringing in other possible explanatory variables, do not actually improve the results appreciably or significantly. None of these other variables comes out to have a statistically significant coefficient. We thus conclude that so far as private investment in the non-agricultural sector is concerned, the best possible explanation that can be obtained is through the equation (6.6). We, therefore, choose this equation :

$$(6.6) \quad \log I^{n} = \underset{(-2.092)}{-14.654} + \underset{(2.555)}{3.012} \log Y^{n}_{-1} - \underset{(-2.278)}{6.765} \log P_{-1} - \underset{(-1.602)}{3.984} \log r^{1}_{-1}$$

$$\bar{R}^2 = 0.61, \quad R^2 = 0.70, \quad d = 2.03.$$

Chapter 7

OTHER RELATIONS OF THE MODEL

7.1 Introduction

In the preceding two chapters we have discussed the consumption functions of two goods and the investment function for the non-agricultural sector. The present chapter will be devoted to a discussion of the rest of the relations of the model.

We first take up rate (or rates) of interest. In our theoretical model we derived a reduced form relation among the rate of interest, money income and unborrowed base money from the condition of equilibrium in the money market. In the next section we, therefore, summarise the theories of demand and supply functions of money.

7.2.1 Theories about Demand for and Supply of Money

So far as the demand for money is concerned, there are, broadly speaking, two rival theories in this field. The quantity theory postulates that money is needed only for transactions purposes and hence that the demand for nominal (or real) money balances depends upon money (or real) income[1/]. The Keynesian theory, on the other hand, emphasises that there exists also an asset demand for money. In fact, Keynes (1936, Chs. 13, 15) talks about three motives for holding money : transactions motive, precautionary motive and speculative motive, and holds that while

1/ There are different variants of the quantity theory. See Friedman (1970) on this point.

the transactions and precautionary demand for money may be supposed to depend on income, the speculative demand for money varies rather inversely with the rate of interest[2].

Thus, according to the Keynesian hypothesis, the demand for money varies positively with income and inversely with rate of interest[3]:

$$(7.1) \qquad M^d = M^d (Y', r) \; ;$$

where M^d is the demand for money, Y', the money national income and r, the rate of interest.

For a long time the supply of money has been treated as an exogenous element in the theoretical literature on macroeconomics. However, works of Polak and White (1955), Brunner (1961), Brunner and Meltzer (1963), Crouch (1965) suggest that it too is an endogenous variable. In fact, the variable which may be treated as a policy variable and which is now supposed to be the main determinant of money supply is what is called the base money. However, given the base money the supply of money varies, upto a limit, in accordance with the variation in the rate of interest. The basic assumption is that commercial banks act in a profit maximising

2/ Tobin (1958) provides two rationalisations for the Keynesian hypothesis that the speculative demand for money is an inverse function of the rate of interest. Some writers hold that even the transactions demand for money depend on the rate of interest (see Baumol, 1952; Tobin, 1956).

3/ It is to be pointed out that the classical quantity theory has later been reformulated. The reformulated version prepared by Friedman(1956) includes several rates of interest as determinants of the demand function of money. However, that is only in principle, since the author himself takes the position that it is hard to establish empirically any interest elasticity of the demand for money (see, e.g., Friedman, 1959).

way in response to changes in the return from lending relative to its cost[4/]. The hypothesis is that given the base money, the amount of excess reserves, or more specifically, the amount of free reserves[5/] (defined to be the difference between the excess reserves of banks and their borrowings from the central bank), which the commercial banks usually maintain is likely to vary with the rate of interest. As the return from lending (measured by the rate of interest) rises relative to the cost of lending (measured, as for example, by the discount rate of the central bank), banks will be willing to supply more deposits and hence to increase the stock of money. The banks do this either by reducing their excess reserves or by increasing their borrowings from the central bank, i.e., in sum, by reducing their free reserves.

In case of India, the <u>sources</u> of base money are (a) Reserve Bank of India's holdings of government securities, (b) its holdings of gold and foreign exchange reserves and (c) borrowings by commercial banks from the RBI (to be denoted by BR). The <u>uses</u> of base money are required reserves (RR) and excess reserves (ER) of commercial banks and currency with the non-bank public (CR). Thus we may write

$$(7.2.1) \qquad M = CR + RR + ER - BR$$

where M is the (unborrowed) base money[6/].

4/ The subsequent discussion is developed along the line of Teigen (1965, pp. 92-5).

5/ Meigs (1962) surveys the historical development of theories of free reserves.

6/ We are using some unconventional notation. Usually M is used to denote the supply of money while the (unborrowed) base money is denoted by UBM or BM^a. We shall, however, use M to denote the second variable while the supply of money will be denoted by M^s.

The amount of currency which the non-bank public desire to hold out of a given supply of money depends upon several factos like banking habits etc., which may be assumed to be given in the short-run. Then one may write

$$(7.2.2) \qquad CR = \eta M^s ,$$

where η is the proportion of money which people desire to hold in the form of currency and M^s is the total supply of money. The required reserves of commercial banks depend upon their deposits (D) and the reserve requirement ratio (α) :

$$(7.2.3) \qquad \begin{aligned} RR &= \alpha D \\ &= \alpha (M^s - CR) \end{aligned}$$

since the supply of money is equal to the sum of CR and D. We now add the function for free reserves, FR (= ER - BR) :

$$(7.2.4) \qquad FR = f(r) \; ; \qquad f' < 0$$

From (7.2.1) - (7.2.4) we get

$$M = \eta M^s + \alpha (1 - \eta) M^s + f(r)$$

Or,

$$(7.2) \qquad M^s = \frac{1}{\eta + \alpha(1-\eta)} M - \frac{f(r)}{\eta + \alpha(1-\eta)}$$

Thus the supply of money varies <u>positively</u> with both base money (M) and rate of interest (r)[7/].

7/ Of course, free reserves, FR (= ER - BR), will also be a function of the discount rate of the Reserve Bank of India (r^d). FR will then tend to vary <u>negatively</u> with r, but <u>positively</u> with r^d. In this case, the supply of money can be shown to be a function of not only M and r, but of r^d also. A rise (fall) in r^d tends to reduce (increase) M^s.

The equilibrium condition for the money market is that the demand for money should be equal to its supply. From (7.1) and (7.2) it then follows that the rate of interest varies positively with money income and inversely with (unborrowed) base money[8/]:

(7.3) $r = L(Y', M)$; $L_{y'} > 0$, $L_m < 0$

In the next section we give a brief account of the works done on the Indian money market and the interest rate.

7.2.2 A Few Empirical Works on Indian Money Market

Empirical studies in India have been influenced by both the quantity and Keynesian theories. Studies in the line of the quantity theory are, as for example, Shah (1962), Agarwala (1970). Although Biswas (1962) does not find any influence of the short term rate of interest on the demand for money, he observes that the price index of shares, time trend and money income have all significantly affected the demand for money.

In fact, studies in the line of the Keynesian theory are quantitatively larger (e.g., Khusro, 1957; Sastry, 1962; Prasad, 1969; Bhattacharya, 1971; Mammen, 1971; Marwah, 1972; Gupta, 1973).

Sastry (1962) observes that over the period from 1935-36 to 1960-61 the income velocity of money (the ratio of money income to the total stock of money) has not remained constant but has been quite responsive

8/ With r^d as an additional factor influencing FR, it is easy to show that r will vary positively with r^d also.

to changes in the rate of interest. Regarding the supply of money he finds that the free reserves of the scheduled commercial banks have been significantly affected by the treasury bill rate, a measure of the short term rate of interest. Marwah (1972) also observes a significant influence of the rate of interest on the demand for money. Bhattacharya (1971) finds that for the period from 1948-49 to 1967-68 income, rate of interest and net worth of the public sector have all significantly affected the demand for money while the two important determinants of the supply of money have been unborrowed base money and the rate of interest.

In an early study Khusro (1957) has attempted an extension of the simple Keynesian liquidity preference theory by including the total stock of securities as one important variable affecting the rate of interest. He argues that even when the stock of money remains constant (or even rises), the rate of interest may go up if the stock of securities rises (or rises sufficiently). Thus Khusro concludes that there will be an inverse relation not so much between the rate of interest and the idle money (viz., the part of money not needed for transactions purposes) as between the rate of interest and the idle money relative to the stock of securities. In an empirical work Khusro finds (for the period 1937-52) a significant inverse relation between a long-term rate of interest and the ratio of idle balances to the total stock of securities of the private sector.

In comparison to all the above studies, Mammen (1971) and Gupta (1973) make a detailed investigation of the monetary and banking sectors of India. They fit different demand functions for different kinds of money — currency, demand deposits and time deposits. Money income, rate (or rates) of interest and a time trend are shown to be important variables affecting these demand functions. Regarding the supply of money, they find the importance of the rate of interest in regulating the excess (or free) reserves of the banks.

This concludes the brief summary of the kind of empirical works which have been done on the Indian money and banking sectors. We now report our own results.

7.2.3 The Present Work

It is to be stated at the outset that we are not so much interested in estimating the various structural equations, as for example, the demand and supply functions of money. Rather, our interest is to estimate the reduced form relation (7.3).

One particular issue, however, remains to be resolved first. The issue is concerned with the choice of a representative rate of interest. The controversy has centered mostly around the choice between long-term and short-term rates of interest, It is, however, argued that the whole issue is concerned rather with the choice of assets which may be viewed as nearest alternatives to money in the structure of the assets of the public[9]. Judging from this angel, one may then prefer rates on short-term securities, as the latter are "just below currency and demand deposits in the hierarchy of liquidity"[10].

In order to decide upon the type of rate of interest which is relevant for the money market and also upon the type of variables which are important determinants of the demand for money, we try to fit the demand for money equation, as a first exercise. We have considered several rates of interest — (a) a long-term rate as measured by the 3 % conversion loan of the government securities 1986 or later, the same as used in the investment function for the non-agricultural sector, (b) a medium-term rate as reflected in the average yield on government securites maturing within five years, and (c) various short-term rates — average yield on time deposits of banks of different maturities : three months, six months and twelve months. Among all these rates the three months' and six months' time deposits rates are seen to fare consistently better than any other rate and between the two themselves, the performance of the six months' time deposit rate is better at times. We have therefore chosen this rate which will subsequently be denoted by r^s, the short-term rate of interest.

We have seen in Section 7.2.1 that the two variables which are supposed to influence the demand for money are money income and rate of interest. However, in an underdeveloped economy like India, where a considerable portion of income does not come into the system of exchange,

9/ See Prasad (1969, pp. 33-4).

10/ Tobin (1948, p.316).

the ideal variable for determing the transactions demand for money would be monetised income.[11] The total (monetised plus non-monetised) income c... be used as a proxy provided the ratio of monetised income to total income remains constant over time. However as the economy develops, it tends to become progressively more monetised. This seems to be the case with India also[12]. However, no time series data on monetised income of India is available. As a proxy, therefore, we have included both total money income (Y') and a time trend (t) as two explanatory variables, apart from short-term rate of interest (r^s), in our demand for money (M^d) function. Our regression result is given below :

$$(7.4) \quad \log M^d = \underset{(2.322)}{3.377} + \underset{(2.877)}{0.460} \log Y' - \underset{(-1.560)}{0.175} \log r^s + \underset{(2.463)}{0.039}\, t$$

$$\bar{R}^2 = 0.98, \qquad d = 1.12$$

We see that the coefficients of the explanatory variables — Y', r^s, t — have expected signs. Y' and t have statistically significant coefficients while the t-ratio for the coefficient of r^s is well above unity.

11/ See Prasad (1969, pp.15-6) and Bhattacharya (1971, pp. 47-8).

12/ Thus the RBI (1961, p. 1046) holds that the monetisation in India has been increasing at a cumulative rate of one per cent per annum. Similarly, on the basis of the National Sample Survey Data, Mukherjee (1967) estimates that the percentage share of non-money transactions in consumption expenditures in India has declined from 36.9 and 36.8 in the third round (August-November, 1951) and the fourth round (April-September, 1952) respectively to 35.5 in the thirteenth round (September, 1957- May, 1958). Again, Mukherjee and Rao (1970, p.6) observe that the above share has declined further to 34.6 in the eighteenth round (April-June, 1964). This increase in the degree of monetisation is noticeable for other kinds of flows also, as for example, investment. See Tiwari (1965) on the last point.

