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A DISAGGREGATED ECONOMETRIC MODEL OF PRICE BEHAVIOUR IN BANGLADESH

By

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ABSTRACT

A large number of studies of price behaviour treat the price variable as a single aggregate variable. Various sectoral prices exhibit different trends and have different implications for the economic agents of an economy. In this study a disaggregated econometric model is formulated to study the problem of price behaviour in a developing country, Bangladesh. The main purpose of this study is to identify the important determinants of sectoral prices. One interesting aspect of this study is its emphasis on the supply side. This is in sharp contrast with a large number of macroeconometric models for developing countries which derive their basic framework from Keynesian-type demand determined models.

A distinction is made between the agricultural and the non-agricultural sectors. At the output level, a distinction is made between food, jute, jute manufactures, non-jute manufactures and services. The labour market in the agricultural sector has been treated separately from that of the manufacturing sector. The equation regarding supply of credit to the private sector is developed in the model of the financial sector.

The complete model consists of forty five equations including twenty two stochastic equations. Since the model

is fairly large, various blocks of equations are estimated independently. The structural equations belonging to the sectoral submodels, which form blocks of simultaneous equations, are estimated using two stage least squares. The reduced form equations for these blocks are derived and identification exercises are carried out to check for identifiability of the structural parameters from the reduced form estimates. The reduced form equations show the nature of the constraints imposed on the reduced form coefficients by the structure of the model. The reduced form equations are estimated using a non-linear least squares estimation technique. The equations forming recursive blocks have been estimated using ordinary least squares.

The qualitative characteristics of the model are examined by conducting simulation experiments. Included among the simulations performed are experiments to study the impacts of fiscal and monetary policies, a lower rate of growth of population, a Hicks-neutral technical change in the production of food, and higher foreign aid.

The estimation and simulation results suggest that the supply response to price changes is very low, especially in the food producing sector. Rigidity in food supply, coupled with a growing population and food demand, have contributed substantially to inflation in Bangladesh. Technical change in the production of food, although increasing the cost of living index, increases per capita real disposable income. The study also provides evidence in support of the view that the structuralist and monetarist positions on inflation in developing countries are complementary rather than being competitive.

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CHAPTER ONE

INTRODUCTORY REMARKS

1.1 Introduction

A large number of developing countries have experienced a high rate of inflation in recent years. In addition some developing countries have a long history of suffering from chronic inflation. Many of the Latin American countries have been plagued with it since the latter part of the nineteenth century.[1] Thus it is quite obvious to even the most casual observer that the problem of inflation is not unique to developed countries.

The question has been raised as to whether the theoretical framework developed to explain the problem of inflation in developed countries is useful in explaining the same problem in developing countries. A group of economists, generally known today as 'structuralists', maintain that the concept of 'demand pull' and 'cost push' inflation are applicable only to the countries already at a high stage of development. These economists argue that inflation in developing countries must be explained by reference to the basic weaknesses of these economies, namely their primitive institutions and the structural rigidities and frictions that impede their growth. Another group of economists, known as 'monetarists', argue that the problem of inflation in developing countries could be explained by reference to an excess of aggregate monetary demand over the supply of real output.

A problem as important as price behaviour in the developing countries, should not be studied in the abstract, ignoring the special features of the developing countries. In the present study, it is argued that the only effective way to study the problem of price behaviour is to use a disaggregated macroeconometric model that embodies the basic structure of the economy.

Most of the earlier studies of inflation in developing countries have analyzed the general price level or the cost of living index as a function of money supply and output [Harberger(1963), Behrman(1973a), Vogel(1974)], or as a function of some index of structural bottlenecks [Argy(1970), Atapattu(1976)]. The only exceptions we have come across are the studies by Corbo(1974) and Marwah(1964, 1972), in which a detailed macroeconometric model has been used.

The advantage of using a macroeconometric model with a sectoral break-down is that it allows one to study the problem of price behaviour from a broader perspective. The important monetarists' and the structuralists' arguments are naturally incorporated into an econometric model of an economy.

At this point it should be mentioned that the inflation rate is the rate of change in the price level. Thus, a study which analyzes the process of price formation is also analyzing the process of inflation. In this context R. Dornbusch and S. Fischer (1978) state that:

> "Since the inflation rate is the rate of change of the price level, a theory which explains how the price level is determined - must also explain how the inflation rate is determined."[2]

1.2. <u>Objectives of the Present Study</u>

The prime objective of the present study is to analyze price formation behaviour in some key sectors of a developing economy and the way these sectoral prices interact among themselves. This behaviour will determine the general price level, which is an weighted average of these sectoral prices. The study is done in the context of the Bangladesh economy.

An attempt is made to compare the two competing views on inflation in developing countries. It is very difficult to quantify the structural hypotheses. Nevertheless, the present study makes an attempt to test, directly and indirectly, the structural hypotheses as well as monetarist hypothesis, regarding inflation in developing countries.

The phenomenon of imported inflation which has received widespread attention among economists in developed countries is no less important for developing countries. Explicit consideration is given to this phenomenon in the present study.

The government plays an important role in the process of economic development in developing countries. The way in which governmental activities affect market prices is another interesting problem to be studied.

The foregoing discussion of objectives clearly suggest the formulation and testing of the following hypotheses. First, as the structuralists suggest, a major thrust of inflationary pressure comes from food prices; second, deficit financing is inflationary; third, external trade and aid play a crucial role in determining the domestic rate of inflation; fourth, the rate of growth of the money supply is an important determinant of inflation, and finally, the high rate of growth of population is responsible for a higher price level.

An interesting aspect of the present study is that it provides a test for the now famous 'two sector theory of inflation'.[3] In fact, the two sector theorists share much of their thoughts with the structuralists of Latin America and Scandinavia.[4]

1.3. Organization of the Study

The organization of the present study is as follows. The monetarist and structural views of inflation in developing countries are presented in the second chapter. This chapter also presents a survey of the important empirical work done on the problem of price behaviour in the developing countries.

In chapter three, some important characteristics of the Bangladesh economy are discussed. These characteristics are crucial for understanding the process of inflation in that country.

In chapter four, the proposed theoretical model is developed. A distinction is made between the agricultural and the non-agricultural sectors. Within the agricultural sector there are two major outputs, namely food and jute. Domestic supply of food falls short of domestic demand for it. The gap is filled by imports. Jute is used as raw material in the jute manufacturing industries. The domestic supply of jute is always in excess of domestic demand for it and the excess is exported. The price of jute is determined in the world market and is endogeneous in the model. A major part of jute manufactures is exported and the rest is domestically consumed. The price of jute manufactures is determined in the world market and is exogeneous in the model. Non-jute manufactures are produced domestically and also imported.

The proposed theoretical model consists of demand and supply equations for these broad groups of outputs plus other equations describing labour market in both the agricultural and the manufacturing sectors and also the government and the financial sector.

In chapter five, parameters of the model are estimated using data from Bangladesh. There is a substantial amount of over identification in the model. The sectoral models are estimated first by using ordinary least squares(OLS) and two stage least squares(2SLS) methods of estimation. Finally, the sectoral models which contain a set of simultaneous equations are estimated using a constrained non-linear least squares(CNLS) method of estimation. An attempt is made to interpret the results in such a way that the structural and monetarist standpoints can be assessed.

In chapter six, the complete model, based on the results obtained in chapter five, is used to carry out simulation experiments under various assumptions about the exogeneous variables. Owing to the presence of nonlinearity in the model, a method of successive iterations has been used to solve the simultaneous system of equations. The implications of these simulations for the monetarist and the structuralist views of inflation are assessed.

Finally, chapter seven provides a brief summary of the study emphasizing both strengths and weaknesses and suggests future directions for research on this topic.

FOOTNOTES TO CHAPTER ONE

1. See Felix(1961), 'An Alternative View of the "Monetarist"-"Structuralists" controversy!, in A.O. Hirschman(ed.), Latin American Issues - Essays and Comments, p. 81.

2. See Dornbusch and Fischer(1978), p. 391.

3. See Gordon(1975), Kaldor(1976) and Nordhaus(1976) for a discussion of two sector models of inflation.

4. See W.H. Branson and J. Myhrman(1974) and W.V. Rijkeghem and G. Maynard(1974) for a lucid discussion of the Scandinavian structural models of inflation.

CHAPTER TWO

REVIEW OF THE LITERATURE ON INFLATION IN DEVELOPING COUNTRIES

2.1 Introduction

This chapter presents a review of theoretical and empirical studies of price behaviour in developing countries. The theories of inflation developed in the western industrialized countries certainly have some relevance for understanding the same problem in the developing countries. But since the present study is concerned with the problem of price behaviour in developing countries, only a very brief survey of the theories of inflation in developed countries is presented in this chapter.

There are two major views of inflation in developing countries: the monetarist view and the structuralist view. In the developed countries the theories of inflation also may be divided into two broad categories, the old theories and the contemporary theories. The old theories centre around the cost-push versus demand-pull controversies. The major contemporary theories are based on three different models, the Phillips model, the monetarist model and the structuralist model.

The basic core of the monetarist models in both the developed and the developing countries is the same. But it is more difficult to see the link between the structuralist models of inflation in the developed and the developing countries.

The theories of price behaviour in developed countries are presented first, followed by the theories for developing countries. This arrangement makes it easier to make a comparative assessment of the divergences between the two different classes of explanations of the same problem in two different worlds - the developed and the developing. Finally a review of the empirical work on the price behaviour in the developing countries is presented.

2.2 The Theories of Inflation in Developed Countries

The literature on the theories of inflation in developed countries is so vast that the review presented in this section contains only selected representative references.[1]

2.2.1 The Old Theories

Bronfenbrenner and Holzman(1963), and Johnson(1963) summarize the old theories of inflation developed in the West. The theories developed in the 1950s and early 1960s differentiate between two different inflationary regimes:

the demand-pull and the cost-push models. In the demand-pull model, excess demand is assumed to be the main cause of price increases. In the cost-push model, the increase in unit costs (wages, costs of raw materials and profit margins) pushes up the price level.

Machlup(1960) points out that an increase in effective demand is also necessary for a cost-push inflation. He subdivides both demand-pull and cost-push inflation into an autonomous and induced component. An autonomous expansion of demand which leads to a price rise is followed by induced or responsive price and wage increases. The former is the 'autonomous demand-pull' inflation and the latter is the 'induced cost-push' inflation. Similarly, an autonomous increase in wages, prices of raw materials and/or profit margins causes an 'autonomous cost-push inflation'. The induced demand-pull inflation develops as a consequence of the cost-push inflation.

2.2.2 Contemporary Theories of Inflation

Three competing hypotheses may be differentiated in the contemporary literature on inflation in developed countries. These are the monetarist inflation model, the structuralist inflation model, and the Phillips curve model. In this section we shall briefly discuss some of the literature based on these three models.[2]

2.2.2.a The Monetarist Model of Inflation

Monetarist models are based on the hypothesis that the various rates of inflation in different countries can be explained by the respective rates of growth of money supply per unit of national output.[3] In general, monetarist models of inflation for a closed economy are based on three fundamental assumptions. These assumptions form a theoretical unity, which Brunner(1970) and Frisch(1975) classify as the acceleration theorem, temporariness, and endogeneous expections.

According to the acceleration theorem, only a change in the rate of growth of money supply affects the unemployment rate. Every constant rate of growth of money supply is consistent with the equilibrium level of output and employment, although at a different rate of inflation. A change in the rate of growth of money supply affects the real sector, but the effect is temporary. In the long run money wage rates and interest rates adjust to the higher inflation rate and the real effects disappear. In the monetarist models, expectations are endogeneous, through an expectation adjustment process. The divergence between the expected and the actual rates of inflation gradually disappears through the working of the adaptive adjustment of expections.

Correct anticipation of all the endogeneous variables ensures steady-state equilibrium and the rate of growth of the money supply then determines the rate of inflation. These three fundamental aspects of monetarist models have been clearly formulated by Friedman(1970, 1971).

The monetarists emphasize that the manner in which a government deficit is financed has a significant effect on inflation. Friedman(1972) argues that if the budget deficit is financed by creating money, it unquestionably produces inflationary pressure; however, if the deficit is financed by borrowing from the public, then interest rates go up and there also may be some inflationary pressure. in the latter case, the increase in rate implies a "crowding-out" effect.

For open economies, under fixed exchange rates, the rate of expansion of the money supply is an endogenous variable, which depends on the world money supply as well as on domestic credit creation. A group of economists, including Mundell(1971), Johnson(1972b) Frenkel(1976), Laidler(1975) and Swoboda(1976) have tried to justify the working of an international quantity theory of inflation, where the world money stock determines the world price level. The above approach is known as the monetary approach to the balance of payments.

Under a floating exchange rate system the transmission of excess demand from one country to another is prevented, but this does not mean that there would be less inflation in the world as a whole. A country generating excess demand may experience worse inflation under a flexible exchange rate than under a fixed exchange rate because in the former case the excess demand is "bottled up" within the country.

2.2.2b The Structuralist Model of Inflation

The advocates of "structural" factors as an explanation for the long-run tendency to generate inflation in the western industrialized countries are Streeten(1962), Olivera(1964), Baumol(1967), and Rijckeghem(1976). Maynard and Rijkckeghem(1976) rigorously formulated the structural hypothesis and statistically tested it for a number of OECD countries. According to them, the following factors are responsible for the long-run tendency of price increases:

(a) productivity growth in the industrial sector is faster than in the services sector;

(b) price level and income elasticities are different between the two sectors;

(c) nominal wages grow at a uniform rate in both sectors and the pace of nominal wage increase is determined by the industrial sector; and

(d) a downward flexibility of money wages and prices.

The increase of money wages at a uniform rate in both the sectors despite a productivity gap between the sectors exerts a cost pressure in the service sector. As a result, the relative price of the output of the services sector rises. A low price elasticity and a high income elasticity for the outputs of the services sector are necessary for this kind of inflation.

According to Hicks(1975), the uniform wage increase, given the productivity gap between the two sectors, can be explained by a "fairness" principle, which is related to historical wage differentials:

> "Wages rise, in the non-expanding industries, not because of labour scarcity, but because of unfairness: because the workers in the non-expanding industries feel that they are getting left behind".[4]

The Scandinavian structural models of inflation are formulated in terms of small open economies which have two sectors - the exposed sector which produces internationally tradable goods and a sheltered sector which produces non-tradable goods.[5] The smallness of these models implies that the country in question is a price taker in the world market. The exposed sector has a higher growth of productivity compared to the sheltered sector, but the growth of nominal wages is uniform in both the sectors.

The world rate of inflation determines the rate of inflation in the exposed sector, because the Scandinavian models are based on the assumption of a fixed exchange rate. In the sheltered sector mark-up pricing is practised, so that a constant profit mark-up is added to unit labour costs. Thus in the Scandinavian models, the rate of inflation in one sector is exogeneously given by the world inflation rate and in the other sector the uniform wage increase despite a lower productivity growth rate causes cost-push inflation. The overall rate of inflation is the weighted average of the sectoral inflation rates.

Although the Scandinavian structural models are small economy models they are representative of this class of models in that the overall inflation rate is generated by differing input intensities and demand elasticities across sectors in an economy. It is the emphasis on sectoral analysis which distinguishes these models.

2.2.2c The Phillips Curve Model

Phillips(1958) found a stable nonlinear negative relationship between the rate of growth of money wages and the unemployment rate for the period 1861-1957 in the United Kingdom. This finding subsequently encouraged more theoretical and empirical research in this area.

Lipsey(1960) has attempted to give the Phillips relationship a strong theoretical foundation. He has used the following theoretical postulates about the individual labour market:

$$w_i = f(e_i); \quad f' > 0, \qquad (2.1)$$

and

$$u_i = g(e_i); \quad g' < 0 \qquad (2.2)$$

Where, w_i, u_i, and e_i are the rate of growth of money wage, the rate of unemployment, and the excess demand for labour, respectively. Aggregating the above function over the entire labour market, the negative relationship between wage inflation and unemployment rate is easily established.

The original Phillips curve has been extended by introducing additional explanatory variables. For example, Perry(1966) introduced, in addition to the unemployment rate, the general price index and the profit rate and as well as changes in the profit and unemployment rates. Hines(1971) introduced the degree of unionization as an additional cost-push variable.

Assuming a definite relationship between wages and prices, a trade-off function can be formulated between rates of inflation and unemployment. The idea that this trade-off function may be used as a basis of government policy was propagated by Samuelson and Solow (1960).

Friedman(1968) and Phelps(1972) argue that the Phillips curve describes a transitory relationship that cannot exist in the long run. According to them the unemployment rate falls temporarily if monetary or fiscal measures cause an unanticipated inflation. Once the rate of inflation is fully anticipated expectations adjust and the unemployment rate rises again to what is termed the 'natural rate of unemployment'.

While acknowledging that the Phillips model may have some short-run validity, monetarists argue that it describes transitional behaviour, for expectations of economic agents will change and eventually agents will fully anticipate the rate of inflation. However the structuralist points based on the structure of the economy and the growth of wages, independent of sectoral demands, seem to offer arguments which are complements and not substitutes for the other two views. This section has provided a brief description of the major theories which have been developed to explain the problem of inflation in developed countries. In the next section a review of the literature on inflation in developing countries is presented.

2.3 Theories of Inflation in Developing Countries

There are two major views of inflation in developing countries - the structuralist view and the monetarist view.[6] According to the structuralists a faulty structure of the economy can account for inflation. Monetarists, on the other hand, claim that faulty policies of the monetary and fiscal authorities are the main causes of inflation.

2.3.1 The Monetarist View of Inflation in Developing Countries

The monetarists maintain that the factors which cause inflation in developing countries are similar to those causing inflation elsewhere and are primarily a matter of excess aggregate monetary demand. Increases in money income occur in response to increases in aggregate demand. Inflation is the result of continuous expansion of aggregate demand after real income has approached the supply or capacity constraints of the economy. According to the Latin American monetarists, inflation is generated by unjustified expansion of government budget deficits.[7] Since the government bond market is not developed in developing countries, government deficits are generally financed by increasing the money supply.

In developed countries, it is argued that changes in the rate of inflation have little or no effect on the real variables in the long run. On this issue the views of the Latin American monetarists are not clear. The Latin American monetarists do argue that in developing economies with price controls, inflation affects the real variables.[8]

Monetarist prescriptions for ending inflation in developing countries include monetary and fiscal restraints, reduction of the multiplicity of foreign exchange rates and import controls, and also the removal of price controls.

2.3.2 The Structuralist View of Inflation in Developing Countries

The structuralists distinguish the causes of inflationary pressure from the mechanism through which inflation develops. The causes of the inflationary pressure are found in the structural limitations of the system. These structural limitations are reflected in the inability of some sectors to adjust to changes in the level or composition of the aggregate demand. Instability of the purchasing power of exports, structural deficiencies in the tax system, bottlenecks in the supply of social overhead capital, and the immobility of factors of production are among the major structural limitations present in almost all the developing countries.

Distortions of the price system, mainly caused by the price control, create a cumulative inflationary pressure. Price control also leads to misallocation of investment funds.

The propagation mechanisms through which inflation develops are (a) the continuous struggle between wage earners and profit earners to improve their share and (b) the struggle between the private and public sectors to increase their share of real resources. The latter manifests itself through the government budget deficit and the way the deficit is financed.

Felix(1961), Campos(1961), Mikesell(1969), Grunwald(1961), Argy(1970), among others have attempted to examine a number of structuralist hypotheses. Five of the hypotheses have received more attention in their studies and these are: (a) the demand shift hypothesis, (b) the agricultural bottleneck hypothesis, (c) the export instability hypothesis, (d) the foreign exchange scarcity hypothesis, and (e) the hypothesis of inelasticity of tax revenue with respect to the price level. In this seation, an attempt is made to elaborate the above structural hypotheses.

The Demand Shift Hypothesis

According to this hypothesis, a shift in the composition of demand is inflationary. There may be widespread excess demand in a developing country, but a shift in the composition of demand, in addition to generalized excess demand exerts inflationary pressure on the economy. The basic idea of the demand shift hypothesis is not much different from the sectoral demand shift theory of Schultz.[9] According to Schultze, in a growing economy demand keeps shifting from one sector to another, and prices rise readily in the sector to which demand has shifted. However, price does not fall as readily in the sector from which demand has shifted, so that there is a general process of escalation of prices.

This hypothesis has greater relevence for developing countries as compared to developed countries. First, developing countries are subject to more abrupt structural shifts due to their industrialization efforts. This often results in changes in the output mix, the income distribution, the rural-urban population ratio and tastes. These changes contribute to the shift in the composition of demand. Secondly, the demand for the exports of the developing countries are declining over time because their exports are mainly primary products. This very process forces on these countries changes in the production mix, which implies a shift in factor demand.

The relative immobility of factors of production in developing countries compared to developed countries is the most important factor which prevents a quick and smooth adjustment of supply to changing demand. Even if there is no generalized excess demand in the economy the shift in the composition of demand is inflationary.

The Agricultural Bottleneck Hypothesis

According to this hypothesis population growth, growth of living standards and urbanization combine to increase demands on the food supply. An excess demand for food develops. In most of the underdeveloped countries food supply cannot adjust to this excess demand. The problem may be dealt with in numerous ways. First, food prices may be allowed to rise, thus generating an inflationary spiral. Second, price control and rationing may be imposed. Third, food imports may be increased. Fourth, subsidies may be granted to food production. Fifth, if the country in question is exporting food, then food exports may be reduced. According to the structuralists all the above measures are inflationary. The first measure is obviously inflationary. Price control is also inflationary in the long run, because price control will lead to distortion in allocation. Subsidies may dampen the rise in food prices, but by increasing the government deficit, may exert inflationary pressure in general. If food imports rise or food exports fall, then other imports must be cut down to maintain equilibrium in the balance of payments. This restriction of other imports is likely to be accompanied by some price rise.

The Export Instability Hypothesis

According to this hypothesis, other things being equal, fluctuations in export receipts will tend to create inflation. Structuralists have rationalized this thesis in a number of ways. First, when receipts rise there is a demand-pull pressure on price but when receipts fall, prices may not fall because of downward rigidity. Secondly, when receipts rise wages in the export sector may rise and that may lead to wage increases in non-exporting sectors also. Thirdly, the government may increase its expenditure when export receipts rise but may not be able or willing to contract its expenditure when receipts fall. Fourthly, in periods of falling export receipts, different income groups, trying to keep their real income level unchanged, would exert an inflationary pressure.

The Foreign Exchange Scarcity Hypothesis

Almost all underdeveloped countries experience difficulties with their balance of payments over the long term. The main reason is the low income elasticity of demand for their exports and high income elasticity of demand for their imports. The long term decline in the balance of payment position calls for two types of measures. The first is import constraints such as duties, quotas and devaluation. The second is domestic import substitution. Both the measures are inflationary. One implication of this scenario is that a long-term deterioration in the balance of payment is more inflationary than a long-term improvement. The reason is that a long term improvement tends to exert a demand-pull inflation which is controllable; on the other hand, a long-term decline exerts a cost-push type inflation which may be harder to control.

Inelasticity of Tax Receipts

Inelasticity of tax receipts is an important structural hypothesis. It is argued that in developing countries, tax revenue does not respond to inflation. In other words, the rate of increase of nominal tax revenue falls behind the rate of inflation. This means that real revenue is diminishing. This phenomenon, which is very common in developing countries, compels the fiscal authorities to adopt deficit financing which may be inflationary.

In this section a brief review of the monetarist and structuralist explanations of inflation in developing countries have been presented. In the next section an attempt is made to compare the explanations of inflation in the developed and the developing countries.

2.4 A Comparision of the Theories of Inflation in Developed and Developing Countries

The structuralists in both the developed and the developing countries prefer to have a sectoral break down of the economy to study the problem of inflation. In the developed countries, the structuralists divide the economy into 'sheltered' and 'exposed' sectors or into manufacturing and services sector. In developing countries the division is between the agricultural and the non-agricultural sectors. However, as we have seen in this chapter, the structuralists of the developed countries emphasize the uniform wage increase in both sectors inspite of different rates of growth of labour productivity as the main cause of inflation. Implied in this arguement is a change in the relative price of the output of the lagging sector.

Structuralists of the developing countries emphasize separate determination of sectoral prices. We have already discussed the important role which the food price plays in the structuralist thesis. Structuralists in the developing countries, however, do not pay much attention to the links between the agricultural and non-agricultural sectors, especially the way in which prices of one sector influence the prices of the other.

A link between the two sectors ('sheltered' and 'exposed' or manufacturing and services) is important for the structuralists in the developed countries. The structuralists in the developing countries identify many sectoral sources of inflationary pressure. But the links between various sources of pressure are either non-existant or unclear.

The differences between the monetarists in the developing and the developed countries are few. Both these groups of economists argue that the rates of growth of money supply per unit of output is the main determinant of inflation. However, the monetarists in the developed countries argue that rate of change of money supply does not affect the real variables in the long run. The monetarists in developing countries argue that because of various price controls the rate of inflation does affect the real variables.

In the developing countries, the government deficit is mainly financed by money creation, because there is no organized bond market. Thus the question of the relative inflationary impacts of bond versus money financed fiscal policy does not arise.

Before going into the discussion of the empirical work on inflation in developing countries, we shall summarize the differences between the structuralists and monetarists in developing countries. The monetarists tend to argue that the money supply is exogeneous, whereas the structuralist position is that the money supply is endogeneous. Monetarists argue that deficit financing and the resulting increase in the money supply can be controlled by the appropriate authorities. The structuralist position is that because of various bottlenecks in developing economies, the authorities have less control of fiscal and monetary variables than the monetarists would like to believe. In general, the position of the monetarists vis a vis the structuralists are similar in the developing economies and the developed economies.

2.5 Empirical Studies of Inflation in Developing Countries

In this section a brief discussion of the empirical work on inflation in various developing countries is presented. It will be found that some empirical studies are clearly more monetarist than structuralist, some more structuralist than monetarist, some are balanced, and some probably fall in neither category.

Harberger(1963) has the honour of making the first serious empirical study of the problem of inflation in a developing country. His study of Chilean inflation uses regression analysis to test the validity of a version of the Latin American monetarist theory of inflation. He first develops an equation in which the price level is a function of the current and lagged money supply, the expected cost of holding cash, and the level of real income. To test this relationship, he first takes differences of this function and arives at the following equation:

$$P_t = a + bY_t + cM_t + dM_{(t-1)} + eA_t \qquad (2.3)$$

Where P_t is the rate of inflation, M_t and $M_{(t-1)}$ are the percentage changes in money supply during the current and the preceding years, Y_t is the percentage change in real income during the current year, and A_t is the percentage change in the consumer price index over the previous two years. The last variable acts as a proxy for the expected cost of holding cash.

Empirical estimates of his model have given satisfactory results in terms of the sign and significance of the parameters. Harberger also estimates another version which introduces a wage variable. Later Diz(1970), Diaz-Alijandro(1965), Colaco(1969), and Vogel(1974), among others, used the Harberger model in its original form, or with some modifications, to study the problem of inflation in many developing countries. The results of all these empirical tests show that both monetarist and structuralist variables play an important role in explaining inflation in developing countries, with more weight attached to the monetarist variables.

Otani(1975) deals with imported inflation in the Phillippines. The model used in his study is an extension of Laidler(1972), and Turnovsky and Kaspura(1974). The Turnovsky and Kaspura model is a Keynesian macroeconomic model, where aggregate demand determines supply. However, their model was constructed to analyse the problem of imported inflation in Canada, which is a developed economy. There is a widespread use of demand-determined models in developed economies, though recently some economists are trying to emphasize the need for more adequate treatment of the supply side.[10] However, Otani incorporates a quantity theory of money to describe the aggregate supply, aggregate demand, and the price adjustment that would clear both the goods and money markets. His model has three equations and three identities. The equations describe the adjustment process in real cash balances, prices(or output), and the demand for imports. The identities describe the general price level, the money supply at the end of the period and the average stock of money during the period.

The formulation of the relationship between money, income, and the price of nontraded goods uses the concept of "normal output". "Normal output" is that level of output beyond which both price and output will increase in response to an increase in demand. The rate of change in prices is a function of the gap between the short-run equilibrium level of output and the normal level of output. The expected rate of inflation and the price of imported raw materials are also used as explanatory variables in the price of nontraded goods equation. The model as a whole traces rates of inflation and changes in money supply fairly well. But it does not trace the changes in output and imports so well.

Argy(1970) formulated and tested four structural hypotheses. The hypotheses are: (a) demand shift, (b) agricultural bottleneck, (c) export instability and (d) scarcity of foreign exchange. The role of these bottlenecks in generating inflation has already been discussed in an earlier section. The way in which Argy constructed indicators to test the above hypothesis will be examined here.

Argy obtained the indicator of demand shift by looking at the changes in the weights of eight sectors in GNP between the years 1958-59 and 1964-65. Data on fifteen countries were used. The demand shift indicator was constructed in the following manner.

$$S = \left[W_b(W_t - W_b)^2\right]^{1/2} \qquad (2.4)$$

where, W_b = Weight for particular sector in base year(1958-59);
W_t = Weight in terminal year (1964-65).

The author himself has pointed out that the changes in the weights do not necessarily represent shifts in the composition of demand but may represent differences in rates of growth of different sectors. In fact, it seems that his index of shift in the composition of demand is actually an index of shift in the composition of supply. This will be a close proxy of shifts in the composition of demand only if the shifts in the composition of supply are solely due only to shifts in the composition of demand.

The agricultural bottleneck hypothesis was tested by constructing two indices of excess demand for agricultural output for each country. For the first index Argy assumed that the elasticity of demand with respect to population growth was one and that the income elasticity of demand was 0.6. The first measure of excess demand was the rate of growth of demand under these assumptions minus the rate of growth of agricultural production for each of the twenty-two countries. The second measure was simply the average annual rate of change in the cost of living for each country.

The second measure is not a very good index of an agricultural supply bottleneck. Symbolically,

$$F = I_f - I_c \qquad (2.5)$$

Where F is an index of the agricultural supply bottleneck, I_f is the annual average rate of change in food prices and I_c is the annual average rate of change of cost of living. However, a major component of I_c is food price, which exerts a downward pressure on F.

Export variability was measured by the variance of the annual percentage changes in dollar export receipts. Two indicators were used to represent the hypothesis of foreign exchange scarcity. The first indicator was the average annual percentage change in the terms of trade. The second indicator was the average import ratio (ratio of imports to Gross Domestic Product) for the period 1959-65 divided by the average import ratio for the period 1954-58. The contraction in the import ratio would be inflationary.

Argy used various combinations of the above indicators to explain the rate of inflation in developing countries. In general, the results did not lend much support to the structuralist view. The fit of the equations were poor and the introduction of a monetarist variable, a measure of deficit financing by the government, improved it.

Glytsos(1977) builds a theoretical model of wage and price changes in developing countries and tests the model with data from 36 developing countries. One important aspect of his model is that it takes into account the dual economy theory of development. He distinguishes between the rural and urban sectors to study the behaviour of wages, but he does not carry over this distinction to study the behaviour of prices. Only the final few equations of a recursive system are used to analyse the determinants of wage and price changes. Some very interesting conclusions emerge from the statistical test of his model. For example, food prices contribute substantially to consumer price increases, more so in low income countries. The impact of import prices is not as strong as food prices. Import prices are more important in the high income countries. The empirical tests for the wage change model conforms to the dual economy model, while the existence of a Phillips curve is questionable. It has been found that price changes are influenced by both monetary and non-monetary variables, with relatively more influence due to the latter.

The studies by Corbo(1974), Marwah(1964) and Marwah(1972) are of special interest because they use macroeconometric models with sectoral breakdown to study the problem of price behaviour. Corbo takes into account the two major views of inflation in developing countries and tries to interpret the results obtained from his models to test the validity of the alternative hypotheses. Marwah does not pay any attention to the structuralist-monetarist debate.

The study of Chilean inflation by Corbo contains a quarterly submodel of the industrial sector which focuses on the prices, wages and cost of living in that sector. But the more important part of his study is the annual econometric model of the Chilean economy. In this model a distinction is made between the sector producing goods and the sector producing services. In the sector producing goods a Cobb-Douglas production function is used. For the services sector a Leontief production function is used.

In the specification of the model, the author successfully introduces various important aspects of the Chilean economy, such as the cost of hiring and rehiring labour, quantitative import restrictions, institutional aspects affecting the demand for money, price controls, oligopolistic elements, and the nature of the capital markets. He uses the method of indirect least squares(ILS) to estimate the equations which are part of a simultaneous system. A very important aspect of his work is his attention to consistency among the sizes of the parameters obtained for different sectors of the economy. He has avoided the technique of mechanically accepting the statistically significant results and in most cases he compares his results with those of others and includes further information on the Chilean economy to examine the consistency of his results.

One of the links between the financial and the real sectors is through the assumption that the difference between the real supply and real demand for money spills over to the commodity market. The disequilibrium in the money market is approximated by the estimated residuals from the demand for money equation. A shortcoming of this model is the emphasis on the demand side. National income is determined by aggregate demand. In a developing country the appropriateness of demand determined models is questionable.

Furthermore, Corbo does not differentiate between the agricultural and non-agricultural sectors. This distinction is very important for a developing country like Chile. He refrains from modelling the agricultural sector explicitly because prices in this sector, according to him, have been politically determined.

Marwah(1964, 1972) uses a disaggregated macroeconometric model to study the problem of price behaviour in India. Marwah(1964) first develops a macroeconomic model, which she calls the global model, and then builds sectoral sub-models which are linked to the global model. These sectors are manufacturing, semi-manufacturing, industrial raw materials, and foodgrains. It has already been mentioned that Marwah's work is of special importance to the present study because she uses a disaggregated macroeconometric model to study the problem of inflation. Another important feature of her model is that she estimates her model with data from the Indian economy. The economic and demographic structure of India is very similar to that of Bangladesh.

The global model is a Keynesian model. In this model there are equations describing consumption, investment, the demand for money, the interest rate, the price level and money income velocity. The supply side of the economy is ignored and national income is determined by aggregate demand. Two alternative versions of the price equation have been used. The first version is based on the hypothesis that the change in price level(ΔP_t) depends on the change in aggregate demand(ΔY_t). A change in aggregate demand is assumed to influence both the price level and output. The split between the two depends on the magnitude of the coefficient of Y_t in a regression equation where P_t is the dependent variable. The second version of the price equation is based on a modified quantity theory, where the income velocity of money is an endogeneous variable. Here she introduces the notion of a "safe" rate of change in money supply. If the rate of increase in money supply is more than the "safe" rate the price level tends to rise.

There are four equations in the model of the manufacturing sector. The price equation is based on the assumption of mark-up pricing. Demand pressure is not explicitly considered in this equation. The supply of manufactured goods is assumed to be demand determined, which is unrealistic for a developing economy.

The demand for manufactured goods, given the production function, determines the demand for labour. However, the demand for labour and supply of labour are not explicitly modelled in this sectoral model. There is a wage equation which contains the value of productivity of labour, the cost of living and the wage rate of the past period as explanatory variables. No explanation is provided for including these variables in the wage equation. It would have been easier to understand the market mechanism, if the structural equations were clearly formulated and reported in the study. The wage equation is a reduced form equation, and the underlying model of wage determination is unclear.

In the semi-manufacturing and raw materials sectors, only the price equations are presented. These equations are, again, reduced form equations.

In the foodgrain sector it is assumed that the excess demand for food is satisfied with food imports. The supply of food depends on the lagged price of food and an index of agricultural production. The index of agricultural production is used as an implicit production function which implies that the supply of food depends on the same general conditions which determine aggregate agricultural production. A production function for aggregate agricultural production has not been specified in this study and so no information on the production function of food is available. The domestic demand for food depends on population and lagged real income. It is surprising that the current price of food does not appear on the right hand side of the demand equation. Lagged real income, instead of current real income has been used by the author to get 'better results'. 'Better results' apparently implies good 'statistical fit'. It is difficult to accept that the lagged income is more relevant in estimating current demand for an essential commodity like food.

Finally, since neither the demand equation nor the supply equation is a function of the current food price, there is no intersection of supply and demand curves in the price-quantity plane. In fact, in the price-quantity plane these two functions are represented by two parallel vertical lines. The gap between these two lines is the excess demand which is equal to food imports. The price of food in the domestic market is positively related to the import of food.

The model used in Marwah(1972) is much the same as in Marwah(1964). One striking difference is that in Marawah(1972) aggregate supply is equated to aggregate demand plus inventory change. She does this to emphasize the supply side of the economy. Inventory investment is determined as a residual and plays the role of equating supply and demand. This way of determining inventories as a residual and hence as an adjustment variable between aggregate supply and aggregate demand has the drawback that it contains not only the statistical discrepency between the income and expenditure accounts but also the estimation errors of all the equations in the model.

2.6 Conclusion

Our survey of both the theoretical and empirical literature suggests that a study of the complex causes of the behaviour of prices cannot be done by only examining the effects of the money supply on the general price level or the cost of living index. The way in which prices in various sectors are determined has to be explained clearly. The role of the government, the monetary authority and the influence of foreign markets on the relevant domestic markets must be incorporated into the model. We propose to construct a macroeconometric model with sectoral disaggregation dictated by the basic features of the Bangladesh economy in order that we may study the problem of the price behaviour in a developing economy.

FOOTNOTES TO CHAPTER TWO

1. As early as in 1951, R. Turvey said, "The literature on the subject is now so extensive that only the specialist can hope to have more than a nodding acquaintance with it". See Turvey(1951), p. 531.

2. For a detailed survey of the literature, see H. Frisch(1977), D.E.W. Laidler and M. Parkin(1975), R.J. Gordon(1975), and R. Solow(1975).

3. For a detailed discussion of the monetarist position, see M. Friedman(1968, 1970 and 1971), A.J. Schawartz(1973), D.E.W. Laidler(1975), M. Parkin(1975), K. Brunner and A.H. Meltzer(1972, 1976), H.G. Johnson(1972).

4. See J.R. Hicks(1975), p. 71.

5. See O. Aukrust(1970); G. Edgren, K. Faxen, and C. Odhner(1973).

6. For a detailed discussion on the monetarists and structuralists views and critical evaluation of both positions see W. Baer and I. Kerstenetzky(1964); see also R.D.O. Campos(1961), D. Felix(1961), V. Argy(1970), and S. Wachter(1976).

7. *op. cit.*

8. See S. Wachter(1976), p. 2.

9. C. Schultze(1969).

10. See L.R. Klein(1978).

CHAPTER THREE

SOME CHARACTERISTICS OF THE BANGLADESH ECONOMY

3.1 Introduction

The description of the economy of Bangladesh presented in this chapter emphasizes the areas on which the present study will focus and as such is an incomplete description of the economy. Bangladesh, with an area of 55,126 square miles and a population of approximately 85 million, is the most densely populated country in the world, excluding the city-states of Singapore and Hong Kong. The per capita income is about $80 per year and 22.2 percent of the population is literate.[1]

3.2 The Structure of Output

The agricultural sector is the most important sector of the Bangladesh economy, contributing approximately 56% of the gross domestic product and employing 75% of the labour force. The manufacturing sector, though very small, has been growing at a steady rate and has more than doubled its share of the GDP over the past 25 years. The services sector, if broadly defined, accounts for about 25% of the Gross Domestic Product. This definition of the services sector includes professional services, trade, communication, banking, power and gas, and housing.[2]

Within the agricultural sector production of food and jute are the most important activities. 93% of the land cultivated in 1977-78 was devoted to the production of food and jute.[3]

Jute is used as a raw material in the jute manufacturing sector and also exported to other countries. Bangladesh is a major producer and exporter of raw jute. In 1953 Bangladesh produced 64% of the total world supply of jute and allied fibres. That percentage has sharply declined over the years and in 1968 it was 35% and in 1977 only 22.6%. A large part of the total production of jute in Bangladesh is exported. About 90% of the total production was exported in the early 1950's, compared to about 50% in the mid-1970's. However, two trends are worth noting here. One is the gradual downward trend of the share of Bangladesh in the world jute market and the other is the upward trend of the production and export of jute manufactures. Table 3.1 shows the trend of the production and export of jute and jute manufactures.

TABLE 3.1

TREND OF PRODUCTION AND EXPORT OF JUTE AND JUTE MANUFACTURES

YEAR	IQJSB	SBWJS	EXJ	IJMS	IEXJM
1955	98.2	49.8	96.9	38.9	28.7
1960	100.0	38.5	74.7	100.0	100.0
1965	110.8	33.5	61.6	131.9	155.3
1970	125.4	36.7	41.5	195.9	263.2
1975	75.1	20.0	44.2	174.1	217.2
1977	89.3	22.6	46.2	197.0	259.0

Source: Industrial Fibres, various issues; Bangladesh Statistical Year Book, various issues.

Notes: IQJSB = Index of Production of Jute by Bangladesh;

SBWJS = % Share of Bangladesh in World Jute Supply;

EXJ = Export of jute by Bangladesh as a percentage of her production;

IJMS = Index of production of Jute Manufactures;

IEXJM = Index of export of Jute Manufactures.

Rice is the most important agricultural crop produced in Bangladesh. Wheat, as close substitute for rice, has been drawing increasing attention from farmers recently, but the share of wheat in the total production of food is not significant. In 1975-76 production of wheat accounted for only 1.6% of the total production of food.[4] In the present study it was not considered worthwhile to study the market for wheat separately and the supply of and demand for wheat has been included in the supply of and demand for rice.

The total supply of food together with the total demand for food determine the amount of food imports. Food is imported by the government and distributed at a subsidised price through government controlled ration shops. Food supplied through these government controlled ration shops directly benefits the urban population, because most of these ration shops are located in the urban areas. The price charged for food by the government is much lower than the open market price. This food subsidy has important implications for the demand for food and for the market price of food. The effects of this food subsidy on the process of development and food price in the open market have been discussed by Stepanek(1979), and Alamgir and Berlage (1972).

Domestic production of food has been often seriously hampered by natural calamities such as floods and droughts. Fluctuations in food imports have been caused mainly by the fluctuations in domestic production. The following table shows the extent of fluctuations in food imports.

TABLE 3.2

IMPORT OF FOOD AS A PERCENTAGE OF TOTAL CONSUMPTION OF FOOD

Year	Import as a % of Consumption
1960	5.6
1965	3.5
1970	12.6
1975	18.6
1977	6.5

Source: Stepanek(1979), p.55.

Within the manufacturing sector the following features are worth noting. A large part of jute manufactures is exported (see Table 3.1). In 1975, 88.5% of the total production of jute manufactures by Bangladesh was exported.[5] The main and most important raw material used by jute manufacturing is domestically produced raw jute. The non-jute manufacturing uses imported raw material and very little domestically produced inputs. The output of the non-jute manufacturing is mostly consumed domestically. These features make it imperative to disaggregate the manufacturing sector into jute and non-jute manufacturing.

Though a major part of the production of jute manufactures by Bangladesh is exported, the share of

Bangladesh in the world market for jute manufactures is not very high. Bangladesh produced about 8% of the world supply in the fifties and slightly over 20% in the mid-seventies.[6] It may, therefore, be assumed that Bangladesh has little or no influence on the world price of jute manufactures.

3.3 Labour Force and Employment

It has already been mentioned that the density of population in Bangladesh is one of the highest in the world. Nearly 91% of the population lives in the rural area and 75% of the labour force is engaged in agriculture.[7]

Though urban employment is growing at a high rate, it is almost inconceivable that its share in total employment will dramatically change in the near future. With a population base of 85 million and a growth rate of population of 2.8% per year, a realistic employment policy has to emphasize the employment and income opportunities in the rural sector.

The employment in the services sector mostly consists of white collar labour, whereas employment in the manufacturing sector mostly consists of unskilled labour.

3.4 Prices and Wages

Prices have been fluctuating, with an upward trend, during the 1950's and through the mid-1960's. But the extent of the fluctuations was not too high. It is only during the late 1960's and the 1970's that the fluctuations can be described as being really violent. The money supply index shows a similar trend during this period, Table 3.3 highlights the common upward trend among the indices of prices, wages and money supply.

TABLE 3.3

INDICES OF PRICES, WAGES, AND MONEY SUPPLY

(BASE YEAR 1959)

Year	Price of Food	Price of Manuf.	Wages (Agri.)	Wages (Manuf.)	C.P.I.	Money Supply
1953	.68	.97	.58	.99	.86	.60
1958	.86	.95	1.02	1.02	.95	.96
1963	.94	1.02	.90	1.20	1.08	1.25
1968	1.30	1.22	.94	1.20	1.31	2.00
1973	3.30	3.94	2.84	4.32	3.01	5.30
1978	4.43	3.18	2.65	3.28	5.67	7.82

Source: See Data Appendix

3.5 Foreign Trade and Aid

During the pre-separation period, the balance of trade of Bangladesh was positive in almost every year. But the picture changed drastically during and after the liberation struggle, and the balance of trade has become negative.[8] This has happened because of the widespread rise in the prices of imports, accompanied by a sharp decrease in exports from Bangladesh. The volume of exports dropped primarily because of the loss of the West Pakistan market.

In the post-separation period, foreign aid and loans have played an important role in the government's attempt to offset the trade deficit.

3.6 The Financial Sector

The rural and agrarian character of the economy of Bangladesh is reflected in the financial statistics as well. There is a lack of banking habits among the people coupled with the absence of banking facilities in the rural areas. Most of the transactions are effected in currency rather than in cheques. The ratio of currency outside banks to the demand deposits for Bangladesh is 1.0. Whereas, the same ratio for U.S.A. and U.K., is .36 and .50 respectively.[9]

The money market in Bangladesh, like most other developing countries is characterized by its dual nature. The organized money market serves the urban sector. The size of the unorganized money market is small. The credit needs of the rural people are mostly met by friends and relatives. There are very few rural money lenders who charge interest on loans and no data is available about these transactions.[10]

The monetary system of Bangladesh is dominated by the central bank of Bangladesh, the Bangladesh Bank, and the commercial banks. There are a few other specialized financial institutions, such as the Bangladesh Shilpa Bank (Bangladesh Industrial Bank),the House Building Finance Corporation, and the Bangladesh Krishi Bank (Bangladesh Agricultural Bank). There are two types of commercial banks, scheduled banks and non-scheduled banks. The number and total asset of non-scheduled banks do not justify any serious attention.[11]

The commercial banking system of Bangladesh closely resembles the British branch banking system. The principal source of funds of the commercial banks is the deposits of the public. Over the years a rising trend in deposits have been observed. Rising nominal income and a rising trend in the rates of interest on saving deposits are the main causes of the rising volume of deposits. Gradual monetization has also played its role.