It now seems that the variables which would faithfully explain the demand for money should include, apart from total money income and rate of interest, a time trend (to account for the increasing degree of monetisation)[13]. Given this observation, it is obvious that the reduced form equation (7.3) should have an additional explanatory variable, the time trend. And the rate of interest would vary <u>positively</u> with t. For, with unchanged total money income and (unborrowed) base money, the higher is the degree of monetisation, the higher will be the rate of interest.

A linear regression of the reduced form equation (7.3) yields satisfactory results with expected signs for all the coefficients. However, using log r^s, instead of simply r^s, yields better results and this is given below :

$$(7.5)\quad \log r^s = \underset{(7.199)}{1.379} + \underset{(1.318)}{0.000057}\, Y' - \underset{(-2.850)}{0.00113}\, M + \underset{(7.505)}{0.139}\, t$$

$$\bar{\bar{R}}^2 = 0.91, \qquad d = 1.30$$

We see that M and t have significant coefficients. The t-ratio for the coefficient of Y' is greater than unity. Considering the highly aggregative nature of our equation (7.3), the estimated equation (7.5) seems to be quite satisfactory. We think that a detailed breakdown of the monetary and banking sectors is likely to yield more satisfactory results,

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13/ Of course, a time trend used as an explanatory variable in a regression equation with time series data is usually supposed to be a *catch-all variable, introduced to capture the effects of all omitted* variables having time trend. A possible explanatory variable which has been omitted in our demand for money is the total wealth of the private sector and this is likely to be increasing over time. Let us recall that time is also a regressor in the M^d-functions of Biswas (1962), Mammen (1971) and Gupta (1973).

as the works of Mammen (1971) and Gupta (1973) would suggest. However, that remains outside the scope of the present study.

As a final observation, we note that introducing discount rate of the RBI (r^d) as an additional variable in (7.5) slightly worsens the results as we see below :

$$(7.6) \quad \log r^s = \underset{(4.697)}{1.372} + \underset{(1.253)}{0.000057}\, Y' - \underset{(-2.716)}{0.00113}\, M + \underset{(6.379)}{0.139}\, t + \underset{(0.036)}{0.00370}\, r^d$$

$$\bar{R}^2 = 0.90, \qquad d = 1.29$$

We thus see that r^d has not a significant coefficient whose t-ratio is nearly zero. This may possibly be due to the fact that over the period under study the change in r^d has been very gradual. However, coefficients of other variables in (7.6) are exactly the same as their counterparts in (7.5). We therefore choose (7.5).

7.3 Long-Term Rate of Interest

We have now two rates of interest in our model : a long term rate (measured by the yield on 3% conversion loan of government securities which will be denoted by r^l) used in our I^n function and a short-term rate (r^s). We, therefore, need a relation for r^l. The variation in r^s would have some obvious bearing on r^l. However, the supply of government securities will also affect its yield. Other things remaining the same, a rise in this supply will tend to lower the prices of securities and hence will tend to raise their yields. Our regression result in fact seems to indicate the validity of this argument :

$$(7.7) \quad r^{l} = \underset{(14.027)}{2.327} + \underset{(3.210)}{0.318\, r^{s}} + \underset{(3.508)}{0.00022\, GS}$$

$$\bar{R}^2 = 0.92, \quad d = 1.12$$

where GS is the stock of government securities held by the public and other banks except the RBI. Both the explanatory variables are seen to have statistically significant coefficients. We, therefore, accept this equation[15].

7.4 Price Formation Relation of the Non-Agricultural Sector

In our theoretical model we pointed out that the two variables which may be supposed to determine the price of non-agricultural good (P^n) are the price of agricultural good (P^a) and the (real) income of the non-agricultural sector (Y^n). Our empirical investigation establishes the validity of our hypothesis.

15/ Including the one-year lagged value of the dependent variable as a third regressor in (7.7) worsens the result, as we see below :

$$r^{l} = \underset{(1.720)}{1.698} + \underset{(1.107)}{0.212\, r^{s}} + \underset{(2.225)}{0.00018\, GS} + \underset{(0.647)}{0.275\, r^{l}_{-1}}$$

$$\bar{R}^2 = 0.92, \quad d = 1.17$$

Thus, r^s now turns out to have a non-significant coefficient and the coefficient of r^{l}_{-1} has a t-ratio which is well below unity.

However, as a first exercise we examine any possible influence of the import price index of crude materials (P^{fr}) on P^n. We observe that the coefficient of P^{fr} never becomes statistically significant. Two such results are given below :

$$(7.8)\quad P^n = \underset{(2.907)}{0.191} + \underset{(16.937)}{0.837}\, P^a - \underset{(-1.182)}{0.045}\, P^{fr}$$

$$\bar{R}^2 = 0.95$$

$$(7.9)\quad P^n = \underset{(2.416)}{0.155} + \underset{(5.430)}{0.643}\, P^a + \underset{(1.784)}{0.000024}\, Y^n + \underset{(0.389)}{0.019}\, P^{fr}$$

$$\bar{R}^2 = 0.96 \qquad d = 0.93$$

Since the coefficient of P^{fr} is not significant and even in one equation it is negative, P^{fr} does not seem to be a relevant explanatory variable. In fact, dropping P^{fr} from the equation (7.9) improves the result as the t-ratios for coefficients of both P^a and Y^n increase :

$$(7.10)\quad P^n = \underset{(3.806)}{0.172} + \underset{(7.842)}{0.673}\, P^a + \underset{(2.234)}{0.000021}\, Y^n$$

$$\bar{R}^2 = 0.96, \qquad d = 1.01$$

Both variables — P^a and Y^n — are seen to have statistically significant coefficients.

As a final exercise, we bring in the one-year lagged value of the dependent variable as a third regressor in (7.10) and the estimated equation is given below :

$$(7.11) \quad P^n = \underset{(2.087)}{0.133} + \underset{(4.918)}{0.557}\, P^a + \underset{(2.553)}{0.000026}\, Y^n + \underset{(0.843)}{0.124}\, P^n_{-1}$$

$$\bar{R}^2 = 0.97, \qquad d = 1.68$$

We see that P^n_{-1} does not have a statistically significant coefficient. We, therefore, accept the equation (7.10).

One final point remains to be stated. The elasticity of P^n with respect to P^a calculated from equation (7.10) is seen to be 0.685 at the sample mean of the variables. In fact, during the period under study relative price of agricultural good $P\left(=\frac{P^a}{P^n}\right)$ varied within the range 0.968 - 1.103. Therefore, the aforesaid elasticity calculated at any point of the sample values is well below unity. Thus our assumption (4.18a) mentioned in Chapter 4 is borne out to be valid.

7.5 Intersectoral Flows of Intermediate Inputs

Our model considers two intersectoral flows of intermediate inputs: X^{na}, the amount of non-agricultural good flowing to agriculture and X^{an}, the amount of agricultural good flowing to non-agriculture. The methods by which these two flows are estimated for all the years under study have already been discussed in Section 5.1 of Chapter 5. There the amount of non-agricultural input used per unit of agricultural income was estimated to be 0.027. Thus we have,

$$(7.12) \quad X^{na} = 0.027\, Y^a$$

The figures of X^{an}, on the other hand, have been obtained on the assumption that it is proportional to the production of agro-based industries. The latter, however, is the product of the non-agricultural sector. We, therefore, regress X^{an} on Y^n and the result is given below :

$$(7.13) \quad X^{an} = \underset{(11.781)}{500.718} + \underset{(26.446)}{0.188}\, Y^n$$

$$\bar{R}^2 = 0.98, \qquad d = 0.90$$

7.6 Indirect Taxes (Less Subsidies) in Two Sectors

The model considers indirect taxes (less subsidies) for two sectors — agriculture and non-agriculture — separately. These are, in fact, measured in terms of prices of respective sectors and are denoted by T^a and T^n. They are regressed respectively on agricultural and non-agricultural incomes and the results are given below :

$$(7.14) \quad T^a = \underset{(-3.862)}{-101.978} + \underset{(5.751)}{0.024}\, Y^a$$

$$\bar{R}^2 = 0.68, \qquad d = 1.62$$

$$(7.15) \quad T^n = \underset{(-11.321)}{-708.703} + \underset{(24.501)}{0.257}\, Y^n$$

$$\bar{R}^2 = 0.98, \qquad d = 0.73$$

One final observation may be pointed out. No previous study has considered indirect taxes (less subsidies) for the two sectors separately. Only aggregate indirect taxes (less subsidies) for the economy as a whole have been considered in some studies. In these studies, the coefficient of aggregate national income in the equation for aggregate indirect taxes is found to be 0.15 (Mammen, 1967) or 0.16(Choudhry and Krishnamurty, 1968). Such a coefficient can be estimated from our two relations (7.14) and (7.15). The share of our agricultural income in total income is 50 per cent or slightly less. This being the case, the estimated coefficient comes out to be 0.14 or slightly more. This compares favourably with estimates of Mammen and Choudhry-Krishnamurty.

Chapter 8

THE MACROECONOMETRIC MODEL AND ITS RESULTS

8.1 Introduction

In this chapter, we first present together all the regression equations of our model. On the basis of these equations we then proceed to find the magnitude and direction of changes in various endogenous variables in response to stipulated changes in the exogenous variables.

8.2 The Complete Model

(8.1) $Y^a = C^a + X^{an} - \frac{1}{P} X^{na} - T^a + Q^a$

(8.2) $C^a = \underset{(3.694)}{5926.216} + \underset{(6.704)}{0.186}\, Y - \underset{(-2.072)}{3423.28}\, P$

$\bar{R}^2 = 0.74, \quad d = 1.98$

(8.3) $X^{an} = \underset{(11.781)}{500.718} + \underset{(26.446)}{0.188}\, Y^n$

$\bar{R}^2 = 0.98, \quad d = 0.89$

(8.4) $X^{na} = 0.027\, Y^a$

(8.5) $T^a = \underset{(-3.862)}{-101.978} + \underset{(5.751)}{0.024}\, Y^a$

$\bar{R}^2 = 0.68, \quad d = 1.62$

(8.6) $Y^n = C^n + X^{na} + I^n - PX^{an} - T^n + Q^n$

(8.7) $C^n = \underset{(-1.109)}{-1493.774} + \underset{(25.534)}{0.594}\, Y + \underset{(0.237)}{329.17}\, P$

$\bar{R}^2 = 0.98, \quad d = 2.26$

$$(8.8)\quad \log I^{n} = -\underset{(-2.092)}{14.654} + \underset{(2.555)}{3.012}\log Y^{n}_{-1} - \underset{(-2.278)}{6.765}\log P_{-1} - \underset{(-1.602)}{3.984}\log r^{l}_{-1}$$

$$\bar{R}^2 = 0.61, \qquad d = 2.03$$

$$(8.9)\quad T^{n} = -\underset{(-11.321)}{708.703} + \underset{(24.501)}{0.257}\, Y^{n}$$

$$\bar{R}^2 = 0.98, \qquad d = 0.72$$

$$(8.10)\quad P^{n} = \underset{(3.806)}{0.172} + \underset{(7.842)}{0.673}\, P^{a} + \underset{(2.234)}{0.000021}\, Y^{n}$$

$$\bar{R}^2 = 0.96, \qquad d = 1.01$$

$$(8.11)\quad \log r^{s} = \underset{(7.199)}{1.380} + \underset{(1.318)}{0.000057}\, Y' - \underset{(-2.851)}{0.00113}\, M + \underset{(7.505)}{0.139}\, t$$

$$\bar{R}^2 = 0.91, \qquad d = 1.30$$

$$(8.12)\quad r^{l} = \underset{(14.027)}{2.327} + \underset{(3.210)}{0.318}\, r^{s} + \underset{(3.508)}{0.00022}\, GS$$

$$\bar{R}^2 = 0.92, \qquad d = 1.12$$

$$(8.13)\quad Y = PY^{a} + Y^{n}$$

$$(8.14)\quad P^{a} = PP^{n}$$

$$(8.15)\quad Y' = P^{n}Y$$

We have 15 equations to determine 15 endogenous variables — P, C^a, X^{an}, X^{na}, T^a, Y^n, C^n, I^n, T^n, P^n, P^a, r^l, r^s, Y and Y'. The exogenous variables in the model are 5 in number — Y^a, Q^a, Q^n, GS, M. We have a time trend t. Hence the model is determinate.