The commercial banks permit the depositors to write cheques on all types of saving deposits except time deposits. Data on the classification of deposits according to the ownership of each type of deposit are not available, but it will not be unreasonable to assume that the major part of the time deposits are privately owned.[12]

Borrowing from the central bank plays a crucial role in the commercial banking system of Bangladesh. This is an important source of funds for commercial banks.

Credit to the private sector and investment in government securities are the two most important assets held by the commercial banks. Over 80% of the non-loan investments of the commercial banks are in government securities.[13] Government securities also play an important role in the banking system. The commercial banks are required to keep 20% of their deposits in liquid assets. Government securities may be used to satisfy this requirement. Compared to holding cash to satisfy this liquidity requirement, holding interest-bearing government securities is definitely more attractive. Moreover, the central bank stands as a guarantor to buy the government securities any time.

In the earlier years, investment in government securities was almost as attractive as loans and advances.

But, in the recent years, loans and advances are yielding a relatively greater return and should be more attractive. However, factors which make government securities more attractive are safety and use of government securities to satisfy liquidity requirements.

The bank rate is an important tool of the central bank for monetary management in the developed countries. In these countries, a rise in the bank rate encourages net inflows of foreign funds, reduction in demand for credit and increases in savings. The bank rate as a tool of monetary management has not been used by Bangladesh Bank very frequently. The currency of Bangladesh is not freely convertible into currancies of other countries and there is no international financial centre in the country. Foreign investment is insignificant. The bank rate has been changed three times during the period, 1953 to 1977.

3.7 Conclusion

The examination of the characteristics of the Bangladesh economy has made it clear that a study of the problem of inflation in Bangladesh must take into account the diverging nature of various sectors. Output may be classified into three major groups: agricultural output, manufacturing output, and output of the services sector.

Out of the two major agricultural crops; food is domestically consumed and jute is used as raw material and also exported abroad. Output of the manufacturing sector could be classified into two broad groups; jute manufactures and non-jute manufactures. While the jute manufacturing mainly uses domestically produced raw materials, the non-jute manufacturing sector mostly uses imported raw materials.

The labour market in the manufacturing sector should be studied separately from the labour market in the agricultural sector. The wages and the nature of the work of the labourers in the manufacturing sector are different from those in the agricultural sector.

The theoretical model formulated in the next chapter is designed to reflect these important features of the Bangladesh economy.

FOOTNOTES TO CHAPTER THREE

1. Government of Bangladesh, Bangladesh Economic Survey, 1977-1978, p. 198.

2. op. cit.

3. op. cit., pp. 5-10.

4. op. cit., pp. 5-10.

5. op. cit., p. 130 and p. 256.

6. See Mustafa(1978), pp. 33.

7. Government of Bangladesh, Statistical Year Book, 1979, chapters 11 and 12.

8. op. cit., p. 268.

9. See International Monetary Fund, International Financial Statistics, February, 1979.

10. See Credit Inquiry Commission Report (Karachi: Manager of Government Publications, 1959).

11. The non-scheduled banks have insignificant assets compared to the assets of scheduled banks. In undivided Pakistan, in 1968 the asset of non-scheduled banks was 1% of the asset of scheduled banks.

12. See Bhuyyan(1971), p. 17.

13. See Bangladesh Bank, Economic Trend, various issues.

CHAPTER FOUR

THE THEORETICAL MODEL

4.1 Introduction

In this chapter a disaggregated econometric model of the Bangladesh economy is developed. The main purpose of this model is to examine how the various sectoral prices are determined and how these sectoral prices ultimately determine the general price level and also the cost of living index. However, in addition to allowing an examination of the price formation mechanism, the model will also provide significant insights into various other questions which are of great importance to planners, politicians and researchers. For example, the present model may be used to compare the effectiveness of fiscal and monetary policies to combat inflation or to increase output.

The sectoral disaggregation of the model has been dictated by the special characteristics of the Bangladesh economy and also by the objectives of this study. The agricultural and non-agricultural sectors of any developing economy have distinctly different characteristics, which must be recognized when modelling these economies. It is clear from the discussion in the previous chapter that a distinction between food and non-food(jute) agricultural output must be made. In the non-agricultural sector, jute manufactures, non-jute manufactures and the service sectors are examined. The labour market is divided into two different markets, the labour market in the agricultural sector and the labour market in the manufacturing sector. There is a financial market in the model which describes the behaviour of the financial variables and their influence on the real variables. Foreign aid and foreign trade are also incorporated into the model. The model is a short run model. Thus, the stock of fixed capital and also its allocation to various sectors is assumed to be exogenous.

In the case of developed economies, which are capable of producing much more than they often do, a frequent problem is to find enough effective demand; otherwise, such economies have a tendency to go into recession.[1] In the developing countries supply is very slow to adapt to changing demands, because of the scarcity of capital goods and imported raw materials and a lack of technological expertise. In the present model interplay of the forces of supply and demand determine outputs and prices in all of the sectors except the services sector. Output in the services sector is determined by a demand function, assuming a horizontal supply curve.

The logical basis for formulating the functional relationships and the interrelations and feedbacks among various sectors are explained in this chapter. The model is presented in blocks of equations. Each block of equations, excluding the final block, describes a market. The final block presents the equations needed to close the model. Once the model is developed, the equations of the model are presented in section 4.8, followed by the flow-charts of the sectoral models. A complete list of the variables appear at the end of section 4.8. The conclusion of the chapter appears in section 4.9.

4.2 Agricultural Sector

It is assumed that the agricultural sector uses land, labour and capital to produce food and non-food(jute) crops. Capital is assumed to be exogeneously given. Given the production relations for both food and non-food, optimizing behaviour on the part of the representative farmer dictates the choice of variables entering into the equations explaining the supply of food and non-food, demand for labour in food production and non-food production, and aggregate land allocation to food and non-food production.

4.2.1 Market for Food

In this section an econometric model for the domestic food market is developed.

The variables entering into the supply equation are determined on the basis of profit maximization behaviour of the representative farmer.[2] The production functions for both food and non-food crops are assumed to be of the neoclassical type and are given below.

$$QFS = QFS(KF, LDF, LNDF) \quad (4.1)$$

$$QJSB = QJSB(KJ, LDJ, LNDJ) \quad (4.2)$$

Where QFS and QJSB are the quantities of food and non-food crops respectively; KF, LDF, and LNDF are capital, labour and land respectively used in the production of food crop; and KJ, LDJ and LNDJ are capital, labour and land respectively used in the production of non-food crop.

It has already been mentioned that capital is assumed to be exogenous to the agricultural sector, at least in the short-run. Land is also assumed to be exogenous in the short run, because consistent data on rent is not available and also there is very little scope for renting in the short run. Marginal productivities of all the factors of production are assumed to be non-negative. The production functions are assumed to be continuous and twice differentiable. Availability of land and capital are constraints on the profit maximization problem.

Profit maximization by the representative farmer leads to the following Lagrangian:

$$Z = PFA.QFS(KF,\ LDF,\ LNDF) + PJ.QJSB(KJ,\ LDJ,\ LNDJ) - WAA.LDF - WAA.LDJ + \lambda(LND - LNDF - LNDJ) + \beta(KA - KF - KJ) \quad (4.3)$$

where PFA and PJ are the prices of food and non-food crops respectively. WAA is the agricultural wage rate and λ and β are the Lagrangian multipliers.

The first order conditions for profit maximization may be written as:

$$\frac{\partial QFS(KA,\ LDF,\ LNDF)}{\partial LDF} = \frac{WAA}{PFA} \quad (4.4)$$

$$\frac{\partial QJSB(KJ,\ LDJ,\ LNDF)}{\partial LDJ} = \frac{WAA}{PJ} \quad (4.5)$$

$$PFA\,\frac{\partial QFS(KF,\ LDF,\ LNDF)}{\partial LNDF} = PJ\,\frac{\partial QJSB(KJ,\ LDJ,\ LNDJ)}{\partial LNDJ} = \lambda \quad (4.6)$$

$$PFA\,\frac{\partial QFS(KF,\ LDF,\ LNDF)}{\partial KF} = PJ\,\frac{\partial QJSB(KJ,\ LDJ,\ LNDJ)}{\partial KJ} = \beta \quad (4.7)$$

$$LND - LNDF - LNDJ = 0 \quad (4.8)$$

$$KA - KF - KJ = 0 \quad (4.9)$$

The solutions for input demand functions are derived from the above set of first order conditions. The input demand functions are:

$$LDF^* = LDF^*(WAA/PFA,\ WAA/PJ,\ PJ/PFA,\ KA,\ LND) \quad (4.10)$$

$$LDJ^* = LDJ^*(\text{same set of variables as above}) \quad (4.11)$$

$$LNDF^* = LNDF^*(\text{same set of variables as above}) \quad (4.12)$$

$$LNDJ^* = LNDJ^*(\text{same set of variables as above}) \quad (4.13)$$

$$KF^* = KF^*(\text{same set of variable as above}) \quad (4.14)$$

$$KJ^* = KJ^*(\text{same set of variable as above}) \quad (4.15)$$

The supply equations for food and non-food crops are derived by substituting the above solutions for inputs into the respective production functions.

The aggregate supply equation for food may be written, assuming a log-linear relationship as:

$$\begin{aligned} \ln QFS = {} & a_{10} + a_{11}\ln PFA + a_{12}\ln PJ + a_{13}\ln LND + a_{14}\ln KA \\ & + a_{15}\ln WAA + a_{16}TIME + a_{17}DUM + a_{18}\ln FLOD \\ & + a_{19}\ln DRO \end{aligned} \quad (4.16)$$

where DUM is a dummy variable introduced to capture the disruption of the normal economic activity during and after the liberation war of 1971.

In the agricultural sector, weather plays a very important role. Weather influences the yield of any agricultural crop in a very complicated way. The single most important weather variable for both rice and jute is rainfall. In our study a positive deviation of rainfall from the normal level is represented by the flood(FLOD) variable; and a negative deviation is represented by the drought(DRO) variable. The normal rainfall has been defined as the area-weighted average rainfall over a twentyfive year period(1953 to 1977). The time trend has been introduced in both the supply of food and jute equations to represent technological change in agriculture such as better seeds and know-how. All other variables have been defined earlier.[3]

In the present model it is assumed that the farmer's behaviour is guided not by the current prices of food and jute but by the expected prices of food(PFA^e) and jute(PJ^e). Assuming naive expectations on the part of the farmers, that is, $PFA^e = PFA_{-1}$ and $PJ^e = PJ_{-1}$, the food supply equation may be written as below:

(T1)[4] $$\ln QFS = a_{10} + a_{11}\ln PFA_{-1} + a_{12}\ln PJ_{-1} + a_{13}\ln LND + a_{14}\ln KA + a_{15}\ln WAA + a_{16}TIME + a_{17}DUM + a_{18}\ln FLOD + a_{19}\ln DRO$$

The demand for food is a final demand and depends on disposable income, own price, the prices of other commodities, population and wealth.

It is an extremely difficult task to find a good measure of wealth. But the wealth variable is thought to have a significant influence on the consumption expenditure of the household. A variable representing liquid assets can be used as a proxy for the wealth variable. Klein rationalised the use of liquid assets as a proxy for the wealth variable in the following way:

> "...liquid assets are a strategic form of wealth, as far as consumer behaviour is concerned. They are the money balances that are spent for goods and services. Other consumer assets are not as easily convertible into spendable form,...At the individual level, liquid assets are highly correlated with overall consumer wealth, and thus serve as a good wealth indicator".[5]

The use of liquid assets as a proxy for wealth is more justified in the context of developing countries, where the financial market is not developed. The most popular forms of keeping wealth are cash, bank deposits and gold. Gold is not usually converted into spendable assets in Bangladesh, except in abnormal situations. Thus in the present model, cash and bank deposits are added together for use as a proxy for wealth in the aggregate demand for food equation.

Thus the demand for food equation is specified as below:

$$\text{(T2)}\quad \ln QFD = a_{20} + a_{21}\ln PNJM + a_{22}\ln LIQ + a_{23}\ln YD + a_{24}DUM + a_{25}\ln PFA + a_{26}\ln POP$$

Where QFD is the demand for food, PNJM is the price of non-jute manufactures, YD is disposable income, LIQ is the measure of liquidity and POP is population.

It has been mentioned in the previous chapter that a chronic shortage of food has characterized Bangladesh for a long time. The government imports food from abroad to satisfy this requirement. Food is sold by government agents at a lower than the market price. The effect of this food subsidy is analysed in subsection 4.2.1a, and modified demand for food equations are derived there. The modified demand for food equations are reported below:

(T2') $\ln TQF = a'_{20} + a'_{21}\ln PNJM + a'_{22}\ln LIQ + a'_{23}\ln AYD + a'_{24}\ln DUM + a'_{25}\ln PFA + a'_{26}\ln POP$

(T2") $\ln QFD = a''_{20} + a''_{21}\ln PNJM + a''_{22}\ln LIQ\ a''_{23}\ln YYD + a''_{24}\ln DUM + a''_{25}\ln IMF + a''_{26}\ln PFA + a''_{27}\ln POP$

where, TQF is the sum of QFD and the amount of food sold through the government rationing system and AYD is the sum of disposable income and the amount of subsidy. In (T2"), IMF is import of food and YYD is the disposable income net of the amount spent on the food supplied by the government.

(T3) $QFS + IMF = TQF$

Equations (T1), (T3) and one of equations (T2), (T2') and (T2'') determine the values of three endogenous variables; namely demand for food(QFD), domestic supply of food(QFS), and price of food(PFA). Since the government controls the import of food (IMF), this variable is treated as exogenous.

4.2.1a. A Digression on the Food Subsidy

The quantity of food sold to every individual through government controlled ration shops is fixed. This quantity is not sufficient to satisfy consumer demand. Food purchased from the open market fills the gap.

Let us briefly examine the behaviour of the typical household under this circumstance. The typical household's utility function and budget constraint are assumed to be the following.

$$U = R^{a}C^{1-a} \quad (D1)$$

$$M = P_g R_g + P_m R_m + P_c C \quad (D2)$$

Where, R = total quantity of food consumed;

R_g = amount of food supplied by the government store;

C = other consumer good(a composite commodity);

P_m = price of food in the open market;

R_m = amount of food bought from the open market;

P_c = price of the composite consumer good;

M = income.

By definition, $R = R_g + R_m$ (D3)

Now (D2) may be written as below.

$$M = P_g R_g + P_m R_m + P_m R_g - P_m R_g + P_c C \quad (D4)$$

$$\text{or, } M + (P_m - P_g)R_g = P_m R_m + P_c C + P_m R_g$$

$$\text{or, } M + (P_m - P_g)R_g = P_m R + P_c C \quad (D5)$$

$(P_m - P_g)R_g$ is the amount of subsidy. This subsidy affects the total consumption of food, and also of other commodities. Since P_m, P_g and R_g are fixed for the household, the amount of the subsidy is independent of the decisions of the household.

The typical household's optimizing problem may be formulated as below.

$$V = R^a C^{1-a} + \lambda\left[M + (P_m - P_g)R_g - P_m R - P_c C\right] \quad \text{(D6)}$$

$$\partial V/\partial R = aR^{a-1}C^{1-a} - \lambda P_m = 0 \quad \text{(D7)}$$

$$\partial V/\partial C = (1-a)R^a C^{-a} - \lambda P_c = 0 \quad \text{(D8)}$$

$$\partial V/\partial \lambda = M + (P_m - P_g)R_g - P_m R - P_c C = 0 \quad \text{(D9)}$$

From (D7) and (D8) we may write the following.

$$[a/(1-a)](C/R) = P_m/P_c$$

$$\text{or, } P_c C = [(1 - a)/a]P_m.R \quad \text{(D10)}$$

Now, using (D10), (D9) may be written as following.

$$M + (P_m - P_g)R_g = P_m R + P_c C$$

$$\text{or, } M + (P_m - P_g)R_g = P_m R + [(1 - a)/a]\, P_m R$$

$$\text{or, } M + (P_m - P_g)R_g = (aP_m R + P_m R - aP_m R)/a$$

$$\text{or, } M + (P_m - P_g)R_g = (P_m R)/a \quad \text{(D11)}$$

From (D11), the demand for food(R) can be found as follows.

$$R = (a/P_m)[M + (P_m - P_g)R_g] \qquad (D12)$$

The demand for food in the open market(R_m) is

$$R_m = [a/P_m][M + (P_m - P_g)R_g] - R_g$$

or, $R_m = [aM/P_m] + [a(P_m - P_g)/P_m - 1]\, R_g$

or, $R_m = [a/P_m][M - P_g R_g] + (a - 1)R_g \qquad (D13)$

Assuming that all the households have identical utility functions, equation (D13) also holds at the aggregate level. Solving for P_m, we have

$$[a/P_m][M - P_g R_g] = R_m - R_g(a - 1)$$

or, $P_m = [a(M - P_g R_g)]/[R_m - R_g(a - 1)] \qquad (D14)$

In the short run, the supply of food in the free market is fixed. Let $R_m = S_m$, the supply of food in the open market. Now, (D14) can be written replacing R_m by S_m, as below.

$$P_m = a(M - P_g R_g)/[S_m - R_g(a - 1)] \qquad (D15)$$

Now let us examine the effect of change in the quantity supplied or price charged by government controlled ration shops on the price of food in the open market.

$$\partial P_m/\partial P_g = (-aR_g)/[S_m - R_g(a - 1)] < 0 \qquad (D16)$$

$$\frac{\partial P_m}{\partial R_g} = \frac{[S_m - R_g(a - 1)](-aP_g) + [a(M - P_g R_g)](a - 1)}{[S_m - R_g(a - 1)]^2} \qquad (D17)$$

From (D16), we may conclude that if price in the government shops is increased, then price in the open market will go down. Analytically one can see the connection very clearly. If price in the government shops is increased, then the difference between the market price and the government store price is reduced and so is the subsidy. If subsidy is reduced, the demand for food in the open market reduces, thus reducing open market price, assuming that food is a normal good.

Again $(\partial P_m/\partial R_g) < 0$, means that if more is supplied through the government shops, then demand for food in the open market will be reduced and hence the price in the open market will fall.

In the light of the above discussion, one may select the variables to be included in the demand for food-equation. According to equation(D12), total demand for food(R) equation should include income adjusted for implicit subsidy involved with the consumption of rice supplied by the government. Equation(T2') has been formulated in this line. In this equation the adjusted disposable income(AYD) is nothing but the sum of the disposable income and the implicit subsidy $[(P_m - P_g)R_g]$. It is worth noting that the implicit subsidy term is dependent on the market price of food(P_m) and so the term is endogenous.

An alternative way to deal with the subsidy problem is to use equation (D13) as the basis of formulating a demand for food equation(R_m). Here the quantity(R_m) is the quantity demanded in the open market. The quantity of food demanded in the open market(R_m) is now a function of disposable income net of expenditure on food sold by government, quantity supplied by the government(R_g), and price in the open market (P_m). Equation(T2") has been formulated in this way.

4.2.2 Market for Jute

Since Bangladesh supplies a major portion of the jute in the world jute market, the jute market of Bangladesh cannot be studied in isolation from the world market. In this section an econometric model of the world jute market is developed within the framework of quantity and price determination under perfect competition. The world price of jute determines the domestic price of jute. Given the domestic price, the quantities of jute domestically produced and consumed are determined and the residual is exported.

The domestic supply of jute is determined by the optimizing behaviour of the farmer analysed earlier in this chapter and may be written as follows.

(T4) $\ln QJSB = a_{40} + a_{41}\ln PFA_{-1} + a_{42}\ln PJ_{-1} + a_{43}\ln LND + a_{44}\ln KA + a_{45}\ln WAA + a_{46}TIME + a_{47}DUM + a_{48}\ln FLOD + a_{49}\ln DRO$

The domestic demand for jute is a derived demand from the production of jute manufactures. Raw jute is the most important raw material in the jute manufacturing industry. There is virtually no close substitute of jute and allied fibres. Thus the production of jute manufactures determines the demand for jute. The demand for jute (QJDB) equation has been specified as below.

(T5) $\ln QJDB = a_{50} + a_{51}\ln QJMS$

where QJMS is the supply of jute manufactures.

The demand for jute by the rest of the world(QJDRW) has been specified as below.

(T6) $\ln QJDRW = a_{60} + a_{61}\ln PJMW + a_{62}\ln PJW + a_{63}\ln YF$

where PJMW is the price of jute manufactures in the world market, PJW is the price of raw jute in the world market and YF is an index of income of those foreign countries who consume raw jute.

The supply of jute by the rest of the world (QJSRW) is hypothesized to depend on the lagged price of raw jute in the world market (PJW_{-1}) and may be written as:

(T7) $\ln QJSRW = a_{70} + a_{71}\ln PJW_{-1}$

The total world supply of jute(QJSW) is given by the following identity:

(T8) $QJSW = QJSB + QJSRW$

The world demand for jute(QJDW) is given by the following identity:

(T9) $QJDW = QJDRW + QJDB$

The world market clearing condition may be written as below:

(T10) $QJSW = QJDW$

The relationship between domestic price of jute and the price of jute in the world market is formulated as below:

(T11) $\ln PJ = a_{110} + a_{111}\ln PJW + a_{112}\ln EXRAT + a_{113}\ln FRET$

where EXRAT is the exchange rate expressed in units of domestic currency per sterling pound and FRET is the freight charges on the transportation of jute and jute goods from ports in Bangladesh to ports in the United Kingdom.

The volume of exported jute is residually determined. The jute mills are very important for the economy of Bangladesh. The jute manufacturing industry as a whole employs the bulk of the urban labour force. Government has always played a crucial role in keeping the jute mills operating at maximum capacity. It has been the policy of the government to encourage processing an increasing volume of raw jute in the country and to export more and more jute goods. Thus, the export of raw jute abroad is residually determined and given by the following identity.

(T12) EXJ = QJSB - QJDB

Equations (T4) to (T12) describes the raw jute market. There are altogether nine equations and nine endogeneous variables. The endogenous variables are the domestic supply of jute(QJSB), domestic demand for jute(QJDB), domestic price of jute(PJ), price of jute in the world market(PJW), jute supplied by the rest of the world(QJSRW), demand for jute by the rest of the world(QJDRW), world demand for jute(QJDW), world supply of jute(QJSW), and exports of jute by Bangladesh(EXJ).

4.3 Manufacturing Sector

The need for distinguishing between jute manufactures and non-jute manufactures has been discussed in the previous chapter. In the following two subsections the econometric models for jute manufactures and non-jute manufactures are presented.

4.3.1 Market for Jute Manufactures

A large part of the output of this industry is exported. We assume that the price of jute manufactures is determined in the world market and that domestic producers take that price as given.

The supply of jute manufactures (QJMS) is described by the following equation.

$$\text{(T13)} \quad \ln QJMS = a_{130} + a_{131}\ln KJM + a_{132}\ln PJMW + a_{133}DUM + a_{134}EXRAT$$

where KJM and PJMW are the capital in jute manufacturing and the price of jute manufactures in the world market. Since it is the policy of the government to encourage processing an increasing volume of raw jute in the country and to export more and more jute goods, the wage rate in the manufacturing sector is not an important influence on the production of jute goods. Thus the wage rate in the manufacturing sector has not been included in this equation.

Exports of jute manufactures depend on the price of jute manufactures in the world market, the exchange rate, the price of a composite substitute of jute manufactures in the world market(PJMS), and an index of income in consuming countries(YF).

(T14) $\ln EXJM = a_{140} + a_{141}\ln PJMW + a_{142}\ln YF + a_{143}DUM$
$+ a_{144}\ln EXRAT + a_{145}\ln PJMS$

The price of jute manufactures in the domestic market(PJM) depends on the price of jute manufactures in the world market(PJMW), the exchange rate(EXRAT) and freight charges(FRET). The equation for the price of jute manufactures is specified as below.

(T15) $\ln PJM = a_{150} + a151\ln PJMW + a152\ln EXRAT + a153\ln FRET$

Domestic use of jute manufactures (QJMD) is determined by the following identity.

(T16) $QJMD = QJMS - EXJM$

The above four equations determine four endogenous variables, namely, supply of jute manufactures (QJMS), export of jute manufactures (EXJM), domestic use of jute manufactures(QJMD), and the domestic price of jute manufactures(PJM).

4.3.2 Market for Non-Jute Manufactures

In the non-jute manufacturing sector, we have demand and supply equations describing the market. Since, in most of the developing countries, the manufacturing sector is characterized by the presence of monopoly we have checked to see how the assumption of monopoly changes the reduced form equations of this market (see Appendix A). It has been found that both competitive and monopoly models give reduced form equations for equilibrium price and quantity containing the same set of variables.

The supply equation for non-jute manufactures(QNJMS) may be formulated as below.

$$\text{(T17)} \quad \ln QNJMS = a_{170} + a_{171}\ln PNJM + a_{172}\ln WMM + a_{173}\ln KNJM + a_{174}\ln IMR + a_{175}DUM + a_{176}TIME + a_{177}DUMP$$

where KNJM is the capital stock in the non-jute manufacturing sector and IMR is imported raw material. Both KNJM and IMR are exogenous. The reasons for treating capital stock as an exogenous variable has already been mentioned at the outset of the chapter. Import of goods falling into any category is strictly regulated by the government through licensing and that is why imported raw material is being treated as exogenous. An additional dummy variable(DUMP) has been included in this equation to capture a possible change in the slope of the supply equation. This is a slope dummy and is the product of the intercept dummy(DUM) and the price of the output(PNJM).

The demand for non-jute manufactures(QNJMD) is specified as following.

$$\text{(T18)} \quad \ln QNJMD = a_{180} + a_{181}\ln YD + a_{182}\ln LIQ + a_{183}\ln PNJM + a_{184}\ln PFA + a_{185}DUM + a_{186}\ln POP$$

Finally, the following identity shows that the demand for non-jute manufactured goods is equal to its domestic supply plus imported non-jute manufactured goods(IMNJM). Since import is largely controlled by the government, IMNJM is treated as an exogenous variable in this model.

(T19) QNJMD - IMNJM = QNJMS

The above three equations determine the supply of, the demand for, and the price of non-jute manufactured goods.

4.4 Labour Market in the Agricultural Sector

The demand for labour in the production of food and jute has been discussed in section 4.2 of this chapter. Both food and jute are agricultural crops and are produced in the rural sector. In this sector the percentage of family labour used is very high. Since a high percentage of family labour is used to produce both food and jute crops; it is very difficult to obtain reliable estimates of labour used in food and jute production separately. For this reason the demand for labour in the production of food and jute are added together to find the aggregate demand for labour in the agricultural sector. The aggregate labour supply function is derived from the assumption of utility maximisation on the part of rural households with respect to the consumption of leisure along with other relevant commodities.

Labour demand in the agricultural sector depends on the same general conditions which determine the agricultural output supply function.

(T20) $$\ln LDA = a_{200} + a_{201}\ln PFA_{-1} + a_{202}\ln PJ_{-1} + a_{203}\ln WAA + a_{204}\ln KA + a_{205}\ln LND + a_{206}DUM + a_{207}\ln FLOD + a_{208}\ln DRO + a_{209}TIME$$

The labour supply equation in the agricultural sector (LSA) may be written as below. Since food is the single most important item of consumption for rural households, the price of food instead of the cost of living index has been used as an exogenous variable in this equation.

(T21) $$\ln LSA = a_{210} + a_{211}\ln WAA + a_{212}\ln PFA + a_{213}\ln RURP$$

Finally, the market clearing condition is as below:

(T22) $$LDA = LSA$$

The above three equations determine three endogenous variables, namely demand for labour in the agricultural sector, supply of labour in the same sector, and the agricultural wage rate. The market clearing condition implies full employment. Data on the real wage rate shows substantial fluctuations during the sample period. This implies that the labour market in the agricultural sector may be treated as competitive.

4.5 Labour Market in the Manufacturing Sector

The demand for labour in jute manufacturing and the demand for labour in non-jute manufacturing are added together to obtain the aggregate demand for labour in the manufacturing sector. Labour supply in the manufacturing sector is based on the assumption of utility maximisation of the urban household with respect to the consumption of leisure along with other relevant commodities.

It has already been mentioned that the volume of output of jute manufactures is largely influenced by government decisions. Thus, the single most important factor which determines the level of employment in this sector is the volume of output. The demand for labour in jute manufacturing sector is specified as below.

(T23) $\ln LDJM = a_{230} + a_{231} \ln QJMS$

The demand for labour in non-jute manufacturing is described by the follwing relation:

(T24) $\ln LDNJM = a_{240} + a_{241}\ln PNJM + a_{242}\ln WMM + a_{243}\ln KNJM + a_{244}DUM + a_{245}\ln IMR + a_{246}TIME + a_{247}DUMP$

The labour supply equation in the manufacturing sector is as follows:

(T25) $\ln LSM = a_{250} + a_{251}\ln WMM + a_{252}\ln CPI + a_{253}\ln URP$

The market clearing condition is as below:

(T26) $LDJM + LDNJM = LSM$

The above four equations determine the values of four endogenous variables, namely, demand for labour in jute manufacturing, demand for labour in non-jute manufacturing, supply of labour in the manufacturing sector, and the wage rate in the manufacturing sector.

4.6 The Financial Sector

In most models of developing economies, the money market or the financial market is described by an equation for the demand for money, an equation for the supply of money and a market clearing condition. In some models the supply of money is taken as exogenous. This type of financial model determines the equilibrium rate of interest. The rate of interest links the financial sector with the real sector.

However, there is very little evidence in favour of the hypothesis that the rate of interest influences the choice of portfolio of the households in developing countries. There are no well developed bond and stock markets in developing countries and the alternatives to holding money are not bonds and stocks but gold and land.

In our model we are using the liquidity variable as a proxy for wealth and this enters into the real sector through the demand equations. The liquidity variable is the sum of demand deposits and cash held by the public. Thus the liquidity variable equals the supply of money. The change in the money supply directly affects the demand for commodities and, consequenty, prices.

The supply of credit by the commercial banking system to the private sector is important for several reasons. The supply of credit directly influences investment in the private sector. There is also direct link between the supply of credit and the money supply. The profit maximising behavior of the banks determines the volume of credit to be supplied. The banks have to work under the constraints of reserve and liquidity requirements and a constraint on borrowing from the central bank.

A theoretical model of the financial sector is developed in Appendix C. The theoretical basis of the equation for the supply of credit (CRED) has been discussed in this appendix and the equation is specified as below.

$$(T27)\quad \ln CRED = a_{270} + a_{271}\ln r_c + a_{272}\ln GS + a_{273}\ln RES + a_{274}\ln DUMF$$

Where r_c is the interest rate charged on bank credit, GS is the stock of government securities, RES is the cash reserves of the commercial banking system, and DUMF is a dummy variable introduced to take care of structural changes occurring in the financial sector during 1960.

The liquidity (LIQ) holding of the public can be defined as following:

$$(T28)\quad LIQ = CWP + CRED - TD + RES + RESF$$

where CWP is cash with public and RESF is the residual from the balance sheet of the commercial banking system.

The above two equations determine the supply of credit to the private sector(CRED) and the stock of liquidity(LIQ).

4.7 Remaining Equations and Identities

Output in the services sector is demand determined. Demand for services by the private sector(YSP) depends on disposable income, wealth and population. The equation is specified as below. Government consumption of services(GC) has been subtracted from the total output of services(YS) to arrive at the demand for services by the private sector.

$$(T29) \quad \ln YSP = a_{280} + a_{281}\ln YD + a_{282}\ln POP + a_{283}DUM + a_{284}\ln CPI + a_{285}\ln LIQ$$

Allocation of imports to various categories namely, food (IMF), non-food consumer goods (IMNJM), raw materials (IMR), and capital goods (IMCAP) are exogenous. Because of the scarcity of foreign exchange, imports are controlled by the government through import licensing. The import policy of the government is declared normally twice a year. The import policy is formulated and modified from time to time to reflect the desirability of importing items falling into the above categories. Most of the items falling into the category of non-food consumer goods are luxury goods. These goods are the least preffered import items and in our model the value of this category of import is residually determined. The following identity gives the total value of imports(IM).

$$(T30) \quad IM = PIMF.IMF + PIMNJM.IMNJM + PIMR.IMR + PCAP.IMCAP$$

Where PIMF, PIMNJM, PIMR, and PCAP are the prices of imported food, imported non-jute manufactured goods, imported raw materials, and imported capital goods respectively. These prices are assumed to be exogenous.

The total value of exports(EX) is given by the following identity.

(T31) $EX = PJW.EXJ.(PJW59).EXRAT + PJMW.EXJM.(PJMW59).EXRAT + EXOT$

Where (PJW59) and (PJMW59) are the prices of one unit of jute and jute manufactures respectively in the world market 1959. EXOT is the value of exports other than jute and jute manufactures.

The change in foreign exchange reserves(ΔFE) is primarily determined by the changes in the value of exports, imports, and inflow of foreign aid(FA). Change in foreign exchange reserve is given by the following identity.

(T32) $\Delta FE = EX - IM + FA + RESF$

where RESF is the residual in the balance of payment identity.

The stock of foreign exchange reserve is given by the following identity.

(T33) $FE = FE_{-1} + \Delta FE$

The direct tax revenue is given by the following identity.

(T34) $DREV = t(YFC)$

Where t is the tax rate applied to the nominal national income, YFC.

In the developing countries indirect tax revenue is mainly derived from export duties, import duties, and commodity taxes, which are mainly imposed on the output of the manufacturing sector. The value of imports net of tax-exempt imports of food, fuel, medicine and raw materials could not be obtained. The value of exports is highly correlated with the value of output of the manufacturing sector. Thus the indirect tax revenue has been specified as a function of the value of output of the manufacturing sector.

$$\text{(T35)} \quad \ln IREV = a_{350} + a_{351}\ln QNJMS + a_{352}\ln QJMS + a_{353}\ln PNJM + a_{354}\ln PJM + a_{355}DUM$$

The change in government securies(ΔGS) is a measure of deficit financing by the government. Beside tax revenue and non-tax revenue, foreign aid is a very important source of financing goverment expenditure. The change in government securities is given by the following identity.

$$\text{(T36)} \quad \Delta GS = GE - DREV - IREV - FA + RESG$$

Where RESG is the residual in the government budget constraint. This includes all the excluded non-tax revenue net of debt servicing.

The following is the definition of the stock of outstanding government securities.

(T37) $GS = GS_{-1} + \Delta GS$

Ideally the general price level should be calculated as the weighted average of the various sectoral prices, but because the prices of the services sector are not available and there is also a residual sector, it is not possible to find the weighted average of the sectoral prices.

The general price level(PP) or the GNP deflator has been estimated as a function of the price of food, the price of non-jute manufactures, the price of jute manufactures, and the price of jute.

(T38) $\ln PP = a_{380} + a_{381}\ln PFA + a_{382}\ln PNJM + a_{383}\ln PJ + a_{384}\ln PJM$

The cost of living index(CPI) is largely determined by the prices of food, manufactured consumer goods, housing and transport services. In the absence of data on prices of services, the cost of living index is estimated as a function of the prices of food, non-jute manufactured goods, and imported non-jute manufactured goods. The equation is reported below.

(T39) $\ln CPI = a_{390} + a_{391}\ln PFA + a_{392}\ln PNJM + a_{393}\ln PIMNJM$

National income is usually defined as the net national product at factor cost. In the absense of any data on capital consumption allowance a concept of gross national income (GNP at factor cost) has been used in the present study.

GDP from the services sector(YS) is given by the following identity.

(T40) YS = YSP + GC

GNP at market prices is given by the following **identities.**

(T41) YY = (PFA59)PFA.QFS + (PJ59)PJ.QJSB + (PJM59).PJM.QJM
+ PNJM.QNJM - (PJ59).PJ.QJDB - PIMR.IMR

(T42) YMP = YY + YS + YOT

where PFA59, PJ59, and PJM59 are the prices of one unit of food, jute, and jute manufactures in the base year of the price indices of our study, 1959. YY, YS, YOT and YMP are GDP excluding the share of services and the other sectors, GDP from the services sector, residual in the GNP identity, and GNP at market prices respectively. YOT includes factor income.

GNP at factor cost is given by the following identity.

(T43) YFC = YMP - IREV + SUB

where YFC is GNP at factor cost and SUB is the government subsidies.

Government expenditure (GE) is defined as following.

(T44) GE = GC + GI

where GI is government investment expenditure.

Disposable income can be defined as GNP at factor cost minus direct taxes, capital consumption allowance and retained earnings of the corporate sector plus transfer payments received by private non-profit organizations and households. Because of lack of data disposable income has been defined as GNP at factor cost net of direct taxes.

(T45) YD = YFC - DREV

There are seventeen equations in the last block of equations which determine the values of seventeen endogenous variables. The endogenous variables are; gross domestic product of the services sector(YS), value of imports(IM), value of exports(EX), change in the stock of foreign exchange reserves(ΔFE), stock of foreign exchange reserves(FE), change in government securities(ΔGS), stock of outstanding government securities(GS), direct tax revenue(DREV), indirect tax revenue(IREV), general price level(PP), cost of living index(CPI), aggregate demand for services by the the private sector(YSP), GDP at market price originating from all the sectors excluding the services and the other sectors(YY), GNP at market price(YFC), GNP at factor cost(YFC), government expenditue(GE), and disposable income(YD).

In all there are fourty five equations in the model determining an equal number of endogenous variables. The endogenous variables have been listed at the end of each block of equations. All the equations of the model are reported again in the next section, followed by a list of all the variables.

4.8 The Complete Theoretical Model

In this section the theoretical model developed for the Bangladesh economy is reproduced in its entirety followed by the flow-charts of the sectoral models. A complete list of the variables appear at the end of this section.

Market for Food

(T1) $$\ln QFS = a_{10} + a_{11}\ln PFA_{-1} + a_{12}\ln PJ_{-1} + a_{13}\ln LND + a_{14}\ln KA + a_{15}\ln WAA + a_{16}TIME + a_{17}DUM + a_{18}\ln FLOD + a_{19}\ln DRO$$

(T2) $\ln QFD = a_{20} + a_{21}\ln PNJM + a_{22}\ln LIQ + a_{23}\ln YYD$
$+ a_{24}DUM + a_{25}\ln IMF + a_{26}\ln PFA + a_{27}\ln POP$

(T2) $\ln TQF = a_{20} + a_{21}\ln PNJM + a_{22}\ln LIQ + a_{23}\ln AYD$
$+ a_{24}\ln DUM + a_{25}\ln PFA + a_{26}\ln POP$

(T3) $QFS + IMF = TQF$

Market for Jute

(T4) $\ln QJSB = a_{40} + a_{41}\ln PFA_{-1} + a_{42}\ln PJ_{-1} + a_{43}\ln LND$
$+ a_{44}\ln KA + a_{45}\ln WAA + a_{46}TIME + a_{47}DUM$
$+ a_{48}\ln FLOD + a_{49}\ln DRO$

(T5) $\ln QJDB = a_{50} + a_{51}\ln QJMS$

(T6) $\ln QJDRW = a_{60} + a_{61}\ln PJMW + a_{62}\ln PJW + a_{63}\ln YF$

(T7) $\ln QJSRW = a_{70} + a_{71}\ln PJW_{-1}$

(T8) $QJSW = QJSB + QJSRW$

(T9) $QJDW = QJDRW + QJDB$

(T10) $QJSW = QJDW$

(T11) $\ln PJ = a_{110} + a_{111}\ln PJW + a_{112}\ln EXRAT + a_{113}\ln FRET$

(T12) $EXJ = QJSB - QJDB$

Jute Manufactures

(T13) $\ln QJMS = a_{130} + a_{131}\ln KJM + a_{132}\ln PJMW + a_{133}DUM$
$+ a_{134}\ln EXRAT$

(T14) $\ln EXJM = a_{140} + a_{141}\ln PJMW + a_{142}\ln YF + a_{143}DUM$
$+ a_{144}\ln EXRAT + a_{145}\ln PJMS$

(T15) $\ln PJM = a_{150} + a_{151}\ln PJMW + a_{152}\ln EXRAT + a_{153}\ln FRET$

(T16) $QJMD = QJMS - EXJM$

Non-Jute Manufactures

(T17) $\ln QNJMS = a_{170} + a_{171}\ln PNJM + a_{172}\ln WMM + a_{173}\ln KNJM$
$+ a_{174}\ln IMR + a_{175}DUM + a_{176}TIME + a_{177}DUMP$

(T18) $\ln QNJMD = a_{180} + a_{181}\ln YD + a_{182}\ln LIQ + a_{183}\ln PNJM$
$+ a_{184}\ln PFA + a_{185}DUM + a_{186}\ln POP$

(T19) $QNJMD - IMNJM = QNJMS$

The Agricultural Labour Market

(T20) $\ln LDA = a_{200} + a_{201}\ln PFA_{-1} + a_{202}\ln PJ_{-1} + a_{203}\ln WAA$
$+ a_{204}\ln KA + a_{205}\ln LND + a_{206}DUM + a_{207}\ln FLOD$
$+ a_{208}\ln DRO + a_{209}TIME$

(T21) $\ln LSA = a_{210} + a_{211}\ln WAA + a_{212}\ln PFA + a_{213}\ln RURP$

(T22) $LDA = LSA$

Labour Market in Manufacturing Sector

(T23) $\ln LDJM = a_{230} + a_{231}\ln QJMS$

(T24) $\ln LDNJM = a_{240} + a_{241}\ln PNJM + a_{242}\ln WMM + a_{243}\ln KNJM$
$+ a_{244}DUM + a_{245}\ln IMR + a_{246}TIME + a_{247}DUMP$

(T25) $\ln LSM = a_{250} + a_{251}\ln WMM + a_{252}\ln CPI + a_{253}\ln URP$

(T26) $LDJM + LDNJM = LSM$

The Financial Sector

(T27) $\ln CRED = a_{270} + a_{271}\ln r_c + a_{272}\ln GS + a_{273}\ln RES$
$+ a_{274}\ln DUMF$

(T28) $LIQ = CWP + CRED - TD + RES + RESF$

Remaining Equations

(T29) $\ln YSP = a_{280} + a_{281}\ln YD + a_{282}\ln POP + a_{283}DUM$
$+ a_{284}\ln CPI + a_{285}\ln LIQ$

(T30) $IM = PIMF.IMF + PIMNJM.IMNJM + PIMR.IMR + PCAP.IMCAP$

(T31) $EX = PJW.EXJ.(PJW59).EXRAT + PJMW.EXJM.(PJMW59).EXRAT + EXOT$

(T32) $\Delta FE = EX - IM + FA + RESF$

(T33) $FE = FE_{-1} + \Delta FE$

(T34) $DREV = t(YFC)$

(T35) $\ln IREV = a_{350} + a_{351}\ln QNJMS + a_{352}\ln QJMS + a_{353}\ln PNJM + a_{354}\ln PJM + a_{355}DUM$

(T36) $\Delta GS = GE - DREV - IREV - FA + RESG$.