8.3 A Method of Analysing Results in a System of Non-Linear Equations

We are interested in finding how the values of the various endogenous variables will change, if some exogenous variable changes in a specified pattern. Since many of the equations are non-linear, there are two approaches for this purpose. One is simulation. In other words, given the initial values of various endogenous variables, the values of these variables can be solved for each time period, once time paths of all exogenous variables are specified. An alternative method is to linearise the model around the sample means of the variables so as to find a reduced form in which all endogenous variables are expressed linearly in terms of predetermined variables only. The second method has been developed and used by Goldberger (1959) to find the various multipliers — impact (first year) and dynamic (later years) multipliers — of the econometric model of Klein and Goldberger (1955) of the U.S. economy. We shall follow this approach here.

Formally, if the non-linear structural system is

$$F\,(y,\ z) = 0$$

where y is a G-component vector of endogenous variables $\{y_j\}$, z is a K-component vector of predetermined variables $\{z_k\}$ and F is a vector of G functions $\{F_i(y,\ z)\}$. Then setting total differential of each of the functions F_i (i = 1, ..., G) equal to zero, one obtains[1]

$$dy = \pi\, dz$$

1/ The present discussion is based on Goldberger (1959, Ch. 3).

where π is the matrix formed from the partial derivatives of the functions F_i with respect to y_j' s and z_k' s :

$$\pi = \left[\frac{\delta F_i}{\delta y_j} \right]^{-1} \left[\frac{\delta F_i}{\delta z_k} \right]$$

If, now, these partial derivatives are evaluated at some set of points (y_o, z_o), the calculation of

$$\pi_o = \pi \Big|_{\substack{y = y_o \\ z = z_o}}$$

provides a linearised version of the reduced form, relating changes in y to changes in z, viz., :

$$dy = \pi_o \, dz$$

Here, the typical element of π_o, say the (j, k)th element, expresses the change in y_j induced by a unit change in z_k; in the symbols of differential calculus, it is $\delta y_j / \delta z_k$. Since we shall be concerned with year to year changes in y and z, we write

$$\dot{y} = \pi_o \dot{z}$$

where a dot (.) over a variable denotes its year to year change. The elements in π_o are usually called the multipliers corresponding to the relevant predetermined variables. Goldberger (1959, p. 20) then comments that : (a) when the point (y_o, z_o) is chosen to correspond to the observed means of the variables over the sample period, the resultant values of the reduced form coefficients may be considered to be average values and may provide reasonably accurate estimates of the multipliers over reasonably wide ranges of the variables, and, (b) the use of a linearised system involves very substantial computational and analytical conveniences.

In the next section we proceed to derive a linearised version of the reduced form of our system in which the reduced form coefficients are calculated at the observed means of the variables within the sample period.

8.4 Reduced Form of Our System

Let us first rewrite the equations (8.10)-(8.12) in general form :

(8.10)' $P^n = c_2 + a_2 P^a + b_2 Y^n$

(8.11)' $\log r^s = c_3 + a_3 (P^n Y) + b_3 M + d_3 t$

(8.12)' $r^1 = c_4 + a_4 r^s + b_4 GS$

Using a dot (.) over a variable to denote its year to year change we have from (8.14) and (8.10)' :

(8.16) $\dot{P}^a = (P^n)\,\dot{P} + (P)\,\dot{P}^n$

(8.17) $\dot{P}^n = e\,\dot{Y}^n + f\,\dot{P}$

where

(8.18) $e = \dfrac{b_2}{1 - a_2 P}$; $f = \dfrac{a_2 P^n}{1 - a_2 P}$

Similarly from (8.13), (8.11)' and (8.12)' we get

$$(8.19) \quad \dot{r}^1 = R_{y_n} \dot{Y}^n + R_p \dot{P} + R_{y_a} \dot{Y}^a + R_m \dot{M} + R_t \dot{t} + R_{gs} GS$$

where

$$R_{y_n} = (a_4 a_3 r^s) \left(P^n + \frac{b_2 Y}{1 - a_2 P} \right)$$

$$(8.20) \quad R_p = (a_4 a_3 r^s P^n) \left(Y^a + \frac{a_2 Y}{1 - a_2 P} \right)$$

$$R_{y_a} = (a_4 a_3 r^s P^a)$$

$$R_m = (a_4 b_3 r^s)$$

$$R_t = (a_4 d_3 r^s)$$

$$R_{gs} = b_4$$

Again, we rewrite equations (8.7) - (8.9), (8.3) and (8.4) in general form :

$$(8.7)' \quad C^n = c_5 + a_5 (PY^a + Y^n) + b_5 P$$

$$(8.8)' \quad \log I^n = c_6 + a_6 \log Y^n_{-1} + b_6 \log P_{-1} + d_6 \log r^1_{-1}$$

$$(8.3)' \quad X^{an} = c_7 + a_7 Y^n$$

$$(8.4)' \quad X^{na} = \beta Y^a$$

$$(8.9)' \quad T^n = c_8 + a_8 Y^n$$

Since in (8.7), the coefficient corresponding to P is not significant, we shall neglect the term b_5. Then we get from (8.6), (8.3)', (8.4)' and (8.7)' - (8.9)' :

$$(8.21) \quad \dot{Y}^n = a\dot{Y}^n + b\dot{P} + a_1\dot{Y}^n_{-1} + b_1\dot{P}_{-1} + d_1\dot{r}^l_{-1} + \dot{Q}^n + c\dot{Y}^a$$

where

$$a = a_5 - a_7P - a_8$$

$$b = a_5Y^a - X^{an}$$

$$(8.22) \quad a_1 = a_6I^n/Y^n_{-1}$$

$$b_1 = b_6I^n/P_{-1}$$

$$d_1 = d_6I^n/r^l_{-1}$$

$$c = a_5P + \beta$$

Similarly, we may rewrite equations (8.2) and (8.5) as follows :

$$(8.2)' \quad C^a = c_9 + a_9 (PY^a + Y^n) + b_9P$$

$$(8.5)' \quad T^a = c_{10} + a_{10} Y^a$$

From (8.1), (8.2)'– (8.5)', we may then write :

$$(8.23) \quad \dot{Y}^a = (a_9 + a_7)\dot{Y}^n + (a_9Y^a + b_9 + \frac{1}{P^2}\beta Y^a)\dot{P}$$

$$+ (a_9P - \frac{1}{P}\beta - a_{10})\dot{Y}^a + \dot{Q}^a$$

which can again be written as

$$(8.24) \quad \dot{P} = g\dot{Y}^n + k\dot{Q}^a + h\dot{Y}^a$$

where

$$g = - \frac{a_9 + a_7}{a_9Y^a + b_9 + \frac{1}{P^2}\beta Y^a}$$

$$(8.25)\qquad k = -\frac{1}{a_9\,Y^a + b_9 + \frac{1}{P^2}\,\beta\,Y^a}$$

$$h = \frac{1 - (a_9 P - \frac{1}{P}\,\beta - a_{10})}{a_9\,Y^a + b_9 + \frac{1}{P^2}\,\beta\,Y^a}$$

Thus the reduced form equations for all endogenous variables are obtained. The next section is devoted to a discussion of the dynamic properties of the model.

8.5 Dynamic Properties - Stability and Equilibrium Multipliers

We first write the equations for the five endogenous variables — Y^n, P, P^n, P^a and r^1. Using the time subscript the equations (8.21), (8.24), (8.17), (8.16) and (8.19) are written below :

$$(8.26.1)\qquad (1-a)\dot{Y}^n_t - b\dot{P}_t = a_1\dot{Y}^n_{t-1} + b_1\dot{P}_{t-1} + d_1\dot{r}^1_{t-1} + \dot{Q}^n_t + c\dot{Y}^a_t$$

$$(8.26.2)\qquad -g\,\dot{Y}^n_t + \dot{P}_t = k\,\dot{Q}^a_t + h\,\dot{Y}^a_t$$

$$(8.26.3)\qquad -e\,\dot{Y}^n_t - f\,\dot{P}_t + \dot{P}^n_t = 0$$

$$(8.26.4)\qquad -(P^n)\dot{P}_t - (P)\dot{P}^n_t + \dot{P}^a_t = 0$$

$$(8.26.5)\qquad -R_{y_n}\,\dot{Y}^n_t - R_p\,\dot{P}_t + \dot{r}^1_t = R_{y_a}\,\dot{Y}^a_t + R_m\,\dot{M}_t + R_{gs}\,\dot{GS}_t + R_t\,\dot{t}$$

Let us define two column vectors — one for the endogenous variables

(8.27) $\dot{y}_t = \left\{ \dot{Y}^n_t, \dot{P}_t, \dot{P}^n_t, \dot{P}^a_t, \dot{r}^1_t \right\}$

and the other for the exogenous variables

(8.28) $\dot{z}_t = \left\{ \dot{Q}^n_t, \dot{Q}^a_t, \dot{Y}^a_t, \dot{M}_t, \dot{GS}_t, \dot{t} \right\}$

and three matrices :

(8.29)
$$B_o = \begin{bmatrix} 1-a & -b & 0 & 0 & 0 \\ -g & 1 & 0 & 0 & 0 \\ -e & -f & 1 & 0 & 0 \\ 0 & -P^n & -P & 1 & 0 \\ -R_{y_n} & -R_p & 0 & 0 & 1 \end{bmatrix} ; \quad B_1 = \begin{bmatrix} a_1 & b_1 & 0 & 0 & d_1 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

$$\Gamma = \begin{bmatrix} 1 & 0 & c & 0 & 0 & 0 \\ 0 & k & h & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & R_{y_a} & R_m & R_{gs} & R_t \end{bmatrix}$$

Then the system (8.26) may be written as

(8.30) $B_o \cdot \dot{y}_t = B_1 \dot{y}_{t-1} + \Gamma \dot{z}_t$

In order to solve the system (8.30) we shall follow the method of Goldberger (1959, Ch.6, pp. 105-13). Let us first introduce the lag operator E which is defined by

(8.31) $E x_t = x_{t-1}$

and the definition is extended to linear functions of E[2]

(8.32) $(\alpha_0 + \alpha_1 E) x_t = \alpha_0 x_t + \alpha_1 x_{t-1}$

where α_0 and α_1 are constants.

A matrix B is also defined whose elements are linear functions in E :

(8.33) $B = B_0 - B_1 E$

That is, if $B_0 = (\beta_{gio})$ and $B_1 = (\beta_{gi1})$, then the (g,i)th element of B is given by $\beta_{gio} - \beta_{gi1} E$.

The system (8.30) can now be written as

(8.34) $B \dot{y}_t = \Gamma \dot{z}_t$

or we may write

(8.35) $|B| \dot{y}_t = (\text{Adj } B) \Gamma \dot{z}_t$

where

$$(8.36) \quad |B| = \begin{vmatrix} 1-a-a_1E & -b-b_1E & 0 & 0 & -d_1E \\ -g & 1 & 0 & 0 & 0 \\ -e & -f & 1 & 0 & 0 \\ 0 & -p^n & -p & 1 & 0 \\ -R_{y_n} & -R_p & 0 & 0 & 1 \end{vmatrix}$$

$$= (1-a-a_1E) - (b+b_1E)g - d_1E(gR_p + R_{y_n})$$

$$= (1-a-bg) - \left[a_1 + d_1R_{y_n} + (b_1 + d_1R_p)g\right] E$$

2/ The definition of E can be extended also to integral powers of E.

Each equation in (8.35) gives, implicitly, the time path of one endogenous variable in terms of the time path of the exogenous variables. An expression for any endogenous variable as an explicit function of time is to be found with three distinct components and together they constitute the complete solution.

The first component — called the basic characteristic component — reflects the inherent response characteristics of the system and is taken from the basic solution to the homogeneous characteristic equation :

$$(8.37) \quad (1-a-bg)\lambda \; - \; \left[a_1 + d_1 R_{y_n} + (b_1 + d_1 R_p) g \right] = 0$$

This equation has a single root λ and hence the basic characteristic component, $\hat{\dot{y}}_t$, of the time path of the endogenous variables may be written as

$$(8.38) \quad \hat{\dot{y}}_t = u \lambda^t$$

where u is a vector of arbitrary constants to be determined by initial conditions. The system is stable (damped) if the absolute value of the root λ is less than unity and unstable (explosive) otherwise.

The second component of the complete solution reflects the exogenous stimuli and is obtained by taking a particular solution of (8.30). This particular component clearly depends upon the time path of the exogenous variables. An important special case is usually considered, i.e., the one when $\dot{z}_t$ is constant over time : $\dot{z}_t = \bar{\dot{z}}$ for all t.

Then the particular solution is also a constant which is given by $\bar{\dot{y}}$ where

$$B_o \bar{\dot{y}} = B_1 \bar{\dot{y}} + \Gamma \bar{\dot{z}}$$

or,

$$(8.39) \qquad \bar{\dot{y}} = (B_o - B_1)^{-1} \Gamma \bar{\dot{z}}$$

Taken together, the basic characteristic component, $\hat{\dot{y}}_t$, and the particular component, $\bar{\dot{y}}$, provide a basic complete solution. And when the vector u is evaluated at specific initial conditions, it represents the <u>initial condition component</u> of the full complete solution. Denoting the evaluated u vector by $\check{u}$, we have the full complete solution :

$$(8.40) \qquad \dot{y}_t = \check{u} \lambda^t + \bar{\dot{y}}$$

where $\bar{\dot{y}}$ is given by (8.39), the case corresponding to $\dot{z}_t = \bar{\dot{z}}$ for all t.

One final result remains to be stated. Our discussion runs in terms of the first differences of the variables. However, Goldberger (1959, pp. 113-14) demonstrates that the inherent dynamic properties — stability etc., — carry over from first differences to absolute levels of variables. In other words, if the system in first differences of variables is stable (unstable), then the system in terms of absolute <u>levels</u> of variables is also stable (unstable). In fact, the time path of the levels, rather than changes, of the endogenous variables can be easily derived. Supposing that initial levels of endogenous variables are given by y_{-1} , their levels at any time T (y_T) is obtained by simply cumulating the changes[3/] :

3/ See Goldberger (1959, f.n. 7, p. 82).

$$(8.41) \qquad y_T = y_{-1} + \dot{y}_o + \dot{y}_1 + \dot{y}_2 + \ldots + \dot{y}_T = y_{-1} + \sum_{t=o}^{T} \dot{y}_t$$

Now, from (8.37) we find that

$$\lambda = \frac{a_1 + d_1 R_{y_n} + (b_1 + d_1 R_p)\, g}{1 - a - bg}$$

The coefficients of the reduced form have, however, following values in our case :

$$(8.42) \qquad \begin{array}{ll} a = 0.146 & bg = 0.369 \\ a_1 = 0.192 & (b_1 + d_1 R_p) g = -0.555 \\ d_1 R_{y_n} = -0.038 & \end{array}$$

Therefore,

$$(8.43) \qquad \lambda = \frac{0.192 - 0.038 - 0.555}{1 - 0.146 - 0.369} = -0.827$$

Since the absolute value of λ is less than unity, our system is stable. However, λ being negative, the path of any endogenous variable is (damped) alternating.

Next, one can find the various multipliers of our system — impact and dynamic. The impact multipliers of unit changes in lagged endogenous and exogenous variables can in fact be calculated from (8.30) as follows :

$$(8.44) \qquad \dot{y}_t = B_o^{-1} B_1 \dot{y}_{t-1} + B_o^{-1} \Gamma \dot{z}_t$$

We shall, however, calculate what Goldberger (1959, pp. 109-13, 115-16, 121-24) has termed <u>equilibrium multipliers</u>. This is in tune of the discussion of our theoretical model presented in Chapter 4. There we discussed the comparative statics results, i.e., the effects that ultimately come upon the endogenous variables in response to a specified change in some exogenous variable.

The particular solution for the endogenous variables in the case of constant $\dot{\bar{z}}$ over time is given by (8.39) which is reproduced below :

$$(8.39) \qquad \dot{\bar{y}} = (B_o - B_1)^{-1} \, \Gamma \, \dot{\bar{z}}$$

Since any given column of the matrix, $(B_o - B_1)^{-1} \, \Gamma$, gives the constant annual changes in the endogenous variables which are compatible with a constant annual change of one unit in the corresponding exogenous variable, the elements of the given column may also be interpreted as the changes in the equilibrium levels of the variables that ultimately come about in response to a unit increase in the level of the relevant exogenous variable(which is thereafter sustained at the level)[4/]. In

---

4/ See Goldberger (1959, pp. 123, 127). Suppose that the initial situation is one of static equilibrium, i.e., $\dot{y}_{-1} = 0$ and that y_{-1} gives the initial levels of endogenous variables. Suppose further that the j-th exogenous variable in z increases by one unit in period 0 and then remains constant thereafter while no change occurs in the other exogenous variables in any period. Thus $(\dot{z}_j)_t = 0$ for $t > 0$ while $(\dot{z}_j)_o = 1$ and all other components of $\dot{z}$ are zero for all $t \geq 0$. Let Γ_j be the j-th column of the matrix Γ. Then from (8.44) we obtain

$$(8.39.1) \qquad \begin{aligned} \dot{y}_o &= B_o^{-1} \, \Gamma_j \\ \dot{y}_t &= (B_o^{-1} B_1)^t \, B_o^{-1} \, \Gamma_j \qquad \text{for } t > 0 \end{aligned}$$

(contd. to the next page)

other words, the equilibrium multiplier of a unit change in any exogenous variable is given by the relevant column of the matrix $(B_o - B_1)^{-1} \Gamma$.

Before we present the equilibrium multipliers we shall note one point. The time variable in $\dot{z}$ (and the corresponding column in Γ) will be neglected. One can, of course, study the effects of the operation

---

Footnote 4 contd.:

Therefore, the levels of the endogenous variables in year T can be calculated in the way given by (8.41) :

$$y_T = y_{-1} + \sum_{t=0}^{T} \dot{y}_t$$

or, we have from (8.39.1)

$$(8.39.2) \quad y_T - y_{-1} = \left[I + (B_o^{-1} B_1) + (B_o^{-1} B_1)^2 + \ldots + (B_o^{-1} B_1)^T \right] B_o^{-1} \Gamma_j,$$

If $(B_o^{-1} B_1)^t \rightarrow 0$ as $t \rightarrow \infty$, the bracketed expression on the RHS of (8.39.2) $\rightarrow$ $(I - B_o^{-1} B_1)^{-1}$ and the change in the equilibrium level of the endogenous variables over the initial equilibrium level is given by

$$(8.39.3) \quad (I - B_o^{-1} B_1)^{-1} \; B_o^{-1} \; \Gamma_j$$

It remains to be seen that the expression in (8.39.3) is equal to $(B_o - B_1)^{-1} \; \Gamma_j$. But this is very easy to show. Let us write

$$(I - B_o^{-1} B_1)^{-1} \; B_o^{-1} = A$$

Then post-multiplying both sides first by B_o and then by $(I - B_o^{-1} B_1)$ we get

$$I = AB_o \; (I - B_o^{-1} B_1)$$

$$= A(B_o - B_1)$$

or,

$$A = (B_o - B_1)^{-1}$$

which then yields the desired result. It can also be shown that as $t \rightarrow \infty$, $(B_o^{-1} B_1)^t \rightarrow 0$ provided the characteristic equation (8.37) has root whose absolute value is less than unity.

of t in isolation[5]. In fact, since by definition t increases by 1.0 each year, one may make the following specification of the time path of the exogenous vector $\dot{z}_t$: all its components except that corresponding to t are zero for all the time and the component of t is 1. One then gets from (8.44) the time path of the endogenous variables in response to the operation of t only. We shall not pursue the matter, but only make a few comments. We have to note that t is there in only one estimated equation, i.e., the one corresponding to the short-term interest rate (the equation (8.11) or (8.11)'). There the main argument for the introduction of t was to capture the effect of increasing degree of monetisation on the demand for money and hence on the rate of interest. Statistically, of course, the introduction of t as an explanatory variable in any equation has the effect of eliminating trend from all the variables. Or, it may be interpreted as a catch-all variable introduced to capture the effects of all other possible explanatory variables which have time trends. There may be other variables which might have influenced the demand for money and which might be increasing over time (e.g., wealth[6]). Hence the neglect of time would mean that we are, in effect, assuming these other variables to remain constant.

We now present our results. Table 8.1 gives the figures of the coefficients of the matrices B_o, B_1 and Γ of the system of equations (8.26) or (8.30).

5/ See, e.g., the discussion in Goldberger (1959, pp.97-100).

6/ As we have pointed out in the preceding chapter, Bhattacharya (1971) observes that the net worth of the private sector has significantly affected the demand for money in India.

Table 8.1 : Form : $B_o \dot{y} = B_1 \dot{y}_{-1} + \Gamma \dot{z}$ with vectors $\dot{y}$, $\dot{y}_{-1}$ and $\dot{z}$ displayed transposed above the matrices B_o, B_1 and Γ respectively.

Equation No.	Y^n	P	P^n	P^a	r^1		Y^n_{-1}	P_{-1}	r^1_{-1}	C^n	Q^a	Y^a	M	GS	t
(8.26.1)	.854	-2070.000					.192	-2466.700	-369.378	1.0		.632			
(8.26.2)	-.000178	1.0									.000476	-.000411			
(8.26.3)	-.00000678	-2.013	1.0			=									
(8.26.4)		-1.018	-.942	1.0											
(8.26.5)	-.000102	-1.771			1.0							.0000555	-.00115	.00022	.141

Table 8.2 shows the equilibrium multiplier effects upon two endogenous variables — Y^n and P — of a unit increase in the various exogenous variables — Q^n, Q^a, Y^a, M and GS. These effects are shown by the relevant columns of the Table 8.2.

Table 8.2 : (Equilibrium) multiplier effects on two endogenous variables Y^n and P of a unit increase in the various exogenous variables.

endogenous variable	exogenous variable				
	Q^n	Q^a	Y^a	M	GS
Y^n	1.1287	-0.5617	1.1746	0.4786	-0.0914
P	0.0002009	0.0003761	-0.0002019	0.0000852	-0.0000163

Similarly, multiplier effects on other endogenous variables P^n, P^a, r^1 can easily be obtained. However, it is convenient to present these effects in terms of elasticities (computed again at the sample means of the variables). Table 8.3 presents these elasticities where other endogenous variables P^n, P^a and r^1 are also included.

Table 8.3 : Percentage change in the equilibrium values of endogenous variables in response to a one per cent increase in the various exogenous variables

endogenous variable	exogenous variable				
	Q^n	Q^a	Y^a	M	GS
Y^n	0.33	-0.01	1.22	0.15	-0.05
P	0.35	0.04	-1.24	0.16	-0.05
P^n	0.90	0.08	-2.17	0.40	-0.14
P^a	1.25	0.12	-3.41	0.56	-0.19
r^1	0.20	0.02	-0.28	-0.43	+0.15

8.6 A Discussion of Results

In this section we discuss the results given in Tables 8.2 and 8.3.

It is sometimes argued that a Keynesian model is not applicable to an underdeveloped country where supply of goods is usually inelastic in the short-run. In such a case a rise in autonomous demand (like government expenditures) would raise mainly prices and not production[7]. Our empirical results show that even if we assume that excess capacity is present in the non-agricultural sector and that production in this sector is perfectly elastic, a rise in the autonomous demand for the good of this sector exerts a greater influence on prices than on production. As our Table 8.3 shows, a one per cent rise in Q^n raises Y^n by only 0.33 per cent. However,

7/ See Rao (1952).

the relative price of agricultural good rises by 0.35 per cent and absolute prices of agricultural and non-agricultural goods rise by 1.25 and 0.90 per cent respectively.

A rise in the autonomous demand for agricultural good reduces non-agricultural income but increases the relative price of agricultural good, two absolute prices and the rate of interest. The elasticities given in column 2 of the Table 8.3 are seen to be rather low. This is because of the fact that the average level of Q^a is very small over our sample period[8/].

A rise in Y^a has all sorts of favourable effects on the economy. A one per cent rise in Y^a raises Y^n by 1.22 per cent, but reduces the relative price of agricultural good by 1.24 per cent. The agricultural price falls by 3.41 per cent while the non-agricultural price falls by 2.17 per cent. It therefore follows that a rise in Y^a reduces money income $(P^aY^a + P^nY^n)$. It is not possible to test such a result against the data. For, these equilibrium multipliers show effects on endogenous variables which ultimately come about in response to a specified shift in

8/ This is obvious if one compares Tables 8.2 and 8.3 and the results corresponding to Q^a and Y^a, both being measured in the same unit. From Table 8.2 it is seen that a unit rise in Q^a raises P by 0.0003761 while that in Y^a reduces P by only 0.0002019. However, from Table 8.3 it is seen that the percentage change in P is only 0.04, if Q^a rises by one per cent but as much as -1.24, if Y^a rises by one per cent. Results of a similar nature hold good in case of Y^n too. In fact, the elasticity of an endogenous variable Y with respect to an exogenous variable Z is given by $\frac{dY}{dZ} \cdot \frac{Z}{Y}$. This will be small (high) if the average sample value of Z is small (high). The average levels of Q^a and Y^a are 89 and 6229 crores of rupees (at 1960-61 prices), respectively.

only one exogenous variable and the real world experiences shocks occuring from all exogenous variables at the same time. Still we may point out that during the First Plan period money national income had fallen in several years[9] and that the First Plan period witnessed substantial growth in agricultural output.