(T37) $GS = GS_{-1} + \Delta GS$

(T38) $\ln PP = a_{380} + a_{381}\ln PFA + a_{382}\ln PNJM + a_{383}\ln PJ + a_{384}\ln PJM$

(T39) $\ln CPI = a_{390} + a_{391}\ln PFA + a_{392}\ln PNJM + a_{393}\ln PIMNJM$

(t40) $YS = YSP + GC$

(T41) $YY = (PFA59)PFA.QFS + (PJ59)PJ.QJSB + (PJM59)PJM.QJM + PNJM.QNJM - (PJ59)PJ.QJDB - PIMR.IMR$

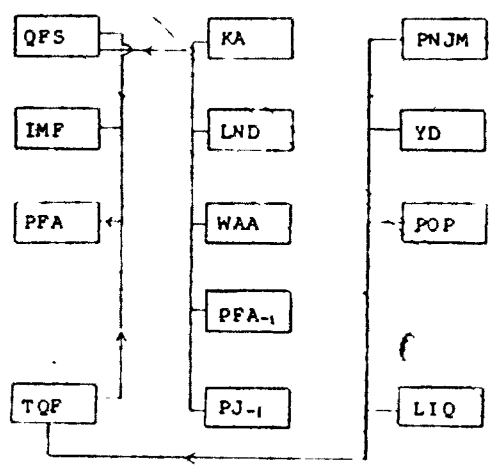
(T42) $YMP = YY + YS + YOT$

(T43) $YFC = YY - IREV + SUB$

(T44) $GE = GC + GI$

(T45) $YD = YFC - DREV$

FIGURE 4.1: FLOW-CHART OF THE FOOD MARKET



FIGUR 4.2: FLOW-CHART OF THE JUTE MARKET

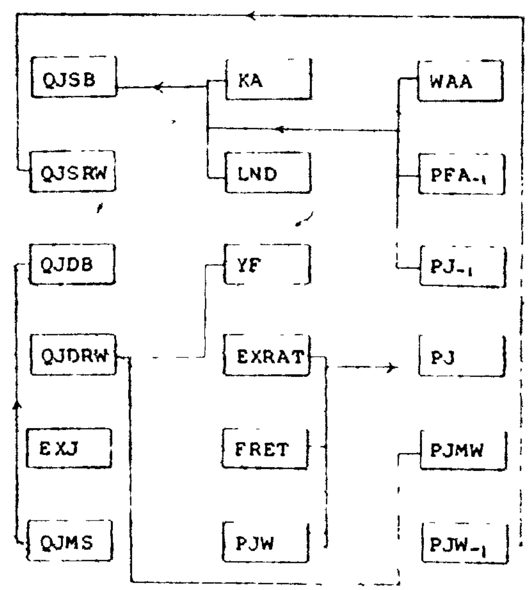


FIGURE 4.3: FLOW-CHART OF THE JUTE MANUFACTURING SECTOR

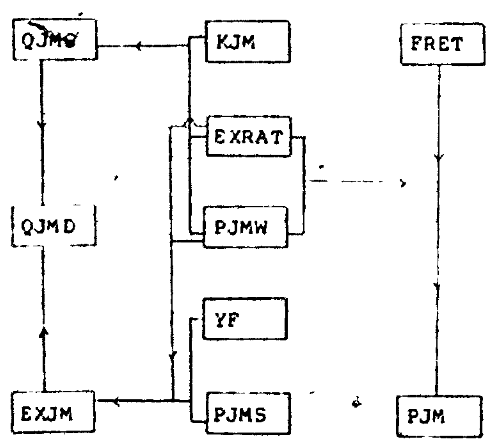


FIGURE 4.4: FLOW-CHART OF THE NON-JUTE MANUFACTURING SECTOR

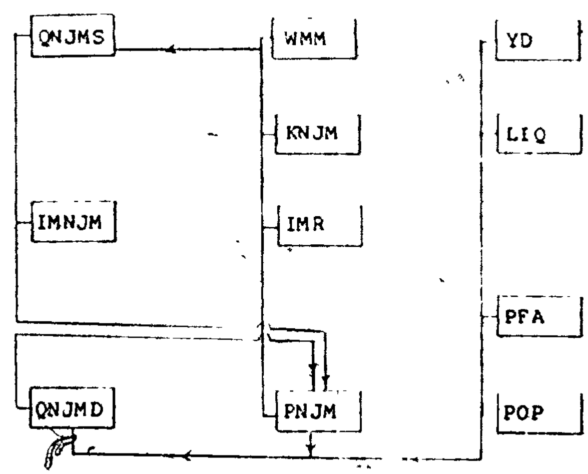


FIGURE 4.5: FLOW-CHART OF THE LABOUR MARKET IN THE AGRICULTURAL SECTOR

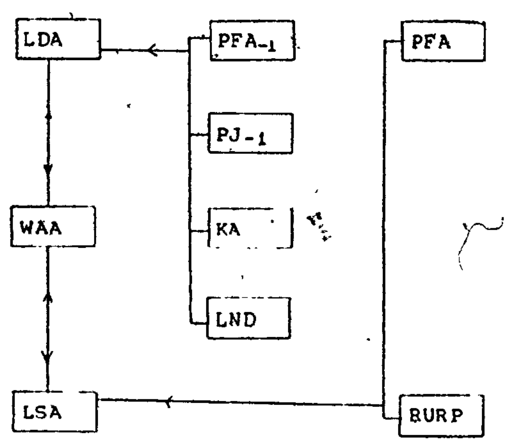
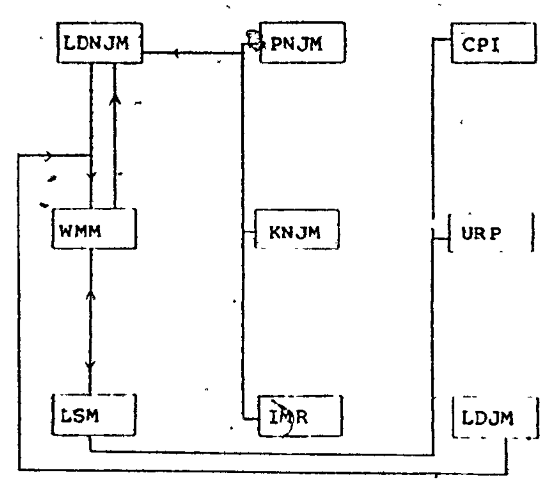
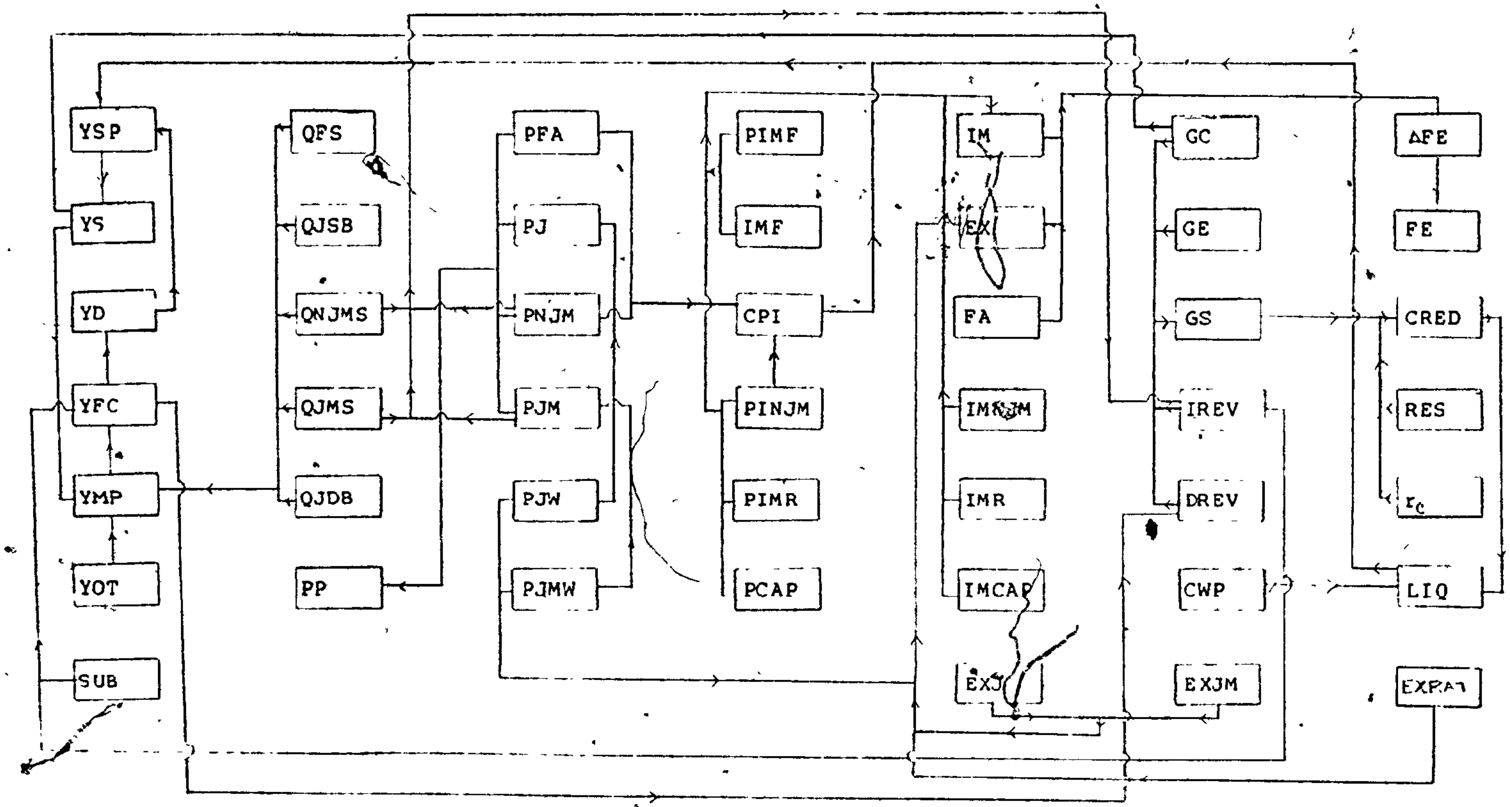


FIGURE 4.6: FLOW-CHART OF THE LABOUR MARKET IN THE MANUFACTURING SECTOR



FLIGURE 4.7: FLOW-CHART OF THE MONETARY, GOVERNMENT AND THE FOREIGN SECTORS



LIST OF THE VARIABLES

AYD = Disposable income adjusted for food subsidy

CPI = Consumer price index

CRED = Bank credit in current taka

CWP = Cash with the public in current taka

DREV = Direct tax revenue in current taka

DUM = Dummy variable for the liberation war

DUMF = Dummy variable in the finacial sector

DUMP = Slope dummy in the non-jute manufacturing sector

EX = Value of exports in current taka

EXOT = Value of exports other than jute and non-jute manufactures

EXJ = Export of jute in volume

EXJM = Export of jute manufactures in volume

EXRAT = Exchange rate

FA = Foreign aid in current taka

FE = Foreign exchange reserve in current taka

FRET = Index of freight charges

GC = Government consumption in current taka

GE = Government expenditure in current taka

GI = Government investment in current taka

GS = Government security in current taka

IM = Value of imports in current taka

IMF = Import of food

IMCAP = Imports of capital goods in millions of constant taka

IMNJM = Imports of non-jute manufactures in millions of constant taka

IMR = Import of raw materials in constant taka

IREV = Indirect tax revenue in current taka

KA = Capital stock in the agricultural sector

KF = Capital in food production

KJ = Capital in jute production

KJM = Capital in jute manufactures production

KNJM = Capital in non-jute manufactures production

LDF = Labour demand in food production

LDJ = Labour demand in jute production

LDJM = Labour demand in jute manufactures

LDNJM = Labour demand in non-jute manufactures

LIQ = Liquidity in current taka

LND = Area of agricultural land

LNDF = Area of agricultural land used in production of food

LNDJ = Area of agricultural land used in production of jute

LSA = Labour supply in the agricultural sector

LSM = Labour supply in the manufacturing sector

PP = General price level

PCAP = Price of capital goods

PFA = Price of food

PIMC = Import price index of consumer goods

PIMNJM = Price index of imported non-jute manufactures

PIMR = Import price index of raw material

PJ = Price index of jute

PJM = Price index of jute manufactures

PJMS = Price of jute manufactures substitute in the world market

PJMW = Price index of jute manufactures in the world market

PJW = Price index of jute in the world market

PNJM = Price index of non-jute manufactures

POP = Population

QFD = Quantity of food demand

QFS = Quantity of food supply

QJDB = Quantity of jute demand by Bangladesh

QJSB = Quantity of jute supply by Bangladesh

QJDRW = Quantity of jute demand by the rest of the world

QJDW = World demand for jute

QJSRW = Rest of the world's demand for jute

QJSW = World supply of jute

QJMS = Supply of jute manufactures

QJMD = Domestic use of jute manufactures

QNJMS = Supply of non-jute manufactures

QNJMD = Demand for non-jute manufactures in constant taka

RES = Cash reserves of commercial banks

RESF = Residual from the balance sheet of the commercial banks

RESG = Residual from the government budget constraint

RURP = Rural population

r_c = Interest rate charged by commercial banks on credit

r_g = Interest rate on government securities

t = Direct tax rate

TIME = Time trend

URP = Urban population

WAA = Index of nominal agricultural wage rate

WMM = Index of nominal wage rate in the manufacturing sector

YD = Disposable income in current taka

YFC = GNP at factor cost in current taka

YOT = National income from sources other than agriculture, manufacturing and services

YS = GDP originating from services sector

YSP = Aggregate demand for services by the private sector

YY = GDP at market price in current taka originating from all the sectors other than the services and the residual sectors.

YMP = GNP at market price in current taka

YYD = Disposable income net of spending on food supplied by the government

4.9. Conclusion

The above model shows the structure of all the important sectors of Bangladesh economy. The discussion of the links among various variables within sectors and the inter-sectoral linkages make clear the complicated nature of interactions among various important economic agents.

Having developed the model, the next task facing us is to estimate the model with data from the Bangladesh economy. In the next chapter, a discussion on the choice of estimation technique, the problem of identification, and the estimates of the parameters of the equations are presented.

FOOTNOTES TO CHAPTER FOUR

1. See Klein(1965).

2. Neoclassical approach has been used to derive supply and demand functions throughout this study. Both theoretical and empirical considerations prompted us to do this. Behrman(1968) points out that in the short run, farmers in a developing country, Thailand, responds rationally to economic incentives. Kelly, Williamson and Cheetham(1972) show that neoclassical assumptions explain the development process quite aptly. Ahmed(1974) gives elaborate justifications for using neoclassical assumptions to derive demand and supply relations for peasant households in Bangladesh.

3. While developing an equation, only the new variables involved in that equation are defined. The variables which have been defined earlier are not defined again. However, a complete list of variables used in the entire model appears in section 4.8.

4. All equations which will appear in the final theoretical model are numbered with a digit preceded by letter 'T'.

5. See Klein and Goldberger(1955), p.8.

CHAPTER FIVE

ECONOMETRIC ESTIMATION OF THE MODEL

5.1 Introduction

The model specified in chapter four has been estimated with data from the Bangladesh economy. The data period extends from 1953 to 1977. The problem of collecting the data, the nature and sources of the data are discussed in Appendix E.

Since the model is fairly large, the various sectoral models are estimated independently. The sub-models describing the markets for jute, non-jute manufactures, and also the labour markets in the agricultural and the manufacturing sectors, each contain a set of simultaneous equations. These sub-models are estimated by ordinary least squares(OLS), two stage least squares(2SLS) and constrained non-linear least squares(CNLS). The sub-models describing the markets for food and jute manufactures each form a block of recursive equations. Ordinary least squares was used to estimate equations of these recursive blocks. The equation of the financial sector contains no current endogenous variable on the right hand side and has been estimated using ordinary least squares(OLS).

The equations appearing in the last block of the model were estimated by using OLS and 2SLS estimation methods.

The selection of estimation technique is discussed in section 5.2. A discussion of the identification exercise is presented in section 5.3. The results of the estimation are presented and discussed in section 5.4. Finally, section 5.5 presents the conclusion to this chapter.

5.2 Selection of Estimation Technique

For the sectoral models which contain a set of simultaneous equations, it is well known that the ordinary least squares method(OLS) of estimation of the structural equations in general leads to inconsistent estimates.[1] If the system is exactly identified then the method of indirect least squares(ILS) can be applied.[2] However, the exercise in identification reveals that there is a substantial degree of over identification in all of the sectoral models.

In the case of over identification there are several methods which lead to consistent estimation.[3] The two stage least squares(2SLS) method is one of the most widely used methods of estimating overidentified structural equations belonging to a simultaneous system.[4] In this context Malinvaud(1970) states that:

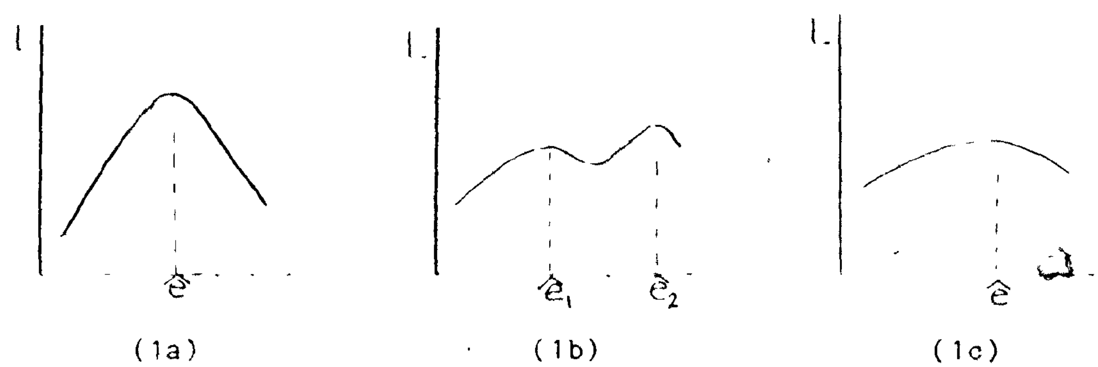
> "In practice it(2SLS) often constitutes the best estimation method for overidentified models. It involves relatively light computation and its results have a fairly good degree of precision". (p. 638)

In our study the two stage least squares(2SLS) method of estimation was used to estimate the equations belonging to a simultaneous system.

Another technique which has been used to estimate the sectoral models with simultaneous equations is the constrained nonlinear least squares(CNLS) method.[5] According to this method, the reduced form equations of the system are estimated imposing the constraints implied by the structure of the model, and then the structural parameters are determined from the estimated reduced form parameters. The structure of our sectoral models imposes constraints both within each of the equations as well as across all the equations. Thus, the full system of equations has to be estimated simultaneously. Estimation of the reduced form equations by the CNLS method uses the full information of the whole model. With respect to the use of full information, the CNLS method is one of the 'full-information' estimation methods, which also include full information maximum likelihood(FIML), three-stage least squares(3SLS) and iterative three stage least squares.[6]

Obtaining parameter estimates using the nonlinear estimation method is a difficult task. The computer programme for nonlinear estimation is based on a systematic "trial and error" method. Different values of the parameters are substituted into the likelihood function and the value of the function is calculated. This procedure is repeated by the computer until there can be no further increase in the value of the likelihood function. At this point it may be mentioned that the maximization of the likelihood function can be achieved by the minimization of the sum of squares of residuals. The CNLS method may give rise to problems if the likelihood function either has more than one peak or is flat at the top. These possibilities may be illustrated with the following diagrams for an extremely simplified case, where the search is related to a single parameter e. In Figure 1a there is no problem in finding $\hat{e}$, since there is one well defined peak. In Figure 1b, the likelihood function has two peaks, the lower peak representing a local maximum and the higher peak representing a global maximum of the function.

FIGURE 5.1: VARIOUS SHAPES OF THE LIKELIHOOD FUNCTION



The problem in this case is that, if the computer starts its search for the maximizing value of e some where near $\hat{e}_1$, then it will reach $\hat{e}_1$ and present this as the converged value of e, while the correct converged value is $\hat{e}_2$. There is not much that can be done about this problem, except to require the computer to search the entire range of possible values of e. The case of a flat-topped likelihood function poses yet another problem. In this case, the likelihood function is clearly very sensitive to changes in the sample data. This means that even a slight error of measurement shifts the maximizing value of e quite markedly.

It has already been mentioned that CNLS is a 'full-information method of estimation'. 'Full-information methods of estimation' are more susceptable to specification errors than limited-information methods of estimation or single-equation estimation methods, since mis-specification in one equation of a simultaneous equation system may directly affect the estimates of other correctly specified equations.[7] It may also hold true with respect to measurement error. The effects of errors of measurement in a particular variable would be transmitted more readily from one equation to another by a full-information method.[8]

The non-linear routine in Time Series Processor (TSP), written by R.E. Hall, Department of Economics, Stanford University, has been used to compute the CNLS estimates. The speed of convergence of this routine, as in all non-linear routines, depends very much on the choice of starting values of the parameters. Great care must be taken in selecting the initial values of the parameters.

In our study, we have computed OLS and 2SLS estimates of the structural parameters. Structural parameters have also been obtained from the estimates of the unconstrained reduced form equations. From these estimates various sets of starting values have been selected. A large number of sets of starting values have been tried to find if the system converges to more than one set of estimates. In cases in which this happened, the set of estimates with the smallest sum of squares of residuals(SSR) has been selected as the final CNLS estimates.

Having discussed the estimation techniques, the next task is to carry out the identification exercises.

5.3 The Identification Exercise

It has already been mentioned that there are four sectoral submodels which contain a set of simultaneous equations. The exercise in identification of the structural parameters via estimation of the reduced form parameters is carried out for these sectoral submodels. These submodels describe the markets for jute and non-jute manufactures and also the labour markets in the agricultural and manufacturing sectors. For every sectoral submodel the reduced form equations along with the identification exercises are presented in Appendix C. The reduced form equations also show the exact nature of the constraints imposed by the structure of the model.

5.4 Econometric Estimates

In this section selected estimation results are reported. For the sectoral models which contain a set of simultaneous equations, OLS estimators are not consistent. However, in some cases OLS estimates are reported for the sake of comparisiod between various estimates. CNLS estimates could not be obtained for the labour markets in both the agricultural and manufacturing sectors. This is due to insufficient memory space in the TSP programme adapted to the CDC 6400 computer at McMaster.

The estimation technique for every equation is indicated below the equation number.[9] The nonlinear routine used in this study does not calculate R^2 and the Durbin-Watson(D.W.) statistic for the structural equations. Thus, for the equations estimated by CNLS, R^2 and D.W. statistic could not be reported. The figures within the parenthesis are the t-scores of the respective coefficients. When more than one estimated equation is presented for a theoretical equation, the equation denoted by an asterik is chosen to be used in simulation.

Several versions of the equations explaining demand for final goods have been estimated. A description of the various versions are presented below.

(a) Nominal: the quantity demanded is a function of, among other variables, nominal income, liquidity holding(used as a proxy for wealth), population, own price and price of other relevant goods;

(b) Inverted Nominal: version (a) with own price on the left hand side and the quantity on the right hand side;

(c) Nominal Per Capita: per capita quantity demanded is a function of, among other variables, per capita nominal income and per capita nominal liquidity holding;

(d) Inverted Nominal Per Capita: version (c) with price on the left hand side instead of quantity;

(e) Real: income, liquidity, and all prices are deflated by CPI;

(f) Invertêd Real: version (e) with deflated own price on the left hand side instead of quantity;

(g) Real per capita: all relevant variables are deflated by CPI and expressed in per capita form;

(h) Inverted real per capita: Version (g) with deflated own price on the left hand side.

Two versions of the supply equations have been estimated. These are:

(1) Absolute price version: prices and wages are in absolute form;

(11) Relative price version: prices and wages are deflated by the relevant output price.

The factor demand equations have as many versions as the relevant output supply equation.

The residuals in some equations, when estimated by OLS or 2SLS, were seriously autocorrelated. These equations have been reestimated using the Cochrane-Orcutt iterative technique[10] to reduce the extent of autocorrelation in the residuals.

Market for Food

The estimated supply of food equation is presented below (equations 5.1.1 and 5.1.2). In both the versions of this equation land(LND), time trend(TIME) and agricultural wage rate(WAA) are significant and have signs consistent with *a priori* expectation.[11] Availability of land is a crucial factor determining the supply of agricultural output, especially in a densely populated country like Bangladesh. Our study only confirms this fact. The time trend which has been included in this equation to represent technological change has the expected sign and bears evidence to the fact that there has been some technological advancement in the agricultural sector.

5.1.1* OLS

$$\ln QFS = \underset{(1.13)}{2.84} + \underset{(1.46)}{0.07}\ln PFA + \underset{(1.75)}{0.09}\ln PJ + \underset{(2.14)}{0.53}LND + \underset{(.59)}{.08}\ln KA$$

$$- \underset{(-1.90)}{0.10}\ln WAA + \underset{(2.61)}{0.01}TIME + \underset{(.59)}{.13}DUM - \underset{(-.80)}{.008}\ln FLOD - \underset{(-1.55)}{0.02}\ln DRO$$

$R^2 = .96$; D.W. = 2.3

In the following version, PJ_{-1} and WAA are deflated by PFA_{-1}.

5.1.2 lnQFS = 4.4 + 0.08lnPJ + 0.49lnLND - .05lnKA -0.14lnWAA
CORC (2.2) (2.2) (2.21) (-.60) (-2.8)

+ 0.01TIME - .02DUM - 0.01FLOD - 0.02lnDRO
(2.9) (-.14) (-1.45) (-1.57)

R2 = .97; D.W. = 2.1

Results of estimation of two versions of the demand for food equation are presented below. Equation 5.2.2 has been estimated in per capita form.

5.2.1* lnTQF = 2.7 - .33lnPFA + .09lnPNJM - .01lnLIQ + .28lnAYD
OLS (3.6) (-1.40) (1.9) (-.09) (1.36)

+ .91lnPOP - .37DUM
(1.33) (-1.89)

R^2 = .95; D.W.=1.75

5.2.2 lnPFA = 2.92 + .013lnPNJM - .22lnLIQ + .19lnYD
CORC (1.13) (.08) (-1.12) (.71)

- .67lnQFD - .10DUM + .04lnIMF
(-1.66) (-.98) (1.29)

R^2= .70; D.W. = .98

In both the versions, population, price of food and disposable income have expected signs. Liquidity appears with a negative sign both versions. In this study food from the agricultural sector includes mainly rice and a limited quantity of wheat. It is not surprising that consumption of starch declines when wealth increases. The implied price elasticity of demand from 5.2.2 is very high(1.49). The estimation results reported in 5.2.1 are much better than the results in 5.2.2. This is mainly because of the fact that, through imports of food and price control, the government always tries to stabilize the food price which makes the food price(PFA) exogenous.