A rise in the base money raises non-agricultural income. But equally important is the effect on prices. Although a comparison with the strict quantity theory cannot be made (since we consider here only the base money and not the total money supply) however, a strict quantity theory does not seem to hold good. A one per cent rise in the base money raises agricultural and non-agricultural prices by 0.56 and 0.40 per cent respectively and reduces the long-term rate of interest by 0.43 per cent.

In the theoretical model in Chapter 4 we did not bring in the stock of government securities. Here we find that a rise in the stock of government securities has, however, small effects on the economy. A one per cent rise in this variable reduces non-agricultural income and the relative price of agricultural good by 0.05 per cent each. Prices of non-agricultural and agricultural goods also fall by 0.14 and 0.19 per cent respectively. The long-term rate of interest, however, rises by 0.15 per cent.

9/ Years 1952-53, 1954-55 and 1955-56. See our Table B.1 in the Appendix B.

8.7 A Final Observation

In the theoretical model set out in Chapter 4 the discussion was run in terms of two demand functions — one for the agricultural good and the other for the non-agricultural good. We made certain assumptions about the partial derivatives of these functions with respect to relative price of agricultural good, non-agricultural income, agricultural income etc. The model, it is to be borne in mind, was cast in terms of (static) equilibrium situations, i.e., the relations which would obtain at the end of the process of all adjustments. And the assumptions about the partial derivatives of the demand functions were made to derive comparative static results — results obtained by comparing two static equilibrium situations.

To obtain these equilibrium relations, therefore, we have to consider the particular solution of our model, the one noted in (8.39). This is, in fact, obtained by substituting $\dot{Y}^n = \dot{Y}^n_{-1} = \bar{\dot{Y}}^n$, $\dot{P} = \dot{P}_{-1} = \bar{\dot{P}}$, $\dot{r}^l = \dot{r}^l_{-1} = \bar{\dot{r}}^l$ etc. in the various relations. Thus from (8.21) we get

$$(8.45)\quad \bar{\dot{Y}}^n = a\bar{\dot{Y}}^n + b\bar{\dot{P}} + a_1\bar{\dot{Y}}^n + b_1\bar{\dot{P}} + d_1\bar{\dot{r}}^l + \bar{\dot{Q}}^n + c\bar{\dot{Y}}^a$$

while from (8.19) we get

$$(8.46)\quad \bar{\dot{r}}^l = R_{y_n}\bar{\dot{Y}}^n + R_p\bar{\dot{P}} + R_{y_a}\bar{\dot{Y}}^a + R_m\bar{\dot{M}} + R_{gs}\bar{\dot{GS}}$$

Therefore, from (8.45) and (8.46) we obtain

$$(8.47)\quad \bar{\dot{Y}}^n = (a + a_1 + d_1 R_{y_n})\bar{\dot{Y}}^n + (b + b_1 + d_1 R_p)\bar{\dot{P}} + \bar{\dot{Q}}^n + (c + d_1 R_{y_a})\bar{\dot{Y}}^a + (d_1 R_m)\bar{\dot{M}} + (d_1 R_{gs})\bar{\dot{GS}}$$

The LHS of (8.47) gives the change in the non-agricultural income while the RHS gives the change in the demand for non-agricultural good. Therefore, using the notations of Chapter 4 and inserting the estimates of the coefficients, we find

$$
\begin{aligned}
(8.48)\qquad D^n_{y_n} &= a + a_1 + d_1 R_{y_n} &&= 0.300 < 1 \\
D^n_p &= b + b_1 + d_1 R_p &&= -1045.5 < 0 \\
D^n_{y_a} &= c + d_1 R_{y_a} &&= 0.611 > 0 \\
D^n_m &= d_1 R_m &&= 0.424 > 0
\end{aligned}
$$

Similarly, for the agricultural good we get from (8.23) :

$$
(8.49)\qquad \dot{\bar{Y}}^a = (a_9 + a_7)\, \dot{\bar{Y}}^n + (a_9 Y^a + b_9 + \frac{1}{P^2} \beta Y^a)\, \dot{\bar{P}} + \dot{\bar{Q}}^a + (a_9 P - \frac{1}{P} \beta - a_{10})\, \dot{\bar{Y}}^a
$$

The LHS gives the change in the agricultural income while RHS gives the change in the demand for the agricultural good. Again using the notations of Chapter 4 and inserting estimates of these coefficients, we find that

$$
\begin{aligned}
(8.50)\qquad D^a_{y_n} &= a_9 + a_7 &&= 0.374 > 0 \\
D^a_p &= a_9 Y^a + b_9 + \frac{1}{P^2} \beta Y^a &&= -2102.4 < 0 \\
D^a_{y_a} &= a_9 P - \frac{1}{P} \beta - a_{10} &&= 0.135 < 1
\end{aligned}
$$

Thus (8.48) and (8.50) show that all the assumptions (A1)-(A6) of Chapter 4 are satisfied and hence the four Propositions of Chapter 4 hold good. This was in fact obvious when we presented equilibrium multipliers in the preceding two sections of the present chapter.

APPENDICES

Appendix A

APPENDIX TO CHAPTER 4

A.1 Theorems on Implicit Functions

THEOREM 1 : Let $F(Y; X^1, \ldots, X^m)$ be a continuously differentiable function (i.e., continuous function possessing continuous partial derivatives) of the independent variables Y and $\{X^1, \ldots, X^m\}$. Let $(Y_o; X_o^1, \ldots, X_o^m)$ be an interior point of the region of definition of F such that

$$(A.1) \qquad F(Y_o; X_o^1, \ldots, X_o^m) = 0$$

and

$$(A.2) \qquad F_y(Y_o; X_o^1, \ldots, X_o^m) \neq 0$$

Then there exists a region R containing $(X_o^1, \ldots, X_o^m)$ in its interior and an interval $Y_1 \leqq Y \leqq Y_2$ around Y_o such that for every $(X^1, \ldots, X^m)$ in R the equation $F(Y; X^1, \ldots, X^m) = 0$ is satisfied by exactly one value of Y in the interval $Y_1 \leqq Y \leqq Y_2$ which is given by a unique function

$$(A.3) \qquad Y = G(X^1, \ldots, X^m)$$

For this value of Y, the equation

$$F\left\{G(X^1, \ldots, X^m); \quad X^1, \ldots, X^m\right\} = 0$$

holds identically in R and, in addition,

$$Y_o = G(X_o^1, \ldots, X_o^m)$$

Further, the function G is continuously differentiable with its partial derivatives being given by

$$(A.4) \qquad G_{x_i} = -\frac{F_{x_i}}{F_y} \qquad (i = 1, \ldots, m)$$

THEOREM 2 : Let $\phi(Y, Z; X^1, \ldots, X^m)$ and $\psi(Y, Z; X^1, \ldots, X^m)$ be two continuously differentiable functions of Y, Z and other independent variables $\{X^1, \ldots, X^m\}$, in a neighbourhood of the point $(Y_o, Z_o; X_o^1, \ldots, X_o^m)$ at which the following equations

$$(A.5) \qquad \begin{aligned} \phi(Y, Z; X^1, \ldots, X^m) &= 0 \\ \psi(Y, Z; X^1, \ldots, X^m) &= 0 \end{aligned}$$

are satisfied. Further, let the Jacobian of ϕ and ψ with respect to Y and Z, i.e.,

$$(A.6) \qquad J = \begin{vmatrix} \phi_y & \phi_z \\ \psi_y & \psi_z \end{vmatrix} = \phi_y \psi_z - \psi_y \phi_z$$

differ from zero at this point. Then in the neighbourhood of the point there exist a <u>unique</u> pair of continuously differentiable functions

$$(A.7) \qquad \begin{aligned} Y &= G(X^1, \ldots, X^m) \\ Z &= H(X^1, \ldots, X^m) \end{aligned}$$

which satisfy the equations (A.5) and the conditions : $Y_o = G(X_o^1, \ldots, X_o^m)$, $Z_o = H(X_o^1, \ldots, X_o^m)$. Further, the partial derivatives of the functions G and H are given by

$$(A.8)\qquad G_{x_i} = -\frac{1}{J}\begin{vmatrix} \phi_{x_i} & \phi_z \\ \psi_{x_i} & \psi_z \end{vmatrix} \qquad H_{x_i} = -\frac{1}{J}\begin{vmatrix} \phi_y & \phi_{x_i} \\ \psi_y & \psi_{x_i} \end{vmatrix} \qquad (i = 1, \ldots, m)$$

For statements and proofs of these theorems see Courant (1936, pp. 117-21, 153), or Khinchin (1960, pp. 462-75).

A.2 The Solution of r in Terms of Y^n, P, Y^a and M

The relation (4.34) in the text has been derived from the equations (4.29)-(4.33). With the help of (4.31)-(4.33), equations (4.29) and (4.30) can be rewritten as follows :

$$(A.9)\qquad \begin{aligned} L'(r, P^n, Y^n, P; Y^a, M) &\equiv L\{P^n(PY^a + Y^n), M\} - r = 0 \\ F'(P^n, Y^n, P) &\equiv F(PP^n, Y^n) - P^n = 0 \end{aligned}$$

We have at the equilibrium point

$$(A.10)\qquad V \equiv \begin{vmatrix} L'_r & L'_{P_n} \\ F'_r & F'_{P_n} \end{vmatrix} = \begin{vmatrix} -1 & YL_{y'} \\ 0 & PF_{P_a} - 1 \end{vmatrix} = (1 - PF_{P_a})$$

which is greater than zero, in view of (4.29). Therefore, by Theorem 2 (stated in the previous section), r (and also P^n) can be solved uniquely in terms of other variables around the equilibrium point :

(A.11) $r = R\,(Y^n, P;\ Y^a, M)$

where R is a continuously differentiable function whose partial derivatives are calculated as follows :

$$R_{y_n} = -\frac{1}{V}\begin{vmatrix} L'_{y_n} & L'_{p_n} \\ F'_{y_n} & F'_{p_n} \end{vmatrix} = -\frac{1}{V}\begin{vmatrix} P^n L_{y'} & YL_{y'} \\ F_{y_n} & (PF_{p_a} - 1) \end{vmatrix}$$

$$= -\frac{1}{(1 - PF_{p_a})}\left[(PF_{p_a} - 1)\,P^n L_{y'} - YL_{y'}F_{y_n}\right]$$

$$= L_{y'}\left(P^n + Y\frac{F_{y_n}}{1 - PF_{p_a}}\right)$$

(A.12)

$$R_p = -\frac{1}{V}\begin{vmatrix} L'_p & L'_{p_n} \\ F'_p & F'_{p_n} \end{vmatrix} = -\frac{1}{V}\begin{vmatrix} P^n Y^a L_{y'} & YL_{y'} \\ P^n F_{p_a} & (PF_{p_a} - 1) \end{vmatrix}$$

$$= -\frac{1}{(1-PF_{p_a})}\left[P^n Y^a L_{y'}\,(PF_{p_a} - 1) - P^n F_{p_a}\,YL_{y'}\right]$$

$$= L_{y'}P^n\left(Y^a + \frac{YF_{p_a}}{1 - PF_{p_a}}\right)$$

$$R_{y_a} = -\frac{1}{V}\begin{vmatrix} L'_{y_a} & L'_{p_n} \\ F'_{y_a} & F'_{p_n} \end{vmatrix} = -\frac{1}{V}\begin{vmatrix} P^a L_{y'} & YL_{y'} \\ 0 & (PF_{p_a} - 1) \end{vmatrix}$$

$$= -\frac{1}{(1-PF_{p_a})}\left[P^a L_{y'}\,(PF_{p_a} - 1)\right]$$

$$= P^a L_{y'}$$

$$R_m = -\frac{1}{V}\begin{vmatrix} L_m' & L_{p_n}' \\ F_m' & F_{p_n}' \end{vmatrix} = -\frac{1}{V}\begin{vmatrix} L_m & YL_y' \\ 0 & (PF_{p_a} - 1) \end{vmatrix}$$

$$= -\frac{1}{(1 - PF_{p_a})}\left[L_m \; (PF_{p_a} - 1) \right]$$

$$= L_m$$

A.3 Empirical Results for I^a

This section is devoted to a discussion of a few empirical results for the private investment demand for non-agricultural good in the agricultural sector (I^a). For this purpose, we have considered four possible explanatory variables : (real) income in the agricultural sector (Y^a), relative price of agricultural good (P), a long-term rate of interest (r^1) and the government capital stock in the agricultural sector (GK^a), obtained by cumulating the government investment in this sector (GI^a). A rise in P means that the price of the product of the agricultural sector increases relatively to the cost of making investment in this sector. Hence a rise (fall) in P will tend to raise (reduce) profitability of investment in the agricultural sector. On a priori grounds, therefore, the coefficient of P in the I^a equation is expected to be positive. A variable like GK^a is considered on the ground that developmental activities (like irrigation facilities, multi-purpose river valley schemes etc.) are usually big in size which could be provided only by the government, and that private investment (like land improvements, uses of agricultural machineries, etc.) is likely to be influenced very much by the availability of these facilities.

To have some idea about the influence of relative price, we first consider agricultural income and one-year lagged value of the relative price as two possible explanatory variables and the estimated equation is given below[1/]:

$$\text{(A.13)} \quad I^a = \underset{(-0.773)}{-662.108} + \underset{(2.123)}{0.082}\, Y^a + \underset{(0.366)}{278.929}\, P_{-1}$$

$$\bar{R}^2 = 0.15$$

We see that although the coefficient of income variable has a t-ratio exceeding two, the coefficient of relative price is not at all significant. When P_{-1} in (A.13) is replaced by P, results do not improve at all, the t-ratio for the coefficient of relative price still remaining below unity (0.774). Introducing Y^a_{-1} (and not Y^a) as an explanatory variable with any one of P or P_{-1} does not help to make the coefficient of relative price significant. One such result is given below :

$$\text{(A.14)} \quad I^a = \underset{(-0.414)}{-255.551} + \underset{(3.704)}{0.101}\, Y^a_{-1} - \underset{(-0.386)}{232.032}\, P_{-1}$$

$$\bar{R}^2 = 0.46.$$

1/ For each equation the log-linear specification has yielded worse result than its linear counterpart so that we report only the latter here.

We see that the relative price has now a negative (although, not significant) coefficient, contrary to a priori expectation.

Exercises with long-term rate of interest (r^1) as a possible explanatory variable for the I^a function do not yield satisfactory results. In all equations where r^1 (current or lagged) is introduced as one explanatory variable, with either Y^a (current or lagged) as another regressor or with Y^a and P (current or lagged) as two other regressors, the coefficient of r^1 never comes out to be significant. Two such results are given below :

$$(A.15) \quad I^a = \underset{(-1.175)}{-\,228.362} - \underset{(-0.485)}{0.031}\, Y^a + \underset{(1.631)}{1.431}\, r^1_{-1}$$

$$\bar{R}^2 = 0.23$$

$$(A.16) \quad I^a = \underset{(-0.494)}{-\,311.998} + \underset{(1.496)}{0.103}\, Y^a_{-1} - \underset{(-0.283)}{172.316}\, P_{-1} - \underset{(-0.039)}{4.074}\, r^1_{-1}$$

$$\bar{R}^2 = 0.40$$

We thus see that not only is the coefficient of the rate of interest not significant, but (A.15) has all sorts of perverse results, viz., the coefficient of income is negative and that of rate of interest is positive. Of course, none of the coefficients in the above two equations is significant.

The next exercise considers GK^a and relative price (current or lagged) as two regressors for the I^a equation. However, relative price never comes out to have a significant coefficient. One such result is presented below :

$$(A.17) \quad I^a = \underset{(0.031)}{18.623} + \underset{(3.843)}{0.124}\, GK^a + \underset{(0.023)}{13.563}\, P_{-1}$$

$$\bar{R}^2 = 0.48$$

However, the coefficient of GK^a is positive and significant, confirming our earlier arguments.

All the above exercises suggest that neither the rate of interest nor the relative price of agricultural good has any significant influence on private investment in the agricultural sector. Agricultural income — both current and one year lagged — may have some influence on I^a and preferably, one should consider some average of the two figures as the relevant income variable. Also, the government's developmental activities in the agricultural sector (measured by GK^a) is likely to influence I^a. As a last exercise, therefore, we introduce both Y^a and GK^a as two possible regressors in the I^a equation and the estimated equation is given below :

$$(A.18) \quad I^a = \underset{(1.677)}{516.348} - \underset{(-1.577)}{0.088}\, Y^a + \underset{(3.429)}{0.208}\, GK^a$$

$$\bar{R}^2 = 0.57$$

We see that the coefficient of income variable is negative (not significant) while that of GK^a is positive and significant. Even if Y^a in (A.18) is replaced by Y^a_{-1} or by an average of Y^a and Y^a_{-1} (let us call it, Y^a_{avr}), the coefficient of the income variable remains negative which is difficult to accept. One such result is shown below :

$$(A.19) \quad I^a = \underset{(1.328)}{779.206} - \underset{(-1.274)}{0.139}\, Y^a_{avr} + \underset{(2.274)}{0.271}\, GK^a$$

$$\bar{R}^2 = 0.54$$

All these results indicate that I^a is significantly influenced neither by relative price, nor by rate of interest, nor even by income in the agricultural sector. Only GK^a may have some influence on I^a. Since GK^a (or even Y^a) in our model is assumed to be determined exogenously, we may conclude that the private investment in agriculture is independent of endogenous forces. And this is the assumption which has been made in our model.

Appendix B

DATA AND THEIR SOURCES

D.1 Price Indices : P^a, P^n, P

P^a : price index of agricultural good;

P^n : price index of non-agricultural good;

P : relative price of agricultural good ($= P^a/P^n$).

All indices are given with base 1960-61 = 1.000.

The price indices of agricultural and non-agricultural goods are estimated by us from the wholesale price indices of various articles (with base 1952-53 = 100), as published in the monthly issues of the Reserve Bank of India (RBI) Bulletin. As for example, figures for the period from 1950-51 to 1955-56 are taken from RBI (1960, 1962). The following items have been defined as agricultural commodities in our case :

item	weight in the general index	weight in the group of agricultural good
1. foodgrains (cereals and pulses)	0.235	0.405
2. fruits and vegetables	0.023	0.040
3. milk and ghee	0.084	0.145
4. fish, eggs and meet	0.017	0.029
5. other food articles	0.050	0.086
6. tobacco raw	0.016	0.028
7. industrial raw materials (fibres, oilseeds, minerals and others)	0.155	0.267
total	0.580	1.000

The price index of our agricultural good (P^a) is estimated as the weighted average of the above 7 items, the weights being their respective importance in this group of items, as shown in the last column. The remaining items in the general (all commodity) price index (to be denoted by p) are defined as non-agricultural commodities having total weight amounting to 0.420. The price index of non-agricultural good (P^n) is then computed by the following rule :

$$(B.1.1) \qquad P^n = \frac{p - 0.580\, P^a}{0.420}$$

These price indices are then converted to the base 1960-61 = 1.0, which are shown in columns (1) and (2) of Table B.1, respectively. The relative price of agricultural good (P) is derived by dividing P^a by P^n and this is shown in column (3) of Table B.1.

Two points should be mentioned in connection with these indices.

First, RBI also computes and publishes price index of agricultural commodities. This, however, cannot be used for our purpose. For, it has a lower coverage than what we need, since agriculture in our work also includes animal husbandry and ancilliary activities. Secondly, some of the items included here in the group of agricultural good are, strictly speaking, non-agricultural commodities (as for example, minerals). However, they are included, as annual figures separately for them are not available for all the years under study. In any case they have very insignificant weights in the group of agricultural commodities.

B.2 : Incomes : Y^a, Y^n, Y, Y'

Y^a : (real) income in the agricultural sector;

Y^n : (real) income in the non-agricultural sector;

Y : aggregate (real) income in the two sectors, measured in terms of non-agricultural price ($= PY^a + Y^n$);

Y' : aggregate money income in the two sectors;

Y^a and Y^n are measured at 1960-61 prices while Y' is at current prices. All the above four variables are expressed in crores of rupees.

Figures for incomes in the agricultural and non-agricultural sectors at 1960-61 prices (Y^a and Y^n) are taken from Government of India (1964a,1971). Net domestic product (NDP, in short) in agriculture (proper), animal husbandry, forestry and logging, and fishing are added to yield Y^a while those in the remaining sectors of the economy are added to give Y^n. Figures for the period, 1954-55 to 1965-66, are taken from Government of India (1971) which publishes Revised Series estimates of NDP. Figures for years prior to 1954-55 are computed in the following way from the Conventional estimates of NDP, as given in Govt. of India (1964a). Year-to-year percentage changes in the 'conventional' estimates of NDP in agriculture and non-agriculture at 1948-49 prices are first calculated and then the 'revised series' estimates of Y^a and Y^n are carried backwards by making use of these percentage changes. Y^a and Y^n are given in columns (4) and (5) of Table B.1.

$Y = PY^a + Y^n$; computed from columns (3)-(5) and shown in column (6) of Table B.1,

$Y' = P^aY^a + P^nY^n$; computed from columns (1), (2), (4) and (5) and shown in column (7) of Table B.1.

B.3 Intersectoral Flows : X^{na}, X^{an}

X^{na} : amount of non-agricultural good used as intermediate inputs in agriculture;

X^{an} : amount of agricultural good used as intermediate inputs in non-agriculture;

Both variables are measured at 1960-61 prices and expressed in crores of rupees.

X^{na} is estimated to be $0.027Y^a$ and it is shown in column (8) of Table B.1. The method of estimating the coefficient 0.027 for X^{na} as well as a part of the method of estimating X^{an} has been described in Section 5.1 of Chapter 5. The rest is described below.

To obtain X^{an}, a time series is first constructed for the index of production of agro-based industries. For the period, 1960 to 1965, figures of this index are taken from various issues of RBI's annual publication Report on Currency and Finance. However, such an index is not available for years prior to 1960 and we have estimated its figures for these years as follows.

For two years 1950 and 1951 an index of production of agro-based industries is computed as the weighted average of indices of production of cotton cloth, cotton yarn, jute manufactures, woollen manufactures and sugar; all these indices are given with base year 1946 = 100. For the period, 1951 to 1960, we have, however, used the weighted average of indices of production of sugar, tea processing, cigarettes, cotton and woollen textiles and jute manufactures; figures of these indices are given with base 1951 = 100 for the period, 1951 to 1955, and with base 1956 = 100, for the period, 1955 to 1960. Figures of aforesaid indices are taken from various issues of the RBI's annual publication, Report on Currency and Finance.

We thus get the index of production of agro-based industries with different years as base years, viz., 1946, 1951, 1956 and 1960. Assuming that the figure for a calendar year refers to the corresponding financial year, the index is then converted to a common base 1960-61 = 1.000. This is denoted by Z and given in column (21) of Table B.2. Now, X^{an} is estimated to be Rs.2084 crores (at 1960-61 prices) in the year 1964-65 (see Section 5.1 of Chapter 5). Hence flows from agriculture to non-agriculture (at 1960-61 prices) are easily calculated as follows :

$$X^{an} = 2084 \times \frac{Z}{1.184}$$

where 1.184 is the value of Z in the year 1964-65. This series is shown in column (9) of Table B.1.

B.4. Investments : I^a, I^n, GI, Δ SA

I^a : private investment (in the form of non-agricultural good) in the agricultural sector;

I^n : private investment (in the form of non-agricultural good) in the non-agricultural sector;

GI : government total investment (in the form of non-agricultural good);

Δ SA : changes in the total (private and government) stock of agricultural good;

All variables are measured at 1960-61 prices and expressed in crores of rupees.

Total net investment in the whole economy at 1960-61 prices is taken from Lal (1970). Let us call this series NDCF. This is given in column (1) of Table B.2. Further, from the same source we calculate the change in stock of agricultural commodities as follows.