Market for Jute

Estimation results of the domestic supply of jute equation have been presented below(equations 5.3.1 and 5.3.2). In 5.3.2 the lagged price of jute(PJ_{-1}) and the agricultural wage rate(WAA) have been deflated by the lagged price of food(PFA_{-1}). In this version land and the relative price of jute have emerged as the most important variables.

5.3.1 OLS

$$\ln QJSB = \underset{(-.34)}{-1.5} - \underset{(-3.83)}{0.36\ln PFA} + \underset{(1.01)}{0.10\ln PJ} + \underset{(2.14)}{1.01\ln LND} - \underset{(-.84)}{.10\ln KA}$$

$$+ \underset{(.31)}{.03\ln WAA} + \underset{(.76)}{.008TIME} - \underset{(-1.06)}{0.44DUM} - \underset{(-.50)}{.01\ln FLOD} - \underset{(-.16)}{.003\ln DRO}$$

$$R^2 = .76; \quad D.W. = 1.97$$

5.3.2* OLS

$$\ln QJSB = \underset{(-1.2)}{-5.5} + \underset{(2.6)}{0.21\ln PJ} + \underset{(2.3)}{1.16\ln Lnd} + \underset{(.38)}{.08\ln KA} + \underset{(1.06)}{0.10\ln WAA}$$

$$+ \underset{(.13)}{.001TIME} + \underset{(.06)}{.02DUM} - \underset{(-.21)}{.005\ln FLOD} - \underset{(-.34)}{.008\ln DRO}$$

$$R^2 = .71; \quad D.W. = 2.01$$

In the equation for supply of jute by rest of the world(QJSRW), the expected world price of jute(PJW-1) is highly significant and has the expected sign. The equation is reported below.

5.4.1 CORC

$$\ln QJSRW = \underset{(101)}{7.66} + \underset{(3.21)}{.24} \ln PJW_{-1}$$

$$R^2 = .94; \quad D.W. = 1.28$$

The equation for the demand for jute by Bangladesh(QJDB) is a part of the recursive block and is estimated by using ordinary least squares. The residuals were seriously autocorrelated and hence the equation was reestimated by using Cochrane-Orcutt iterative technique. The coefficient of the domestic supply of jute manufactures is significant and has the expected sign. The results are presented below.

5.5.1 CORC

$$\ln QJDB = \underset{(-.08)}{-.12} + \underset{(3.83)}{1.04} \ln QJMS$$

$$R^2 = .68; \quad D.W. = 1.9$$

The estimation results of the equation explaining the demand for jute by rest of the world(QJDRW) are presented below. All coefficients in 5.6.1 and 5.6.2 have expected sign. In CNLS version the coefficient of PJMW is unrealistically large. The intercept in equation 5.6.3 is absent because the structural intercept is not identified(see Appendix C).

5.6.1 $\ln QJDRW = 6.62 + 0.48\ln PJMW - 0.28\ln PJW + 0.15\ln YF$
CORC (7.87) (1.42) (-1.48) (.88)

$- 0.09TIME$
(1.30)

$R^2 = .93$; D.W. = 1.32

5.6.2* $\ln QJDRW = 5.99 + 0.39\ln PJMW - 0.17\ln PJW + 0.51\ln YF$
2SCORC (7.1) (1.54) (-1.43) (2.3)

$- 0.05TIME$
(-1.87)

$R^2 = .91$; D.W. = 1.79

5.6.3 $\ln QJDRW = 6.1\ln PJMW - 1.8\ln PJW + 1.24\ln YF + 0.26TIME$
CNLS (.31) (-.50) (2.82) (1.11)

The domestic price equation is a part of the simultaneous block of equations describing the jute market. The various versions of this equation was estimated by using ordinary least squares(OLS), two stage least squares(2SLS) and non-linear least squares(CNLS) methods of estimation. The results are presented below. All the variables have expected signs. The price of jute in the world market is highly significant in all equations but has an unrealistically high value in the CNLS equation. In equation 5.7.3 the intercept term is absent because the structural intercept is not identified(see Appendix C).

5.7.1 $\ln PJ = - 0.65 + 0.89\ln PJW + 0.23\ln EXRAT + 0.14\ln FRET$
OLS (-1.42) (5.52) (1.19) (1.25)

$R^2 = .91$; D.W. = 1.27

5.7.2* 2SLS

$$\ln PJ = -0.63 + 0.89\ln PJW + 0.22\ln EXRAT + 0.18\ln FRET$$
$$(-1.33)\quad(4.95)\qquad(1.09)\qquad(1.48)$$
$$R^2 = .91;\ D.W. = 1.31$$

5.7.3 CNLS

$$\ln PJ = 2.12\ln PJW + .007\ln EXRAT + 0.56\ln FRET$$
$$(.44)\qquad(.05)\qquad(1.53)$$

Market for Jute Manufactures

For the equations in the jute manufacturing sector, only ordinary least squares estimates are appropriate. The estimated equations of this sector are presented below.

In the supply equation(5.8.1), all the coefficients except the coefficient of the exchange rate(EXRAT) have expected signs. However, the coefficient of EXRAT is not statistically significant. EXRAT has been defined as Taka per Sterling Pound.

5.8.1 OLS

$$\ln QJMS = 4.4 + .29\ln KJM + .32\ln PJMW - .24DUM - .17EXRAT$$
$$(5.5)\quad(3.1)\qquad(1.5)\qquad(-.66)\quad(-.95)$$
$$R^2 = .95;\ D.W. = 1.85$$

Two estimated equations describing the export of jute manufactures are presented below. All the coefficients in 5.9.1 have the expected signs.

5.9.1* OLS

$$\ln EXJM = -5.1 - 1.8\ln PJMW + 1.4\ln YF - 2.2DUM + 1.1\ln EXRAT$$
$$(-1.4)\quad(-1.3)\qquad(1.8)\quad(-1.7)\quad(2.0)$$
$$+ .72\ln PJMS$$
$$(2.5)$$
$$R^2 = .84;\ D.W. = 1.4$$

5.9.2 CORC

$$\ln EXJM = 4.4 + .79\ln PJMW + .34\ln YF - 1.0DUM - .42\ln EXRAT + .39\ln PJMS$$
$$(2.6) \quad (1.4) \quad (1.0) \quad (-1.7) \quad (-1.7) \quad (3.4)$$

R^2 = .95; D.W. = 2.4

The domestic price of jute manufactures equation is presented below. All the coefficients have expected signs. The coefficients of all the variables except the coefficient of FRET are statistically significant.

5.10.1 OLS

$$\ln PJM = -1.13 + 0.98\ln PJMW + 0.44\ln EXRAT + .06\ln FRET$$
$$(2.6) \quad (7.0) \quad (2.7) \quad (.65)$$

R^2 = .95; D.W. = 1.13

Market for Non-Jute Manufactures

The estimated equation of the non-jute manufacturing sector are presented below. In supply equations 5.11.1 and 5.11.2, all variables have signs consistent with our *a priori* expectations except for capital in the non-jute manufacturing sector(KNJM). However, the coefficient of this variable is not statistically significant. Imported raw materials(IMR) has a large impact on supply in this sector.

5.11.1 OLS

$$\ln QNJMS = \underset{(1.09)}{3.7} + \underset{(.39)}{.04\ln PNJM} - \underset{(-1.69)}{.44\ln WMM} - \underset{(-.45)}{.17\ln KNJM}$$

$$+ \underset{(3.33)}{.61\ln IMR} - \underset{(-.93)}{.16DUM} + \underset{(3.67)}{.07TIME} - \underset{(-1.34)}{.28DUMP}$$

$R^2 = .97$; D.W. = 1.26

5.11.2* 2SLS

$$\ln QNJMS = \underset{(1.32)}{8.10} + \underset{(9.71)}{.25\ln PNJM} - \underset{(-1.65)}{.73\ln WMM} - \underset{(-.97)}{.62\ln KNJM}$$

$$+ \underset{(1.40)}{.43\ln IMR} - \underset{(-1.26)}{.30DUM} + \underset{(2.62)}{.09TIME} - \underset{(-1.13)}{.32DUMP}$$

$R^2 = .97$; D.W. = 1.46

5.11.3 CNLS

$$\ln QNJMS = \underset{(.33)}{.85} - \underset{(-2.5)}{.67\ln PNJM} - \underset{(-1.64)}{.30\ln WMM} + \underset{(.83)}{.28\ln KNJM}$$

$$+ \underset{(4.44)}{.50\ln IMR} - \underset{(-2.7)}{.54DUM} + \underset{(5.74)}{.07TIME} + \underset{(1.67)}{.63DUMP}$$

In the demand for non-jute manufactures equation, the price of non-jute manufactures(PNJM) has the appropriate sign in all four versions. The dummy variable also has appropriate sign. The import of non-jute manufactures has wrong sign in three versions but is not statistically significant. All other variables have appropriate signs in a majority of the cases. This equation has been estimated in per capita form.

5.12.1 CORC

$$\ln QNJMD = \underset{(1.25)}{2.27} - \underset{(-.12)}{.03\ln YD} + \underset{(1.72)}{.33\ln LIQ} - \underset{(-.91)}{.12\ln PNJM}$$

$$- \underset{(-2.9)}{.53\ln PFA} - \underset{(-1.64)}{.16DUM} + \underset{(.20)}{.007\ln IMNJM}$$

$R^2 = .95$; D.W. = 2.1

5.12.2* $\ln QNJMD = 1.93 + .001 \ln YD + .40 \ln LIQ + .07 \ln PNJM$
2SCORC $\quad (.66) \quad (.02) \quad (1.57) \quad (.20)$

$- .69 \ln PFA - .22 DUM + .031 \ln IMNJM$
$(-2.80) \quad (-1.45) \quad (.57)$.

$R^2 = .97$; D.W. = 2.1

5.12.3 $\ln QNJMD = -9.07 + 1.28 \ln YD + 1.30 \ln LIQ - .67 \ln PNJM$
2SLS $\quad (-1.54) \quad (1.40) \quad (2.37) \quad (-1.6)$

$- .10 \ln PFA - .18 DUM + .20 IMNJM + .36 DUMP$
$(-.21) \quad (-.33) \quad (1.53) \quad (.62)$

$R^2 = .61$; D.W. = .47

5.12.4 $\ln QNJMD = 19.12 - 1.4 \ln YD - 2.09 \ln LIQ - 5.47 \ln PNJM$
CNLS $\quad (1.84) \quad (-.85) \quad (-2.08) \quad (-2.77)$

$- .05 \ln PFA - 1.9 DUM - .46 \ln IMNJM$
$(-.01) \quad (-2.38) \quad (-2.44)$

Equation 5.12.2 has been used in simulation because, the implied coefficient of population is quite reasonable(.57). In this version the coefficients of all the variables excluding PNJM and IMNJM have reasonable magnitudes and expected signs. It is worth noting that the own price elasticity in the CNLS version is unrealistically large, a result which is common to all the CNLS estimates of demand equations.

Labour Market in the Agricultural Sector

Estimation results of the demand for labour equation are presented below. Availability of land is the single most important variable which determines the demand for labour in agriculture. The price and the wage variables are also signiffcant and have expected signs in a majority of the cases.

5.13.1 OLS

$$\ln LDA = \underset{(-1.14)}{-2.5} + \underset{(1.83)}{.08\ln PFA} + \underset{(1.94)}{.09\ln PJ} - \underset{(-1.27)}{.06\ln WAA}$$

$$- \underset{(-1.27)}{.15\ln KA} + \underset{(3.21)}{.65\ln LND} + \underset{(.92)}{.19DUM}$$

$R^2 = .93$; D.W. = 1.25

5.13.2* 2SLS

$$\ln LDA = \underset{(.85)}{5.0} + \underset{(1.82)}{.16\ln PFA} + \underset{(1.46)}{.11\ln PJ} - \underset{(-1.81)}{.36\ln WAA}$$

$$- \underset{(-1.67)}{.45\ln KA} + \underset{(.29)}{.13\ln LND} + \underset{(.66)}{.23DUM}$$

$R^2 = .83$; D.W. = 2.3

5.13.3 OLS

$$\ln LDA = \underset{(-1.0)}{-2.7} + \underset{(1.96)}{.05\ln PFA} + \underset{(.87)}{.05\ln PJ} - \underset{(-1.48)}{.08\ln WAA}$$

$$- \underset{(-1.93)}{.30\ln KA} + \underset{(3.3)}{.70\ln LND} - \underset{(-.28)}{.07DUM} - \underset{(-.69)}{.009\ln FLOD} + \underset{(.35)}{.005\ln DRO}$$

$R^2 = .93$; D.W. = 1.47

5.13.4 2SLS

$$\ln LDA = \underset{(1.35)}{2.47} + \underset{(1.74)}{.27\ln PFA} - \underset{(-.55)}{.08\ln PJ} - \underset{(-1.74)}{.81\ln WAA}$$

$$- \underset{(-1.8)}{1.46\ln KA} - \underset{(-.76)}{.88\ln LND} - \underset{(-.89)}{.53DUM} - \underset{(-1.35)}{.06\ln FLOD} + \underset{(.31)}{.01\ln DRO}$$

$R^2 = .55$; D.W. = 2.6

In the labour supply equation(LSA) rural population(RURP) is the most important variable. The agricultural wage rate(WAA) has the appropriate sign in both versions but is not statistically significant. Estimation results of this equation are reported below.

5.14.1 $\ln LSA = -.96 + .002\ln WAA + .002\ln PFA + .96\ln RURP^{*}$
CORC (-4.4) (.16) (.11) (17.71)

$R^2 = .99$; D.W. = 1.91

5.14.2* $\ln LSA = -1.06 + .02\ln WAA - .015\ln PFA + .98\ln RURP$
TSCORC (-4.6) (.84) (-.64) (17.11)

$R^2 = .99$; D.W. = 1.97

Labour Market in the Manufacturing Sector

The estimated demand for labour equation in jute manufacturing is presented below.

5.15.1 $\ln LDJM = -6.18 + .33\ln QJMS$
CORC (-4.12) (1.40)

$R^2 = .95$; D.W. = 2.0

The estimation results of demand for labour in non-jute manufacturing sector are quite interesting. The wage rate in the manufacturing sector deflated by the price index of non-jute manufactures, the slope dummy(DUMP) and the time trend have correct signs(see 5.16.2). However, only the coefficients of the real wage rate and the time trend are statistically significant.

$$\text{5.16.1} \quad \ln LDNJM = \underset{(.51)}{5.7} + \underset{(3.01)}{.55\ln PNJM} - \underset{(-.37)}{.40\ln WMM} - \underset{(-.52)}{.68\ln KNJM}$$

2SLS

$$+ \underset{(.50)}{.21DUM} - \underset{(-.51)}{.16\ln IMR} + \underset{(1.40)}{.07TIME} - \underset{(-.57)}{.32DUMP}$$

$R^2 = .96$; D.W. = 2.0

In the following version the wage rate in the manufacturing sector(WMM) is deflated by price of non-jute manufactures(PNJM).

$$\text{5.16.2*} \quad \ln LDNJM = \underset{(.18)}{0.34} - \underset{(-2.43)}{.38\ln WMM} + \underset{(2.19)}{.40DUM} - \underset{(-.39)}{.12\ln IMR}$$

2SLS

$$+ \underset{(2.40)}{0.06TIME} - \underset{(-.77)}{0.10DUMP}$$

$R^2 = .94$; D.W. = 2.14

The estimation results of the labour supply in the manufacturing sector equation are presented below. All the coefficients have correct signs and all of them except the CPI are statistically significant.

$$\text{5.17.1} \quad \ln LSM = \underset{(-4.12)}{-0.65} + \underset{(1.63)}{.35\ln WMM} - \underset{(-.21)}{0.04\ln CPI} + \underset{(4.9)}{0.65\ln URP}$$

2SLS

$R^2 = .91$; D.W. = 1.25

The Financial Sector

The equation for the supply of credit to the private sector is the only stochastic equation in this sector. The estimated equation is reported below. All the variables have correct signs and all of these except the interest rate on bank credit are statistically significant.

5.18.1 CORC

$$\ln CREDP = -1.94 + 0.87\ln RC + 0.72\ln GS + 0.47\ln RES + 0.40DUME$$
$$(-1.35) \quad (.87) \quad (2.41) \quad (2.87) \quad (2.09)$$

$R^2 = .98$; D.W. = 1.78

Remaining Equations

The estimated equation describing aggregate demand for services by the private sector is presented below. All the coefficients except the coefficient of CPI have expected signs. The equation has been estimated in per capita form and the implied coefficient of population is .55.

5.19.1 2SLS

$$\ln YSP = 1.73 + 0.45\ln YD - 0.15DUM + 0.53\ln CPI$$
$$(1.06) \quad (1.58) \quad (-1.5) \quad (1.76)$$

$R^2 = .97$; D.W. = .96

The estimated equation for revenue receipt from indirect taxes is presented below.

5.20.1 CORC

$$\ln IREV = -0.814 + 0.31\ln PNJM + 0.31\ln QNJM + 0.84\ln PJM + .84\ln QJM + 0.015DUM$$
$$(.87) \quad (1.42) \quad (1.42) \quad (3.65) \quad (3.65) \quad (.078)$$

$R^2 = .97$; D.W. = 1.25

The estimated general price index and consumer price index equations are presented below. As expected the food price emerges as the single most important variable in both the equations.

5.21.1 $\ln PP = 0.09 + .61\ln PFA + .04\ln PJ + .003\ln PNJM + .20\ln PJM$
CORC (2.6) (8.2) (.44) (.03) (1.7)

$R^2 = .99$; D.W. = 1.55

5.22.1 $\ln CPI = 1.18 + .47\ln PFA + .188\ln PNJM + .12\ln PIMC$
CORC (1.70) (6.0) (2.3) (1.55)

$R^2 = .99$; D.W. = .73

5.5 Conclusion

Once the estimated model is presented, we can now comment on some of the important relationships which emerge from the empirical estimates. While some of the relationships are as expected, some are not.

In the food sector, population exerts a significant pressure on the demand for food. This is quite expected and in line with the structuralists' belief.

Liquidity holding, though used as a proxy for wealth, is nothing but money supply. In the demand equations, this variable often has a positive sign. This supports the monetarist hypothesis.

Imported raw material has come out as a crucial determinant of the supply of non-jute manufactures. Capital in the jute-manufacturing sector is the most important variable in the supply of jute manufactures. In a developing country like Bangladesh, where capital is almost entirely imported, supply rigidity is the natural outcome. Thus the supply of manufactured goods in both sectors is dependent on the limited availability of foreign exchange.

In the next chapter some simulation experiments are carried out to evaluate the results of changes in various exogenous variables (not necessarily policy parameters).

FOOTNOTES TO CHAPTER FIVE

1. See, for example, Johnston(1972), chapter 12.

2. See, for example, Kmenta(1971), p. 551; Johnston(1972), pp. 344-346.

3. For various methods of estimating an over identified equation belonging to a system of simultaneous equations see any standard text book of econometrics.

4. For a precise description of two stage least squares estimators, see Johnston(1972), pp. 380-384.

5. For details about nonlinear least squares, see Kmenta(1971), pp. 461-472 and Malinvaud(1970), pp. 325-373.

6. See Johnston(1972), chapter 13.

7. See, for example, Denton and Oksanen(1973), p. 345.

8. See Denton and Oksanen(1973), p. 345.

9. OLS for ordinary least squares, 2SLS for two stage least squares, CNLS for Constrained nonlinear least squares, CORC for Cochrane-Orcutt iterative least squares, 2SCORC for two stage Cochrane-Orcutt iterative least squares.

10. For a discussion of Cochrane-Orcutt iterative technique, see Johnston(1972), p. 262.

11. A priori expectation is based on the comparative statics exercises found in standard text books of microeconomic theory. We have also carried out some comparative statics exercises. A detailed comparative statics exercise for a similar model may be found in Ahmed(1978).

CHAPTER SIX

SOME SIMULATION EXPERIMENTS

6.1 Introduction

In the foregoing chapters we have dealt with the specification and estimation of an econometric model of the Bangladesh economy. The next logical step is to perform simulation experiments using this model. Simulation experiments are used to assess the performance of the model as a whole in predicting the values of the various endogenous variables. Simulation experiments are also used in studying the consequences of changes in the values of various exogenous variables and parameters.[1] In particular, it is important to know how prices would respond to various shocks generated by deliberate policies of the economic agents of that economy(e.g., a change in a tax rate) and also shocks which are generated outside the control of the economic agents of that economy (e.g., higher import or export prices for a small country).

In section 6.2 the method of solution is discussed. The predictive performance of the model is assessed in section 6.3. Various simulation experiments are analysed in section 6.4. The results are summarized in section 6.5.

6.2 The Method of Solution

In a linear model, the performance of the model and the consequences of alternative policies could be studied by computing the reduced form of the model. However, owing to the non-linearity of the present model, no such simplified scheme can be used. Nonlinearities are due to the logarithmic treatment of various equations and the inclusion of the product of two or more variables in some identities.

The block of equations containing a set of non-linear equations has been solved by using an iterative technique called Brown's technique.[2] A set of initial values for the endogenous variables together with actual values of predetermined variables and parameters are supplied. Unlike the Gauss-Siedel iterative technique, normalization of equations is not necessary in Brown's method. However, the speed of convergence depends crucially on the starting values of the endogenous variables. Also, elimination of identities by substitution and the "tuning up" of the intercepts speeds convergence.

In dynamic simulation, the lagged endogenous variables play a crucial role. In the first period, the values of the lagged endogenous variables are supplied. In subsequent periods, the values of the lagged endogenous variables are the solution values of the relevant endogenous variables in the previous period.

6.3 Predictive Accuracy of the Model

It is important that a model predicts the endogenous variables reasonably well before it is used to study the effects of changes in exogenous variables. The model was used to generate the endogenous variables for the period from 1954 to 1977. The first period was excluded from simulation because of the presence of several lagged endogenous variables.

Values of the predicted endogenous variables are presented in Appendix D. Mean absolute percentage error(MAPE)[3] has been calculated for these variables and is reported in the same appendix. Actual values of all endogenous variables are reported in the appendix on data. As a whole, the predictive performance of the model is quite good. The values of MAPE are quite low for most of the important endogenous variables (lower than 5%).

In dynamic simulations of a non-linear model, one has to be aware of the fact that a "one shot" change in an exogenous variable will normally produce different results depending upon the period in which the change is taking place. In the present study, for several simulation experiments, a shock was given at different periods.

A unit change in an exogenous variable immediately changes the values of the relevant endogenous variables. The resultant change in an endogenous variable is termed an impact multiplier. However, in dynamic simulation, this shock is transmitted to subsequent periods through the influence of the lagged endogenous variables.

A sustained change in an exogenous variable beginning at a particular time period has continuing effects on the system. This takes place in a complex way through the combined operation of the impact multipliers and the coefficients of the lagged endogenous variables. A "one shot" increase in an exogenous variable in the first period influences the endogenous variables for four to five subsequent periods in our model. But in the second and in all subsequent periods the value of the same exogenous variable is changed. These changes have a similar influence on the set of endogenous variables, which reinforce the effects of the change taking place in the first period. Ultimately, at the end of the sample period, the values of the endogenous variables will reflect cumulative effects of changes in the exogenous variable taking place throughout the entire sample period.