The Appendix 1.3 of Lal gives changes in stocks of different commodities, viz., (a) foodgrains, (b) agricultural other than foodgrains, (c) livestock, etc., as well as changes in stocks of commodities in different sectors, viz., (i) manufacturing, (ii) commerce, (iii) mining, (iv) electricity and (v) public administration (excluding foodgrains). Now, (a) (b) and (c) are all agricultural commodities while a portion of stocks held in (i) and (ii) is in the form of agricultural commodities. We assume that 13 per cent of changes in stocks in manufacturing and 15 per cent of that in commerce are changes in stocks of agricultural commodities. The former proportion is obtained rather arbitrarily, being the proportion of total bank advances to industries given to cotton and jute textiles (two largest users of agricultural materials) in 1964-65. The proportion in commerce is estimated in the following way. Detailed figures of stocks of different commodities held in registered wholesale trade as well as those of stocks of all commodities held in retail trade in years 1959-60 and 1960-61 are given in Government of India (1969a). Thus between these two years stocks of agricultural commodities in registered trade are estimated to have increeased by Rs. 8 crores and those of all commodities, by Rs. 54 crores. The ratio of the former to the latter comes out to 0.15. We assume this proportion to be valid for other years also. Thus, the change in stocks of agricultural commodities =(a)+(b)+(c)+ 13 per cent of (i) + 15 per cent of (ii). Since these figures are given at current prices, we divide them by the implicit price deflator for change in stocks of all commodities, as calculated from Lal (1970), and in this way, obtain the change in stocks of agricultural commodities at 1960-61 prices. This is shown as Δ SA in column (2) of Table B.2 and in column (13) of Table B.1.

Next, the total net investment in the form of non-agricultural good (to be denoted by TI) is calculated as

$$(B.4.1) \qquad TI = NDCF - \Delta SA$$

This is shown in column (3) of Table B.2. The problem now is one of dividing TI among public and private investment in two sectors — agriculture and non-agriculture.

Khera and Narain (1972) give total reproducible tangible wealth in various sectors (at 1960-61 prices) at the end of several years, 1949-50, 1950-51, 1955-56 and each of the years from 1960-61 to 1965-66. From this, total net investment as well as net investment in agriculture, animal husbandry and allied activities (the sum total of which is treated as net investment in agriculture) are calculated : over the six year period, 1949-50 to 1955-56, over the five year period, 1956-57 to 1960-61, and then for each of the years, 1961-62 to 1965-66. Then the proportions of investment in agriculture out of total investment are calculated for these periods/years and these are shown below :

period	investment in agriculture as a proportion of total investment
1949-50 to 1955-56	0.262
1956-57 to 1960-61	0.158
1961-62	0.192
1962-63	0.166
1963-64	0.182
1964-65	0.186
1965-66	0.219

We next assume that the proportion observed during the period, 1949-50 to 1955-56, or that during the period, 1956-57 to 1960-61, is valid for each of the intervening years within the given period. Applying these proportions to our series of TI, estimated earlier, we obtain total (public plus private) net investment (in the form of non-agricultural good) in the agricultural sector at 1960-61 prices. This series is called TI^a and is shown in column (4) of Table B.2.

Lal (1970) gives two series — (A) public gross domestic capital formation (DCF) in fixed assets (i.e., construction and machinery) at 1960-61 prices, and, (B) depreciation for public gross DCF at current prices. The same source also gives depreciation for total (public plus private) gross DCF at both current and 1960-61 prices and therefore an implicit price deflator for depreciation is easily calculated. Applying this deflator to the series (B) we obtain depreciation for public gross DCF at 1960-61 prices. Let us call this series (C). Subtracting now (C) from (A) we obtain public net DCF in fixed assets at 1960-61 prices. Let us call this GFI which is shown in column (5) of Table B.2. Further, Lal gives changes in stocks of all goods at 1960-61 prices (ΔS) and also the share of government holdings in ΔS for all the years under study. Let us call the last variable h. Then changes in the government stock of non-agricultural good (ΔSN^g) are calculated as follows : First, changes in total stock of non-agriculture good (ΔSN) are obtained from ΔS and ΔSA :

(B.4.2) $\Delta SN = \Delta S - \Delta SA$

and next, ΔSN^g is obtained :

(B.4.3) $\Delta SN^g = h \, \Delta SN.$

This is given in column (6) of Table B.2. Adding ΔSN^g to GFI, we obtain total public net investment (in the form of non-agricultural good) in two sectors. This is denoted by GI and is given in column (7) of

Table B.2 and also in column (19) of Table B.1 :

$$(B.4.4) \quad GI = GFI + \Delta SN^{g}$$

Now, government investment in agriculture can be estimated from the central and state government budgets published each year in the Report on Currency and Finance. From two tables in this publication : 'Capital Budget of the Govt. of India — Developmental Disbursement' and 'Capital Budgets of States — Developmental Expenditures', figures on central and state governments investment in irrigation and multipurpose river valley schemes are added together. These are given at current prices. Adjusting for depreciation and deflating by the price index of rural construction like land improvement, irrigation etc., as given in RBI (1972, p. 1748) we obtain the series of public investment (in the form of non-agricultural good) in agriculture at 1960-61 prices. This is denoted by GI^{a} and is shown in column (8) of Table B.2. Now, the series of private investment (of non-agricultural good) in agricultural sector at 1960-61 prices (I^{a}) as well as that of private investment (of non-agricultural good) in non-agricultural sector at 1960-61 prices (I^{n}) are easily calculated,

$$(B.4.5) \quad I^{a} = TI^{a} - GI^{a}$$

$$(B.4.6) \quad I^{n} = TI - GI - I^{a}$$

These are shown in columns (20) and (21) of Table B.1.

B.5 Exports and Imports : E^a, F^a, E^n, F^n

E^a : export of agricultural good;

F^a : import of agricultural good;

E^n : export of non-agricultural good;

F^n : import of non-agricultural good.

All variables are measured at 1960-61 prices and expressed in crores of rupees.

First, figures of total exports and imports of two goods are taken from Govt. of India (1964a,1971). Figures for the period, 1960-61 to 1965-66, are taken from Item Nos. 1 and 6 of "Account 6 : All Accounts — External Transactions" as given in Govt. of India (1971, pp.32-33). Figures for years prior to 1960-61 are taken from Item Nos. 1 and 2 of Table 4 in Govt. of India (1964a). These figures are shown in columns (10) and (13) of Table B.2.

The next problem is to divide the total figure into those of agricultural and non-agricultural goods. For this purpose, the following items are classified as agricultural commodities[1/]: (1) eggs (025); (2) fish : fresh, chilled or frozen (031); (3) wheat and spelt including meslin (041); (4) maize (corn) unmilled (044); (5) cereals, unmilled other than wheat, rice, barly and maize (045); (6) fruits and nuts, fresh, not including oil nuts (051); (7) vegetables, fresh and dry, roots and tubers, not including artificially dehydrated (054); (8) tea and mate (074);

1/ Figures in parantheses refer to the division number of the respective items, as given in Govt. of India (1956).

(9) spices (075); (10) tobacco unmanufactured (121); (11) hides, skins and furskins undressed (211); (12) oil seeds, oil nuts and oil kernels (221); (13) wood in the round or roughly squarred (242); (14) silk (261); (15) wool and other animal hair (262) exclusive of wool or fine hair, carded or combed, including tops and of waste of wool and other animal hair; (16) cotton (263); (17) jute (264); (18) crude animal materials, inedible, n.e.s. (291); (19) crude vegetable materials inedible, n.e.s. (292).

There are a few items which are not included in the above group owing to two reasons — (i) data on them are not available for all the years under study and (ii) their figures are insignificant. Now, export and import figures of the above 19 items are added to give exports and imports of agricultural good. Export and import figures of these items are taken from Thanawala (1967) for the period, 1950-51 to 1960-61 and from various issues of the Report on Currency and Fiance and the Reserve Bank of India Bulletin for subsequent years. These two series are shown in columns (11) and (14) of Table B.2. Since total exports and imports are already obtained, exports and imports of non-agricultural good are easily obtained and are shown in columns (12) and (15) of Table B.2.

All these export and import figures are given at current prices and hence are to be deflated by the export and import prices of two goods to obtain their values at constant prices.

Export and import prices of two goods are computed from the unit value indices of exports and imports of these items. The figures on the latter are given in various issues of the <u>Report on Currency and Finance</u> with different years as base years, viz., 1948-49, 1952-53 and 1958. So far as export prices are concerned, three indices are important for our purpose : general (all commodity) export price (p^e), export price of food (P^{ef}) and that of crude materials (P^{er}). Similarly, we have taken figures of general import price index (p^f), import price of food (P^{ff}) and that of crude materials (P^{fr}). All these indices for all the years 2/ are first converted to a uniform base 1948-49 =1.00 and then transformed to the base 1960-61 = 1.00. Then the import price index of agricultural good (P^{fa}) is computed as a weighted average of P^{ff} and P^{fr}, with weights being the shares of imports of food and raw materials in total imports of agricultural good in 1960-61. These shares are estimated to be 0.598 and 0.402 respectively. Further, the shares of imports of agricultural and non-agricultural goods in total merchandise imports in 1960-61 are estimated to be 0.268 and 0.732 respectively and therefore, the import price index of non-agricultural good (P^{fn}) is computed as

$$P^{fn} = \frac{P^f - 0.268\, P^{fa}}{0.732}$$

2/ For a few years (viz., 1957, 1958, 1959) the indices are given for calendar years only. We have assumed them to be the same as those for the corresponding financial years.

In a similar way, the export price index of agricultural good (P^{ea}) and that of non-agricultural good (P^{en}) are computed. The shares of exports of food and raw materials in total exports of agricultural good in 1960-61 are estimated to be 0.761 and 0.239 respectively while those of agricultural and non-agricultural goods in total merchandise exports in 1960-61 are 0.379 and 0.621, respectively. Thus we compute :

$$P^{ea} = 0.761 P^{ef} + 0.239 P^{er}$$

$$P^{en} = \frac{P^{e} - 0.379 P^{ea}}{0.621}$$

P^{ea}, P^{en}, P^{fa}, P^{fn} and P^{fr} are shown in columns (16)- (20) of Table B.2. Dividing exports and imports of two goods at current prices by the relevant price indices, we obtain their values at 1960-61 prices and these are shown in columns (11), (12), (16) and (17) of Table B.1.

One more trade variable we need, namely, import of machinery and equipment (F^{me}). Its figures at current prices are taken from Lal (1970); deflating that by P^{fn} we obtain its values at 1960-61 prices. This is shown in column (9) of Table B.2.

B.6 Government Consumption : GC

GC : government(real) consumption, measured at 1960-61 prices and expressed in crores of rupees.

Government consumption expenditures at current prices are taken from (a) Govt. of India (1971) for years, 1960-61 to 1965-66, and from (b) Govt. of India (1964a) for years prior to 1960-61. Since the definition of the government sector consumption has changed between these two sources, certain adjustments have been made for figures before 1960-61. In two years 1960-61 and 1961-62 both estimates of government consumption — revised estimate in (a) and conventional estimate in (b) — are given and revised estimate is, on average, 96 per cent of the conventional estimate.

Therefore, we have scaled down the figures for years, 1950-51 to 1959-60, from (a) by 4 per cent. Having obtained thus government consumption at current prices we have divided it by the implicit price deflator of the conventional series of NDP in non-agriculture, obtained from (b) and other issues of the same publication. In this way, we obtain government consumption at 1960-61 prices (GC) and this is given in column (18) of Table B.1.

B.7 : Indirect Taxes : T^a, T^n

T^a : indirect taxes less subsidies in agriculture

T^n : indirect taxes less subsidies in non-agriculture.

Both variables are measured at 1960-61 prices and expressed in crores of rupees.

Figures for total indirect taxes less subsidies (in two sectors) at current prices are first taken from Govt. of India (1971) for years, 1960-61 to 1965-66, and from Govt. of India (1964a), for years prior to 1960-61. However, indirect taxes less subsidies are not available separately for two sectors. In the input-output table of Manne and Rudra (1965), charges for trade, transport and indirect taxes in agriculture accounts for 5.78 per cent of total such charges. We assume this proportion to be valid for all the years under study. Accordingly, we compute indirect taxes less subsidies separately for two sectors — agriculture and non-agriculture — at current prices.

To obtain these figures in real terms (i.e., in terms of prices of respective sectors), we have deflated them by the implicit price deflators of NDP in respective sectors. In this way, we obtain indirect taxes less subsidies in two sectors in real terms — T^a and T^n — which are given in columns (10) and (15) of Table B.1.

B.8 : Private Consumptions and (Net) Autonomous Demands : C^a, C^n, Q^a, Q^n

Q^a : (net) autonomous demand for agricultural good;

Q^n : (net) autonomous demand for non-agricultural good;

C^a : private consumption of agricultural good;

C^n : private consumption of non-agricultural good;

All variables are measured at 1960-61 prices and expressed in crores of rupees.

$Q^a = E^a + \Delta SA - F^a$; computed from column (11)-(13) and shown in column (14) of Table B.1

$Q^n = E^n + GC + GI + I^a - F^n$; computed from columns (16)-(20) and shown in column (22) of Table B.1.

$C^a = Y^a + \frac{1}{P} X^{na} + T^a - (X^{an} + Q^a)$; computed from columns (3), (4), (8)-(10) and (14) and shown in column (23) of Table B.1.

$C^n = Y^n + PX^{an} + T^n - (X^{na} + I^n + Q^n)$; computed from columns (3), (5), (8), (9), (15), (21) and (22) and shown in column (24) in Table B.1.

B.9. Money, Rates of Interest and Government Securities : M, r^s, r^l, GS

M : unborrowed base money;

r^s : short-term rate of interest;

r^l : long-term rate of interest;

GS : stock of government securities held by the public and other banks except the RBI;

M and GS are expressed in crores of rupees while r^s and r^l are given in percentages.

In Chapter 7 we have also used another variable — the stock of money supply with the public. Let us denote it by M^s.

M^s : The definition of money adopted here is the same as used by RBI. Figures of stock of money (defined to be the sum of currency and deposit money) with public have been derived from the table entitled "Money Supply with the Public (Revised Series)" in the Reserve Bank of India Bulletin. These figures are given on a monthly basis for the period, April 1950 to March 1963, in RBI (1964, pp.1238-42) and figures for the subsequent period are taken from the subsequent issues of the Bulletin.

These figures refer to the stock of money on a particular day, e.g., at the end of a month or a year, whereas what we require is figures of average stock during the year. Such average stock is estimated by first deriving the average figure for a month by taking an arithmetic average of the figures at the beginning (assumed to be equal to that at the end of the previous month) and at the end of the given month and then deriving the yearly average by taking an arithmetic average of these monthly figures. Such average figures of stock of money with public are given in crores of rupees in column (27) of Table B.1.

M : unborrowed base money (= currency with the public + cash in hands and balances with RBI of all scheduled banks — borrowings of all scheduled banks from RBI).

Figures of currency with public, cash in hands of all scheduled banks and their balances with and borrowings from RBI are all taken from RBI (1964) and various issues of RBI Bulletins and Report on Currency and Finance. For each of these series the average stock during a particular year has been calculated as the arithmetic average of all end of week or end of month figures. The variable M, thus calculated, is shown in column (26) of Table B.1.

GS : The figures of government debt considered here include debt issued by the Govt. of India and the various State Governments[3/]. These figures are given in RBI's annual publication

3/ Because of lack of relevant figures for the whole period, the debts of the local authorities, such as port trusts, city corporations and municipalities, are not included.

Report on Currency and Finance, under the heading "Debt Position of the Govt. of India" and "Debt Position of States", respectively. These sources have been used here to derive gross value of public debt. From this, we have deducted the amount of debt held by the Central and State Governments and by non-residents so as to derive figures of the amount of the debt held by the non-government sectors[4/]. From the resulting figure government debt held in the Banking and Issue Departments of the RBI are further deducted so as to get figures of public debt held by the public and other banks except RBI. The average figure for each year is then calculated by taking out the average of two consecutive end-year figures. The resultant series is called GS and is shown in column (28) of Table B.1

r^s: Short-term rate of interest, measured by the rate given by the major scheduled banks on fixed deposits of six months' maturity. In our empirical work we have used several short-term rates of interest measured by rates on time deposits of three months', six months' and twelve months' maturities. Figures of all these rates have been derived from the table entitled, "Short-Term Money Rates (Revised Series)", published in various issues of RBI Bulletin. The method used for compiling them are described in RBI (1963, pp.646-54). The rates on fixed deposits of different maturities

4/ Figures of debt held by non-resident are taken from Prasad (1969, p.147) for years upto 1955-56. In fact, the method of estimating GS is exactly the same as in Prasad (1969, pp.145-46) except that we include also the debt held by banks (other than RBI).

are given for selected major scheduled banks (other than the State Bank of India) in three chief banking centres, namely, Bombay, Calcutta and Madras. r^s is estimated for a given year as an arithmetic average of rates on six months' deposits at the three centres in that year. This series is given in column (30) of Table B.1.

The figures of these rates from 1950-51 to 1960-61 are taken from RBI (1963) and those for subsequent years, from subsequent issues of the RBI Bulletin.

r^l : Long-term rate of interest, measured by the yearly average yield on 3 per cent conversion loan, 1986 or later, of the Govt. of India securities; taken from various issues of the RBI's annual publication, "Report on Currency and Finance". This is shown in column (29) of Table B.1.

One more variable used in the text is to be mentioned, namely, the time trend.

t : Time trend with the year 1950-51 as 1; shown in column (25) of Table B.1.

Table B.1

year	P^a	P^n	P	Y^a	Y^n	Y	Y'	X^{na}
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1950-51	0.894	0.897	0.997	5090	4035	9110	8169	137
1951-52	0.949	0.936	1.014	5207	4169	9449	8843	141
1952-53	0.821	0.783	1.049	5395	4338	9997	7826	146
1953-54	0.857	0.819	1.046	5841	4499	10609	8691	158
1954-55	0.778	0.789	0.986	5899	4677	10493	8279	159
1955-56	0.732	0.756	0.968	5902	5015	10728	8111	159
1956-57	0.850	0.839	1.013	6195	5329	11605	9737	167
1957-58	0.876	0.863	1.015	5889	5484	11461	9892	159
1958-59	0.927	0.884	1.049	6536	5738	12594	11131	176
1959-60	0.954	0.925	1.031	6433	6089	12721	11769	174
1960-61	1.000	1.000	1.000	6821	6545	13366	13366	184
1961-62	0.999	1.008	0.991	6881	6978	13797	13908	186
1962-63	1.016	1.042	0.975	6702	7453	13987	14575	181
1963-64	1.077	1.102	0.977	6894	8064	14799	16312	186
1964-65	1.265	1.179	1.073	7517	8544	16610	19582	203
1965-66	1.380	1.251	1.103	6464	8709	15839	19815	175

Table B.1 (contd.)

year	X^{an}	T^a	F^a	E^a	Δ SA	Q^a	T^n	F^n
	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
1950-51	1148	23	266	262	64	60	377	496
1951-52	1263	29	340	217	66	-57	458	463
1952-53	1338	28	209	234	35	60	412	412
1953-54	1355	28	139	221	43	125	449	491
1954-55	1371	39	126	241	-11	104	510	613
1955-56	1463	40	138	260	37	159	543	717
1956-57	1559	40	111	253	100	242	614	1068
1957-58	1576	47	133	225	33	125	712	1124
1958-59	1596	46	184	253	190	259	737	877
1959-60	1634	52	220	258	127	165	816	827
1960-61	1761	55	301	243	78	20	892	937
1961-62	1853	62	214	256	31	73	987	856
1962-63	1905	70	213	261	19	67	1134	1028
1963-64	1955	78	251	268	-27	-10	1388	1095
1964-65	2084	75	320	282	89	51	1514	1156
1965-66	2134	86	313	276	11	-26	1658	1014

Table B.1 (contd.)

year	E^n	GC	GI	I^a	I^n	Q^n	C^a	C^n
	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
1950-51	423	555	276	151	394	909	4042	4117
1951-52	351	562	306	146	338	902	4169	4527
1952-53	489	598	320	56	142	1051	4164	4815
1953-54	486	642	367	57	156	1061	4540	4990
1954-55	493	684	445	95	233	1104	4624	5043
1955-56	615	730	617	149	384	1394	4484	5037
1956-57	593	798	679	52	653	1054	4599	5648
1957-58	658	904	928	52	216	1418	4392	6003
1958-59	539	968	692	39	239	1361	4895	6373
1959-60	604	1009	926	61	167	1773	4855	6476
1960-61	541	1086	1021	134	485	1845	5279	6684
1961-62	554	1170	1018	206	544	2092	5205	6979
1962-63	613	1389	1240	166	444	2380	4986	7439
1963-64	771	1765	1384	243	538	3068	5217	7570
1964-65	759	1806	1495	267	540	3171	5646	8380
1965-66	665	1941	1645	362	455	3599	4601	8492

Table B.1 (contd.)

year	t	M	M^s	GS	r^1	r^s
	(25)	(26)	(27)	(28)	(29)	(30)
1950-51	1	1366	1862	1827	3.15	1.41
1951-52	2	1376	1881	1880	3.39	1.76
1952-53	3	1281	1754	2012	3.66	2.60
1953-54	4	1300	1762	2101	3.64	2.60
1954-55	5	1354	1845	2282	3.67	2.65
1955-56	6	1486	2038	2477	3.74	2.69
1956-57	7	1583	2216	2601	3.99	3.09
1957-58	8	1679	2331	2774	4.18	3.65
1958-59	9	1775	2390	3101	4.13	3.66
1959-60	10	1911	2543	3532	4.05	3.40
1960-61	11	2046	2718	3921	4.06	3.45
1961-62	12	2162	2837	4292	4.16	3.73
1962-63	13	2341	3087	4642	4.49	3.74
1963-64	14	2545	3457	5019	4.66	3.75
1964-65	15	2748	3852	5475	4.80	4.34
1965-66	16	2954	4218	6068	5.46	4.57

Table B.2

year	at 1960-61 prices and in crores of rupees								
	NDCF	△ SA	TI	TI[a]	GFI	△ SN[g]	GI	GI[a]	F[me]
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1950-51	885	64	821	215	276	-	276	64	138
1951-52	856	66	790	207	306	-	306	61	124
1952-53	553	35	518	136	320	-	320	80	120
1953-54	623	43	580	152	367	-	367	95	128
1954-55	761	-11	773	203	442	3	445	108	135
1955-56	1187	37	1150	301	603	14	617	152	200
1956-57	1484	100	1384	219	648	31	679	167	245
1957-58	1229	33	1196	189	819	109	928	137	254
1958-59	1160	190	970	153	686	6	692	114	197
1959-60	1281	127	1154	182	919	7	926	121	237
1960-61	1665	78	1640	259	941	80	1021	125	260
1961-62	1624	31	1768	339	933	85	1018	133	286
1962-63	1794	18	1850	307	1071	169	1240	141	364
1963-64	2120	-27	2165	394	1250	134	1384	151	386
1964-65	2286	89	2302	428	1390	105	1495	161	426
1965-66	2442	11	2462	539	1500	145	1645	177	443

Table B.2 (contd.)

year	at current prices and in crores of rupees					
	exports			imports		
	total	agricultural good	non-agricultural good	total	agricultural good	non-agricultural good
	(10)	(11)	(12)	(13)	(14)	(15)
1950-51	740	233	507	710	239	471
1951-52	850	236	614	1040	438	602
1952-53	710	201	509	700	230	470
1953-54	640	197	443	650	154	496
1954-55	700	251	449	750	125	625
1955-56	760	237	523	840	137	703
1956-57	770	248	522	1170	113	1057
1957-58	800	214	586	1300	142	1158
1958-59	720	240	480	1100	197	903
1959-60	780	248	532	1010	224	786
1960-61	784	243	541	1238	301	937
1961-62	802	248	554	1102	212	890
1962-63	835	253	582	1214	207	1007
1963-64	985	260	725	1365	248	1117
1964-65	1015	271	744	1526	358	1168
1965-66	954	276	678	1449	354	1095

Table B.2 (contd.)

year	base 1960-61 = 1.00					
	P^{ea}	P^{en}	P^{fa}	P^{fn}	P^{fr}	Z
	(16)	(17)	(18)	(19)	(20)	(21)
1950-51	0.89	1.20	0.90	0.95	1.19	0.653
1951-52	1.09	1.75	1.29	1.30	1.94	0.719
1952-53	0.86	1.04	1.10	1.14	1.30	0.761
1953-54	0.89	0.91	1.11	1.01	1.25	0.771
1954-55	1.04	0.91	0.99	1.02	1.24	0.780
1955-56	0.91	0.85	0.99	0.98	1.21	0.832
1956-57	0.98	0.88	1.02	0.99	1.25	0.887
1957-58	0.95	0.89	1.07	1.03	1.11	0.893
1958-59	0.95	0.89	1.07	1.03	1.11	0.907
1959-60	0.96	0.88	1.02	0.95	1.04	0.929
1960-61	1.00	1.00	1.00	1.00	1.00	1.000
1961-62	0.97	1.00	0.99	1.04	1.04	1.052
1962-63	0.97	0.95	0.97	0.98	1.03	1.082
1963-64	0.97	0.94	0.99	1.02	1.07	1.110
1964-65	0.96	0.98	1.12	1.01	1.22	1.184
1965-66	1.00	1.02	1.13	1.08	1.35	1.212

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