6.4 The Simulation Experiments

A large number of simulation experiments were performed with the model. Dynamic simulation experiments permit one to measure both the impact and long run effects of variations in an exogenous variable.

The solution obtained with the actual values of the exogenous variables is called the control solution. The solution obtained after changing the value of an exogenous variable may be called a disturbed solution or a shock solution. A comparison between the control solution and a shock solution shows how the model responds to a particular shock.

A shock solution obtained after a "one shot" change in an exogenous variable may be used to calculate the dynamic multipliers of that exogenous variable. In fact, if the magnitude of the one shot change in the value of the exogenous variable at a particular time period is unity, then the difference between the shock solution and the control solution gives us the multipliers.

In most of the simulation experiments, the effect of a one unit change in the exogenous variable were examined. However, ~~in~~ some cases a percentage change in the value of an exogenous variable or a parameter was considered to be more meaningful, and so a percentage change was used. While reporting the results of various simulation experiments the percentage change in the value of the relevant endogenous variables are reported.

In simulations involving a once and for all shock, the shock was given at three different time periods during the sample period. The first shock was given at the second period (1954), the second shock was given at the twelfth period (1964); and the third shock was given at twentieth period (1972). For the sake of policy formulations, simulation results of a shock applied at a later part of the sample period are more relevant. Thus, for simulation experiments involving a once and for all change, results pertaining to a shock applied at the twentieth period have been singled out and reported. However, in one case, the results of shocks applied at three different time periods are reported for the sake of comparision of the varying degree of response. This is done in simulation experiments involving an increase in government expenditure.

6.4.1 The impact of Changes in Government Expenditure

In this experiment the effects of an increase of one million taka in government expenditures are examined. It is assumed that half a million taka is spent on government consumption of services and the rest is spent on government investment. Two different kinds of simulations were carried out; a one shot increase and a sustained increase in government expenditure. As mentioned earlier, the shock of a one shot change in government expenditure was given to the system at three different time periods; period two, period twelve, and period twenty. Response of the endogenous variables differ depending on when the shock was given. The results of these simulation experiments are presented in Tables 6.1 to 6.4.

The consequences that emerged are in line with our *a priori* expectations. All prices and wages increase in response to an increase in government expenditure. However, output does not respond quite as favourably and as a result per capita real disposable income falls. Low price elasticity of supply in all the sectors is the main cause of this result.

An increase in government expenditure automatically increases the flow of outstanding government securities. The increase in government securities has a positive influence on the supply of credit to the private sector, which, in turn, has a positive effect on the liquidity variable. Let us recall here that the liquidity variable can be interpreted as a proxy for the money supply. Thus, an increase in government expenditure increases the government deficit which when financed by an increase in government securities, increases the money supply via the supply of

TABLE 6.1

THE PERCENTAGE CHANGE IN ENDOGENOUS VARIABLES DUE TO AN INCREASE IN GOVERNMENT EXPENDITURE BY ONE MILLION CURRENT TAKA IN 1954

TIME	CPI	PFA	PNJM	PP	PJM	WAA	WMM	CRED
1954	.58571	.67829	.74375	.41285	-.02600	.07303	.57565	.29243
1955	.21924	.24931	.28942	.16313	.36366	.35663	.22325	.05602
1956	.20621	.23227	.27438	.14010	-.05598	.27939	.21122	.04201
1957	.15212	.17615	.19419	.11106	.13309	.11507	.15011	.07303
1958	.11707	.13509	.15212	.08303	.01900	.14911	.11607	.05301
1959	.08404	.09805	.10405	.06202	.04901	.08504	.09103	.06202

TABLE 6.1 (CONTINUED)

YEAR	LIQ	QFS	QJSB	QNJM	YO	LDNJM	PRYD	FE
1954	.06502	-.00800	.00900	-.23373	.41887	.17816	-.16586	-.01623
1955	.01400	.01300	-.13691	-.09096	.17716	.06902	-.04199	.27111
1956	.00900	.01400	.02200	-.08596	.16213	.06602	-.04399	.17077
1957	.01700	.00200	-.05498	-.06098	.12107	.04701	-.03100	.34410
1958	.01300	.00700	-.00800	-.04799	.10706	.03601	-.01000	.45611
1959	.01400	.00200	-.02200	-.03299	.08604	.02500	.00200	.31442

Note: PRYD is per capita real disposable income. Definitioins for all other variables appear in Section 4.8.

TABLE 6.2

THE PERCENTAGE CHANGE IN ENDOGENOUS VARIABLES DUE TO AN INCREASE IN GOVERNMENT EXPENDITURE BY ONE MILLION CURRENT TAKA IN 1964

TIME	CPI	PFA	PNJM	PP	PJM	WAA	WMM	CRED
1964	.24731	.29042	.30547	.17816	.02400	.10105	.23628	.07303
1965	.08003	.09004	.10405	.05902	.10506	.16313	.08003	.01000
1966	.07303	.08404	.09505	.05101	-.00500	.09204	.07403	.01000
1967	.07103	.08303	.09004	.05201	.03401	.04801	.07002	.01300
1968	.06802	.07703	.08504	.04801	.01900	.06202	.06602	.01000
1969	.05602	.06402	.06902	.03901	.02800	.05201	.05301	.01400

TABLE 6.2 (CONTINUED)

YEAR	LIQ	QFS	QJSD	QNJM	YD	LDNJM	PRYD	FE
1964	.04301	.00100	-.01300	-.09595	.22926	.07403	-.01800	.43990
1965	.00700	.00700	-.05199	-.03299	.07603	.02500	-.00400	.56169
1966	.00700	.00500	.00200	-.03000	.06402	.02300	-.00900	.58374
1967	.00900	.00100	-.01700	-.02900	.06102	.02200	-.01000	.74464
1968	.00900	.00300	-.00900	-.02700	.06002	.02100	-.00800	.50201
1969	.00700	.00100	-.01100	-.02200	.05001	.01700	-.00500	.40266

TABLE 6.3

THE PERCENTAGE CHANGE IN ENDOGENOUS VARIABLES DUE TO AN INCREASE IN GOVERNMENT EXPENDITURE BY ONE MILLION CURRENT TAKA IN 1972

TIME	CPI	PFA	PNJM	PP	PJM	WAA	WMM	CRED
1972	.12908	.15111	.16313	.09204	.01400	.05702	.12608	.02100
1973	.04501	.05101	.05602	.03201	.04501	.08604	.04401	.00600
1974	.02700	.03201	.03501	.01900	.00200	.04501	.02700	.00400
1975	.01700	.01900	.02100	.01209	.00600	.01800	.01500	.00300
1976	.01500	.01600	.01700	.01000	.00300	.01400	.01400	.00200
1977	.01400	.01600	.01800	.01000	.00400	.01100	.01300	.00200

TABLE 6.3 (CONTINUED)

YEAR	LIQ	QFS	QJSB	QNJM	YD	LDNJM	PRYD	FE
1972	.01700	0.00000	-.00800	-.05199	.10706	.04001	-.02200	.07624
1973	.00600	.00400	-.02700	-.01800	.04701	.01400	.00200	.15025
1974	.00400	.00200	-.00100	-.01100	.03000	.00800	.00300	.15002
1975	.00300	.00100	-.00600	-.00700	.01700	.00500	-.00000	.10493
1976	.00200	.00100	-.00200	-.00500	.01500	.00500	-.00000	.03959
1977	.00200	.00100	-.00300	-.00500	.01400	.00500	-.00000	.04500

TABLE 6.4

THE PERCENTAGE CHANGE IN ENDOGENOUS VARIABLES DUE TO A SUSTAINED INCREASE IN GOVERNMENT EXPENDITURE BY ONE MILLION CURRENT TAKA

YEAR	CPI	PFA	PNJM	PP	PJM	WAA	WMM	CRED
1954	.58571	.67829	.74375	.41285	-.02600	.07303	.57565	.29243
1955	.58470	.67225	.75282	.42088	.34961	.40181	.58169	.22926
1956	.51834	.59174	.67628	.36667	.15913	.52437	.52236	.19118
1957	.50226	.57565	.65010	.35764	.19519	.41385	.50226	.18918
1958	.34560	.39779	.44398	.24831	.16514	.39980	.34259	.16413
1959	.26936	.31349	.33958	.19519	.09905	.29142	.26335	.17215
1960	.28440	.33155	.35463	.20521	.08904	.22726	.27438	.16514
1961	.29544	.34359	.37069	.21323	.10806	.23427	.28641	.11707
1962	.33356	.38675	.42088	.23929	.09204	.25232	.32453	.09705
1963	.30145	.35061	.37972	.21724	.10806	.26335	.29443	.08404
1964	.25533	.29644	.32152	.18317	.08504	.24530	.24931	.06202
1965	.23227	.26836	.29343	.16714	.08003	.20721	.22726	.04401
1966	.21323	.24630	.27137	.15312	.07403	.18918	.21022	.03801
1967	.21824	.25132	.27639	.15612	.06502	.17615	.21523	.03201
1968	.20220	.23327	.25733	.14511	.07103	.17415	.19920	.03100
1969	.16714	.19319	.21122	.12007	.07603	.16213	.16313	.03901
1970	.17816	.20421	.23327	.12608	.05201	.14511	.17916	.02100
1971	.18317	.20822	.24229	.12908	.05401	.14310	.18617	.00800
1972	.13509	.15612	.17515	.09705	.05001	.14010	.13509	.01700
1973	.12608	.14711	.15512	.09104	.03301	.11106	.12007	.02400
1974	.08003	.09404	.10005	.05902	.03301	.09505	.07703	.01400
1975	.05001	.05802	.06202	.03601	.01400	.06402	.04701	.00700
1976	.04301	.05001	.05301	.03100	.01100	.04001	.04101	.00600
1977	.04201	.04901	.05301	.03000	.01100	.03401	.04001	.00500

TABLE 6.4 (CONTINUED)

YEAR	LIQ	QFS	QJSB	QNJM	YD	LDNJM	PRYD	FE
1954	.06502	-.00800	.00900	-.23373	.41887	.17816	-.16586	-.01623
1955	.05602	.00900	-.13191	-.23572	.44197	.18016	-.14190	.26049
1956	.04001	.02000	-.06098	-.21178	.40582	.16213	-.11194	.35877
1957	.04401	.01300	-.08097	-.20379	.38574	.15612	-.11593	.62667
1958	.03901	.01500	-.07297	-.13990	.30647	.10606	-.03899	.94518
1959	.04101	.01100	-.04399	-.18694	.26635	.08203	-.00300	.65340
1960	.04601	.00700	-.03999	-.11094	.27237	.08504	-.01200	.72355
1961	.04401	.00700	-.04399	-.11693	.27438	.08904	-.02100	1.01253
1962	.04601	.00700	-.04399	-.13191	.29744	.10105	-.03599	1.03939
1963	.04401	.00800	-.05498	-.11993	.27839	.09104	-.02300	.98883
1964	.03601	.00900	-.04599	-.10095	.23929	.07803	-.01500	1.32[illegible]6
1965	.03201	.00700	-.03999	-.09296	.21022	.07002	-.02200	1.46775
1966	.02500	.00700	-.03599	-.08596	.18317	.06602	-.03000	1.63248
1967	.02400	.00500	-.03199	-.08796	.18116	.06702	-.03699	2.07631
1968	.02600	.00600	-.03499	-.08097	.17615	.06302	-.02500	1.41639
1969	.02200	.00500	-.03100	-.06598	.15011	.05101	-.01700	1.14113
1970	.01300	.00500	-.02200	-.07297	.13008	.05702	-.04799	1.99511
1971	.00800	.00500	-.02800	-.07497	.11807	.05802	-.06498	2.13801
1972	.01300	.00500	-.02900	-.05498	.11306	.04201	-.02200	.23058
1973	.02300	.00400	-.02000	-.04899	.12808	.03801	.00200	.43419
1974	.01500	.00300	-.02200	-.03199	.08704	.02400	.00700	.42902
1975	.00900	.00300	-.01200	-.02000	.05301	.01500	.00300	.30263
1976	.00800	.00200	-.00800	-.01700	.04401	.01300	-.00100	.11342
1977	.00700	.00100	-.00800	-.01700	.04001	.01300	-.00200	.13168

private credit. When the "one shot" increase in deficit was applied at period twenty (i.e., 1972) the price of food increased by .15% and the cost of living index went up by .13%. The upward pressure on prices continued until the end of the sample period. The results of this set of experiments appear to confirm the monetarists position regarding inflation in developing countries.

6.4.2 The Impact of Higher Versus Lower Rates of Growth of Population

The rate of growth of population during the sample period shows some fluctuations. To compare the effects of different rates of growth of population, two simulation experiments were run. One experiment maintains a constant 2.6% growth rate while the other uses a constant 2.7% growth rate of population. The results of these two simulations are presented in Tables 6.5 and 6.6 below. In these tables the simulated values of the endogenous variables, not the percentage difference between simulated values and control solutions, are presented.

The cost of living index and other price and wage indices are higher for a higher rate of growth of population. The only exception occurs in the non-jute manufacturing sector. In this sector both price and wages are higher for a lower rate of growth of population. A

TABLE 6.5

THE VALUE OF ENDOGENOUS VARIABLES UNDER THE ASSUMPTION OF A POPULATION GROWTH RATE OF 2.6%

YEAR	CPI	PFA	PNJM	PP	PJM	WAA	WMM	CRED
1954	.76372	.48124	1.32628	.69524	.84512	.68926	.99293	205.81753
1955	.77184	.52659	1.28163	.73583	.91681	.80251	1.00321	242.69366
1956	.85804	.63210	.99253	.83007	1.15385	.89631	.99925	239.50397
1957	.90748	.67643	.86277	.85915	.91400	.99935	1.06962	295.96760
1958	.94352	.84529	.99093	.97659	.70081	1.00419	1.04055	319.87810
1959	.97281	.98198	1.01949	1.08191	.99347	.98391	1.01391	339.30859
1960	.99706	.96961	1.18616	1.09723	1.78849	.90370	1.05191	420.97355
1961	1.02489	.94760	1.40637	1.08522	1.89813	.95363	1.06663	573.43810
1962	1.05628	.97497	1.55016	1.08793	1.24800	1.04705	1.23839	744.86277
1963	1.05923	.90150	1.69086	1.03511	1.15718	.89368	1.23221	918.76465
1964	1.09190	.87255	1.65425	1.02133	1.35293	.39560	1.31328	1213.77425
1965	1.11807	.95658	1.40332	1.08774	1.61073	.95582	1.12607	1633.54863
1966	1.17760	1.10549	1.15986	1.19117	1.70380	1.00367	1.20698	1717.62878
1967	1.24183	1.16172	1.00194	1.22582	1.59878	.92387	1.22705	2162.47786
1968	1.28237	1.24243	.90975	1.27504	1.56063	.90809	1.22689	2398.16706
1969	1.33421	1.35688	.98232	1.34653	1.56332	.90980	1.43505	1688.33818
1970	1.36046	1.33682	1.19523	1.33596	1.52018	1.14075	1.51210	2020.27718
1971	1.50373	1.44700	1.50929	1.40927	1.74534	1.40336	1.86049	4080.15395
1972	2.04848	2.09786	2.06079	1.79391	2.05322	1.89423	2.06990	5558.03551
1973	2.94115	3.14565	3.08620	2.31445	2.45859	2.74044	4.40469	7419.22587
1974	4.49286	5.65240	4.05402	3.34990	3.18092	3.18210	5.38518	9614.23412
1975	5.38055	6.13248	4.17841	3.54919	3.58805	3.57960	4.38842	10455.15043
1976	5.20146	4.35990	4.03675	2.89554	3.97546	2.57194	3.09600	12339.49040
1977	5.56518	4.24317	4.13733	2.86813	4.49844	2.58726	3.34274	15911.85965

TABLE 6.5 (CONTINUED)

YEAR	LIQ	QFS	QJSB	QNJM	YD	LDNJM	PRYD	FE
1954	927.53451	7945.57143	899.56382	407.05162	10167.07666	.82938	289.40254	165.09809
1955	996.08241	7006.82533	1003.35032	507.36466	9954.00239	.83631	273.63641	298.18253
1956	1148.83079	7298.76183	1049.58487	577.55288	11271.80777	.83674	272.09536	324.18430
1957	1265.82581	7907.60315	1022.14639	618.98436	12696.86003	.84817	282.88084	257.68987
1958	1374.71264	7276.82558	1060.58933	666.95995	12443.95199	.99962	260.26421	190.64954
1959	1422.24231	7723.40030	1047.05841	724.18726	13055.30704	1.00510	258.45449	309.63417
1960	1500.47950	9026.95157	1016.20461	824.43640	15158.54988	1.05448	285.74723	325.25370
1961	1508.01576	9524.28375	1179.78795	971.32391	16719.48358	1.29487	299.05344	280.22938
1962	1564.85743	9135.47075	1141.30771	1125.46324	17808.30143	1.34438	301.22400	289.83311
1963	1785.70755	9632.32588	1036.11146	1277.29520	17936.44580	1.45470	287.42279	325.22553
1964	2053.94990	10421.43477	1059.43391	1436.16264	18863.79961	1.46438	285.83904	248.32295
1965	2255.80010	10357.95394	1131.16121	1560.38833	20746.44115	1.47341	299.21241	231.86456
1966	2577.84743	9915.15824	1234.14043	1697.75149	23548.79664	1.31159	314.29861	214.07695
1967	2803.71331	10254.89057	1223.49892	1878.46456	26061.38511	1.29126	321.47966	164.72266
1968	2856.57890	11142.47878	1144.05014	1976.81057	27732.49197	1.31145	322.87199	260.87108
1969	3011.33867	11574.85093	1198.50473	1839.15223	29776.35794	1.25081	324.76106	343.92674
1970	3284.86226	11484.80343	1280.21076	1675.18687	34348.71885	2.55507	358.12686	183.16325
1971	3768.15210	10468.75096	1001.09532	1493.41392	39493.05055	2.51288	363.12973	172.64438
1972	6804.29970	9940.47415	990.17332	1569.62184	42325.71077	2.99029	278.76374	1986.61388
1973	8067.83139	10912.23592	1144.18743	1309.49913	54345.65801	3.01138	243.43195	1045.42826
1974	9358.96513	11514.47248	1009.97413	1226.92952	91142.54605	2.98285	260.94772	1068.24444
1975	8722.66422	11988.70218	766.63438	1153.15853	106336.08814	3.02330	248.24851	1515.78579
1976	9065.21645	12290.59974	832.55559	1710.90885	91198.15996	3.52556	214.55181	4101.36708
1977	11684.05067	12589.77178	911.28893	1869.33868	103945.29187	3.62596	222.16941	3462.60820

TABLE 6.6

THE VALUE OF ENDOGENOUS VARIABLES UNDER THE ASSUMPTION OF A POPULATION GROWTH RATE OF 2.7%

YEAR	CPI	PFA	PNJM	PP	PJM	WAA	WMM	CRED
1954	.76372	.48124	1.32628	.69524	.84512	.68926	.99293	205.81753
1955	.77240	.52741	1.28065	.73652	.91677	.80265	1.00870	242.66211
1956	.85917	.63398	.99087	.83159	1.15470	.89727	.99809	239.42974
1957	.90928	.67944	.86063	.86149	.91488	1.00157	1.06779	295.79895
1958	.94522	.84950	.98654	.97959	.70182	1.00730	1.03728	319.67345
1959	.97442	.98746	1.01298	1.08563	.99492	.98747	1.00925	339.14916
1960	.99950	.97662	1.17774	1.10210	1.79148	.90738	1.04659	420.84727
1961	1.02818	.95594	1.39550	1.09109	1.90279	.95854	1.06078	573.11707
1962	1.06101	.98564	1.53826	1.09526	1.25107	1.05381	1.23172	744.34899
1963	1.06491	.91294	1.67701	1.04318	1.16070	.90057	1.22516	918.05748
1964	1.09810	.88457	1.63865	1.02997	1.35743	.39911	1.30459	1212.74298
1965	1.12555	.97160	1.38951	1.09822	1.61696	.96512	1.11835	1632.55247
1966	1.18646	1.12469	1.14777	1.20388	1.71148	1.01478	1.19825	1716.27239
1967	1.25192	1.18353	.99064	1.23996	1.60657	.93522	1.21744	2160.66214
1968	1.29377	1.26791	.89865	1.29111	1.56869	.92017	1.21654	2397.11210
1969	1.34705	1.38698	.96947	1.36491	1.57416	.92294	1.42206	1687.89927
1970	1.37884	1.37307	1.18433	1.35819	1.53045	1.15951	1.90309	2017.12801
1971	1.52635	1.48951	1.49676	1.43466	1.75797	1.43011	1.85066	4073.46798
1972	2.07562	2.15739	2.03393	1.82511	2.06752	1.93259	2.05158	5552.92447
1973	2.98047	3.23931	3.03779	2.35662	2.47473	2.79471	4.35716	7427.02014
1974	4.54760	5.81831	3.97594	3.41003	3.20112	3.24670	5.31254	9628.18487
1975	5.44060	6.30952	4.08577	3.61174	3.60604	3.65107	4.31959	10466.13410
1976	5.26805	4.49686	3.95002	2.95105	3.99698	2.62214	3.04926	12347.01979
1977	5.64805	4.38913	4.05411	2.92838	4.52736	2.64219	3.29600	15914.88319

TABLE 6.6 (CONTINUED)

YEAR	LIQ	QFS	QJSB	QNJM	YD	LDNJM	PRYD	FE
1954	927.53451	7945.57143	899.56382	407.05162	10167.07666	.82938	289.40254	165.09809
1955	996.05253	7006.68519	1003.37039	507.45600	9961.66993	.83614	273.64736	298.17072
1956	1148.76186	7298.76183	1049.29102	577.80128	11289.85710	.83636	272.17156	324.39688
1957	1265.66126	7907.91946	1021.73761	619.37444	12727.62364	.84760	283.00533	258.10411
1958	1374.52019	7277.40775	1059.91077	667.75411	12481.21509	.99844	260.57411	191.29224
1959	1422.08588	7724.17268	1046.38851	725.45569	13103.30805	1.00342	258.97451	310.58820
1960	1500.34446	9027.85431	1015.45290	826.02910	15229.50586	1.05250	286.38516	326.79728
1961	1507.68403	9525.52198	1178.58518	973.34637	16809.17252	1.29220	299.69710	283.02459
1962	1564.34111	9137.02391	1139.99596	1127.73897	17921.02709	1.34158	301.77876	293.27920
1963	1784.99341	9634.25254	1034.50673	1280.01874	18066.41556	1.45146	287.96077	329.15578
1964	2052.94371	10424.04046	1057.56037	1439.71434	19011.89282	1.46063	286.45712	252.76139
1965	2254.80777	10360.64736	1129.00275	1564.37240	20935.04860	1.46945	299.92538	237.17201
1966	2576.48153	9918.23241	1231.46525	1702.30756	23783.56322	1.30784	315.06329	220.66774
1967	2801.91951	10258.48041	1220.61487	1883.92002	26339.10511	1.28728	322.28759	172.47549
1968	2855.49361	11146.60226	1141.14794	1982.96802	28079.35815	1.30706	324.02994	269.43820
1969	3010.91711	11579.59759	1195.15361	1845.30527	30197.97053	1.24630	326.21926	354.36090
1970	3281.74312	11489.85786	1276.70778	1678.67488	34841.69219	2.54831	358.42423	195.54308
1971	3761.48837	10474.30087	997.39811	1496.07456	48034.62565	2.50668	362.65434	186.21270
1972	6799.26638	9946.63916	986.15151	1574.66842	43022.99417	2.97936	279.65162	2001.02718
1973	8075.58023	10918.45767	1139.72240	1314.69503	55517.85724	2.99831	245.40194	1061.47126
1974	9372.82665	11521.26803	1005.68080	1233.14118	93250.99428	2.96717	263.77068	1084.55514
1975	8733.66170	11995.65764	763.40600	1160.01707	108739.45731	3.00519	251.05707	1530.04886
1976	9072.83443	12296.74657	828.94184	1720.63726	93253.79185	3.50496	216.61492	4113.44066
1977	11687.08892	12596.57210	906.98871	1879.08456	106301.00302	3.60589	223.87105	3472.49887

higher rate of growth of population exerts more demand pressure on food and consequently the price of food and the wage rate in the agricultural sector increase. In the demand for non-jute manufactures equation PFA appears with a negative sign. Thus, when population increases, PFA increases and demand for non-jute manufactures falls.

Another possible explanation is that, when population increases, PFA and WAA increase. This implies a redistribution of income in favour of the lower income group. The lower income group has a higher marginal propensity of consumption for food and a lower marginal propensity of consumption for most manufactured goods. So, this redistribution of income lowers the demand for non-jute manufactured goods and the price and wages in this sector fall. However, distribution of income has not been built into the model and thus, there is no firm support for the above explanation.

The results of this set of experiments supports the view of the structuralist school that a high rate of growth of population influences the cost of living index through a higher food price.

6.4.3 <u>The Impact of Changes in Imported Raw Materials</u>

In this set of experiments the effects of an increase in imported raw materials are examined. Two

TABLE 6.7

THE PERCENTAGE CHANGE IN ENDOGENOUS VARIABLES DUE TO AN INCREASE IN IMPORTED RAW MATERIALS BY ONE MILLION CONSTANT TAKA IN 1972

TIME	CPI	PFA	PNJM	PP	PJM	WAA	HMM	CRED
1972	-.23073	-.29257	-.23073	-.17884	.00700	-.03100	-.20180	.08804
1973	-.00800	-.00700	-.01700	-.00800	-.09995	-.14489	-.01200	.00500
1974	-.00200	0.00000	-.00400	.00100	.02600	-.03899	-.00300	.00300
1975	0.00000	0.00000	.00100	-.00100	-.00600	.00800	0.00000	-.00100
1976	0.00000	0.00000	0.00000	0.00000	.00200	-.00200	0.00000	.00100
1977	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

TABLE 6.7 (CONTINUED)

YEAR	LIQ	OFS	QJSB	QNJM	YD	LDNJM	PRYD	FE
1972	.07103	.00300	-.00400	.13209	-.19381	-.06198	.03701	-.10373
1973	.00500	-.00700	.06002	.00500	-.01200	-.00400	-.00400	-.21599
1974	.00300	-.00400	-.01700	.00100	-.00300	-.00100	-.00100	-.20789
1975	-.00100	.00100	.00500	0.00000	0.00000	0.00000	0.00000	-.14787
1976	0.00000	0.00000	-.00100	0.00000	0.00000	0.00000	0.00000	-.05557
1977	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-.06721

TABLE 6.8

THE PERCENTAGE CHANGE IN ENDOGENOUS VARIABLES DUE TO A SUSTAINED INCREASE IN IMPORTED RAW MATERIALS BY ONE MILLION CONSTANT TAKA

YEAR	CPI	PFA	PNJM	PP	PJM	WAA	WMM	CRED
1954	-1.62859	-1.95955	-1.88403	-1.20172	.07503	-.21178	-1.54002	.85060
1955	-1.50063	-1.79274	-1.76523	-1.13155	-1.02075	-1.14934	-1.43354	.83043
1956	-1.53116	-1.81336	-1.83888	-1.12463	-.37629	-1.45629	-1.48881	.88792
1957	-1.07617	-1.27777	-1.28566	-.80474	-.66875	-1.17998	-1.04451	.64306
1958	-.84541	-1.02075	-.37323	-.63398	-.26365	-.98809	-.80276	.58169
1959	-.64988	-.80177	-.70550	-.50074	-.32348	-.69160	-.59125	.45101
1960	-.53556	-.65882	-.59025	-.40916	-.20379	-.58727	-.49278	.30847
1961	-.42410	-.52661	-.45695	-.32846	-.20978	-.45894	-.38725	.26034
1962	-.36732	-.45596	-.39322	-.28260	-.12792	-.38625	-.33643	.21423
1963	-.30753	-.38625	-.31949	-.23971	-.12093	-.31450	-.27662	.19018
1964	-.24470	-.31251	-.24370	-.19481	-.09396	-.27063	-.21676	.17014
1965	-.21976	-.28360	-.21178	-.17585	-.08297	-.22076	-.19182	.14310
1966	-.23971	-.30553	-.23772	-.18882	-.07597	-.20379	-.21178	.15412
1967	-.20479	-.26066	-.20379	-.16287	-.08896	-.20878	-.18283	.12308
1968	-.18283	-.23472	-.17884	-.14489	-.06498	-.18683	-.16087	.10005
1969	-.26565	-.33643	-.27063	-.20878	-.07397	-.17684	-.23572	.14410
1970	-.30952	-.37928	-.34142	-.23572	-.11993	-.23572	-.28858	.14911
1971	-.25767	-.31949	-.28061	-.19880	-.09595	-.26664	-.24370	.10806
1972	-.24470	-.30454	-.25866	-.18882	-.07097	-.22674	-.22375	.09305
1973	-.19182	-.24370	-.19281	-.15188	-.07397	-.20479	-.16786	.05702
1974	-.13491	-.17884	-.11693	-.11094	-.04799	-.16786	-.11094	.06502
1975	-.10295	-.14290	-.07397	-.08796	-.03000	-.12292	-.07897	.06402
1976	-.08796	-.12193	-.06498	-.07597	-.02600	-.09495	-.06798	.04801
1977	-.08796	-.11893	-.06998	-.07397	-.02400	-.08297	-.07097	.04501

TABLE 6.8 (CONTINUED)

YEAR	LIQ	QFS	QJSB	QNJM	YD	LDNJM	PRYD	FE
1954	.18818	.02300	-.02500	.80220	-1.16318	-.47686	.47312	-.28725
1955	.20220	-.02600	.38775	.74677	-1.13452	-.44799	.37169	-1.16718
1956	.18417	-.05498	.14410	.75282	-1.19579	-.46392	.34058	-1.76339
1957	.15011	-.04199	.27939	.53442	-.84441	-.32447	.23427	-3.13826
1958	.13509	-.04099	.11707	.43193	-.75811	-.24869	.08804	-4.92437
1959	.10706	-.02500	.14511	.33958	-.64988	-.18283	-.00000	-3.61121
1960	.08604	-.02200	.09104	.27839	-.52860	-.15188	.00700	-3.95317
1961	.09805	-.01700	.08704	.23026	-.40418	-.11893	.02000	-5.25410
1962	.10205	-.01500	.06002	.20421	-.33344	-.10395	.03401	-5.55745
1963	.09805	-.01100	.06202	.17615	-.28559	-.08496	.02200	-5.34033
1964	.10005	-.01000	.05001	.14911	-.23073	-.06598	.01400	-7.24326
1965	.10405	-.00700	.04101	.13810	-.20279	-.05838	.01700	-8.13282
1966	.10305	-.00600	.03701	.14711	-.21078	-.06498	.02300	-9.13295
1967	.09404	-.00700	.04301	.12808	-.17585	-.05598	.02300	-11.92298
1968	.08404	-.00600	.03201	.11407	-.16686	-.04899	.01500	-8.33288
1969	.08003	-.00400	.03000	.15212	-.24769	-.07197	.01300	-6.90729
1970	.09104	-.00600	.04801	.17215	-.23173	-.08896	.07803	-12.57859
1971	.11607	-.00900	.04901	.15712	-.17385	-.07497	.08404	-13.93760
1972	.08003	-.00700	.04201	.14010	-.20878	-.06898	.03601	-1.60741
1973	.05301	-.00700	.04401	.10906	-.20379	-.05099	-.01200	-3.20312
1974	.06702	-.00700	.03201	.08804	-.15688	-.03399	-.02200	-3.38922
1975	.07703	-.00400	.02500	.07803	-.12193	-.02300	-.01900	-2.61080
1976	.06402	-.00300	.02200	.06602	-.10095	-.02000	-.01300	-1.10988
1977	.06102	-.00200	.01800	.06402	-.08896	-.02100	-.00100	-1.42621

hypothetical cases were examined. One is a "one shot" increase in imported raw materials of one million 1959 taka in 1972. The other case is a sustained increase in import of raw materials during the sample period. The results of these experiments are summarized in Tables 6.7 and 6.8.

An increase in imported raw materials increases the supply of output by the non-jute manufacturing sector. This directly reduces the price of non-jute manufactured goods. Lower prices of non-jute manufactured goods lowers the cost of living index and works through all the sectoral models. All prices decrease and real disposable income increases for most of the sample period.

The results of this set of experiments support the views of the structuralists. Developing countries in general suffer from a chronic shortage of foreign exchange reserves.[4] Because of this problem, these countries fail to import enough raw materials to run the manufacturing sector at full capacity. Given the availability of cheap labour, a small dose of imported raw material has a noticeable effects on prices and output.

6.4.4 The Impact of Change in Foreign Aid

In this set of experiments effects of an increase in foreign aid by one million current takas are examined. It is assumed that the extent of deficit financing is reduced by

TABLE 6.9

THE PERCENTAGE CHANGE IN ENDOGENOUS VARIABLES DUE TO AN INCREASE IN FOREIGN AID BY ONE MILLION CURRENT TAKA IN 1972

TIME	CPI	PFA	PNJM	PP	PJM	WAA	WMM	CRED
1972	-.08496	-.09895	-.10594	-.06098	.00200	-.01100	-.08197	-.01500
1973	-.00300	-.00200	-.00600	-.00300	-.03399	-.04899	-.00400	.00200
1974	-.00100	0.00000	-.00100	0.00000	.00900	-.01300	-.00100	.00100
1975	0.00000	0.00000	.00100	0.00000	-.00200	.00300	0.00000	0.00000
1976	0.00000	0.00000	0.00000	0.00000	.00100	-.00100	0.00000	0.00000
1977	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

TABLE 6.9 (CONTINUED)

YEAR	LIQ	QFS	QJSB	QNJM	YD	LDNJM	PRYD	FE
1972	-.01300	.00100	-.00100	.03301	-.06798	-.02500	.01700	.05090
1973	.00200	-.00200	.02000	.00200	-.00400	-.00100	-.00100	.08574
1974	.00100	-.00100	-.00600	0.00000	-.00100	0.00000	-.00000	.08706
1975	0.00000	0.00000	.00100	0.00000	0.00000	0.00000	0.00000	.06217
1976	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	.02372
1977	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	.02658

TABLE 6.10

THE PERCENTAGE CHANGE IN ENDOGENOUS VARIABLES DUE TO A SUSTAINED INCREASE IN FOREIGN AID BY ONE MILLION CURRENT TAKA

YEAR	CPI	PFA	PNJM	PP	PJM	HAA	WMM	CRED
1954	-.39621	-.45695	-.50373	-.28061	.01700	-.04899	-.39024	-.19182
1955	-.39422	-.45397	-.50870	-.28559	-.23572	-.27063	-.39422	-.14889
1956	-.35138	-.40020	-.45884	-.24869	-.10694	-.35437	-.35537	-.12392
1957	-.33942	-.38824	-.44003	-.24270	-.13191	-.28061	-.34042	-.12292
1958	-.23373	-.26864	-.30055	-.16786	-.11094	-.27063	-.23373	-.10694
1959	-.18383	-.21277	-.23073	-.13191	-.06698	-.19681	-.17884	-.11194
1960	-.19082	-.22375	-.23971	-.13890	-.05998	-.15488	-.18583	-.10694
1961	-.19880	-.23073	-.24969	-.14390	-.07297	-.15788	-.19381	-.07597
1962	-.22275	-.25866	-.28160	-.16087	-.06198	-.16886	-.21876	-.06398
1963	-.20279	-.23373	-.25567	-.14589	-.07197	-.17684	-.19780	-.05598
1964	-.17885	-.19780	-.21676	-.12292	-.05698	-.16486	-.16686	-.03999
1965	-.15488	-.17984	-.19681	-.11194	-.05399	-.13890	-.15288	-.02800
1966	-.14190	-.16387	-.18183	-.10195	-.04899	-.12692	-.14090	-.02500
1967	-.14489	-.16786	-.18683	-.10395	-.04399	-.11793	-.14390	-.02000
1968	-.13491	-.15588	-.17285	-.09695	-.04699	-.11593	-.13291	-.02000
1969	-.11094	-.12892	-.14290	-.08097	-.05099	-.10894	-.10994	-.02600
1970	-.11993	-.13691	-.15688	-.08496	-.03599	-.09695	-.12093	-.01300
1971	-.12193	-.13890	-.16187	-.08596	-.03699	-.09595	-.12592	-.00400
1972	-.09096	-.10395	-.11793	-.06498	-.03299	-.09396	-.09096	-.01000
1973	-.08396	-.09795	-.10494	-.06098	-.02200	-.07497	-.08097	-.01600
1974	-.05399	-.06198	-.06598	-.03899	-.02100	-.06338	-.05099	-.00900
1975	-.03299	-.03899	-.04099	-.02400	-.01000	-.04399	-.03299	-.00500
1976	-.02800	-.03399	-.03599	-.02100	-.00600	-.02600	-.02700	-.00300
1977	-.02900	-.03299	-.03499	-.02000	-.00600	-.02300	-.02800	-.00300

TABLE 6.10(CONTINUED)

YEAR	LIQ	QFS	QJSB	QNJM	YD	LDNJM	PRYD	FE
1954	-.04199	.00500	-.00500	.15913	-.28061	-.12093	.11607	.64070
1955	-.03599	-.00500	.08904	.16013	-.29556	-.12292	.09905	.51735
1956	-.02500	-.01400	.04101	.14511	-.27063	-.11094	.08103	.65108
1957	-.02900	-.00900	.05502	.13910	-.25866	-.10594	.08103	1.10463
1958	-.02400	-.01100	.04901	.09505	-.20579	-.07297	.02800	1.86016
1959	-.02700	-.00800	.03100	.07303	-.17784	-.05598	.00600	1.42619
1960	-.03000	-.00500	.02700	.07603	-.18283	-.05798	.00300	1.59658
1961	-.03000	-.00500	.03100	.07903	-.18183	-.05998	.01700	2.03257
1962	-.03100	-.00500	.02900	.08904	-.19780	-.06798	.02500	2.21616
1963	-.02900	-.00600	.03701	.08003	-.18483	-.06098	.01800	2.24980
1964	-.02400	-.00600	.03000	.06802	-.15788	-.05199	.01300	3.22298
1965	-.02000	-.00400	.02600	.06202	-.13990	-.04799	.01500	3.74540
1966	-.01600	-.00400	.02300	.05702	-.12093	-.04239	.02100	4.30579
1967	-.01600	-.00400	.02100	.05802	-.11993	-.04499	.02500	5.75199
1968	-.01700	-.00300	.02300	.05401	-.11693	-.04099	.01800	4.14244
1969	-.01500	-.00400	.02100	.04501	-.09995	-.03399	.01100	3.41364
1970	-.00900	-.00300	.01400	.04901	-.08596	-.03699	.03401	6.16618
1971	-.00500	-.00200	.01900	.05101	-.07797	-.03899	.04401	6.85264
1972	-.00900	-.00300	.02000	.03701	-.07497	-.02800	.01500	.78098
1973	-.01400	-.00300	.01300	.03301	-.08496	-.02500	-.00100	1.53471
1974	-.01000	-.00300	.01500	.02100	-.05698	-.01600	-.00300	1.59438
1975	-.00500	-.00200	.00800	.01300	-.03599	-.01000	-.00300	1.20683
1976	-.00600	-.00100	.00600	.01100	-.03000	-.00800	-.00200	.48021
1977	-.00400	0.00000	.00500	.01100	-.02600	-.00800	.00300	.59579

an amount equal to the inflow of the additional amount of foreign aid. Effects of both a one shot and a sustained increase in foreign aid are presented in Tables 6.9 and 6.10 respectively. The results are interesting. An increase in foreign aid is not inflationary.

For a small country like Bangladesh foreign aid accounts for a significant part of the government revenue. If more foreign aid is received then the extent of deficit financing adopted by the government is less. Thus, the influence of foreign aid on prices is negative.

The way the additional amount of foreign exchange is spent is an important issue. If this amount is spent to increase import of raw materials then there will be further downward pressure on prices. This is evident from the simulation results presented in the preceding section (6.4.4).

6.4.5 The Impact of A Change in Direct Tax Rate

In this experiment effects of a sustained 10% increase in the direct tax rate are examined. The results are quite interesting and presented in Table 6.12. A higher direct tax rate lowers disposable income and thereby reduces demand for final goods and services. Prices in general respond to this lower demand and go down. A higher direct tax rate also increases the total government revenue and for

TABLE 6.11

THE PERCENTAGE CHANGE IN ENDOGENOUS VARIABLES DUE TO A 10% INCREASE IN THE DIRECT TAX RATE

YEAR	CPI	PFA	PNJM	PP	PJM	WAA	WMM	CRED
1954	-3.77972	-4.36679	-4.76284	-2.69210	.17014	-.47686	-3.71138	-2.01149
1955	-3.98925	-4.58172	-5.08515	-2.89817	-2.27082	-2.63857	-3.95948	-1.70726
1956	-4.07082	-4.65421	-5.23784	-2.90982	-1.14934	-3.60926	-4.07562	-1.80452
1957	-4.36679	-5.00349	-5.58970	-3.14062	-1.60104	-3.29064	-4.35053	-1.85753
1958	-3.97677	-4.59508	-5.00824	-2.88264	-1.48388	-3.58130	-3.89992	-2.35678
1959	-3.36798	-3.92394	-4.16958	-2.46023	-1.34882	-3.26066	-3.24518	-2.46803
1960	-3.15515	-3.67285	-3.91817	-2.29720	-1.10386	-2.84670	-3.04760	-1.89384
1961	-3.88550	-4.52159	-4.81806	-2.82629	-1.15330	-2.72518	-3.75181	-1.69055
1962	-4.16958	-4.83044	-5.21699	-3.02529	-1.36362	-3.20550	-4.06315	-1.29948
1963	-4.13603	-4.79712	-5.15915	-3.00299	-1.29356	-3.43270	-4.01709	-1.25308
1964	-4.39547	-5.10982	-5.45365	-3.19679	-1.24123	-3.42594	-4.25004	-1.22839
1965	-4.36487	-5.05857	-5.45554	-3.17065	-1.49570	-3.56008	-4.25004	-.90984
1966	-4.47097	-5.15726	-5.64067	-3.23066	-1.41292	-3.63335	-4.39069	-.88902
1967	-4.67614	-5.38271	-5.92238	-3.37377	-1.47107	-3.67960	-4.61034	-.74819
1968	-4.15904	-4.79331	-5.26247	-3.00687	-1.53411	-3.74988	-4.08425	-.66875
1969	-3.50317	-4.04396	-4.42319	-2.54213	-1.55774	-3.39213	-3.42884	-.89398
1970	-4.21652	-4.81235	-5.44325	-3.00784	-1.13847	-3.10381	-4.23089	-.57733
1971	-4.95738	-5.62934	-6.48890	-3.52439	-1.34290	-3.43560	-5.04623	-.25069
1972	-3.94988	-4.53304	-5.04243	-2.84281	-1.42672	-3.80281	-3.92106	-.53755
1973	-2.27668	-2.64149	-2.85641	-1.65613	-1.03560	-3.07183	-2.21705	-.39422
1974	-2.93701	-3.45973	-3.55237	-2.14467	-.43406	-2.06537	-2.76603	-.62007
1975	-3.71426	-4.38017	-4.47288	-2.72421	-.66577	-2.36752	-3.48773	-.68862
1976	-3.75758	-4.41459	-4.56454	-2.75144	-.87812	-2.91856	-3.55815	-.57136
1977	-3.86051	-4.49771	-4.77046	-2.80491	-.91281	-3.01947	-3.71715	-.48980

TABLE 6.11(CONTINUED)

YEAR	LIQ	QFS	QJSB	QNJM	YD	LDNJM	PRYD	FE
1954	-.44501	.05301	-.05698	1.55192	-2.77283	-1.16417	1.04644	.21100
1955	-.41414	-.05099	.86875	1.65759	-3.08540	-1.24716	.94140	-1.56625
1956	-.37430	-.13191	.44398	1.70741	-3.24905	-1.28665	.85665	-2.51672
1957	-.43206	-.09396	.67124	1.82546	-3.42401	-1.37447	.98583	-4.36799
1958	-.54650	-.12292	.66319	1.63218	-3.61697	-1.22741	.37470	-6.98365
1959	-.58826	-.11693	.60885	1.35307	-3.42111	-1.01779	-.05498	-5.27784
1960	-.53059	-.09795	.49723	1.26898	-3.12125	-.95640	.03501	-6.15423
1961	-.64292	-.07297	.48115	1.56918	-3.67382	-1.17899	.22024	-9.02658
1962	-.61808	-.09296	.64407	1.70233	-3.79800	-1.27974	.38775	-9.91083
1963	-.64392	-.10794	.67024	1.68301	-3.89223	-1.26394	.25432	-9.47218
1964	-.72536	-.10095	.67225	1.78372	-4.19928	-1.33797	.20521	-12.78075
1965	-.65783	-.10794	.74879	1.78270	-4.03628	-1.33994	.34359	-14.77890
1966	-.59125	-.11294	.68735	1.84277	-3.92394	-1.38729	.57263	-17.26616
1967	-.57733	-.11094	.72159	1.93753	-3.97196	-1.45925	.73872	-23.11960
1968	-.56142	-.12592	.76693	1.70640	-3.70271	-1.29652	.47613	-16.22718
1969	-.50174	-.12193	.63903	1.42607	-3.23550	-1.08606	.27738	-13.61156
1970	-.35437	-.09296	.46608	1.77253	-3.13675	-1.33994	1.12731	-24.46598
1971	-.27263	-.08996	.69843	2.12527	-3.26356	-1.60596	1.79288	-26.34459
1972	-.43903	-.13191	.84757	1.63929	-3.34672	-1.23827	.62796	-2.91412
1973	-.36234	-.12892	.62394	.91718	-2.37241	-.69358	-.09795	-5.64495
1974	-.63696	-.05798	.29443	1.14956	-3.17549	-.86325	-.24570	-5.53967
1975	-.82458	-.04799	.56559	1.45752	-3.99021	-1.09100	-.28659	-3.78941
1976	-.77895	-.07897	.71454	1.48796	-3.98349	-1.11375	-.23472	-1.34240
1977	-.66677	-.08496	.67930	1.55497	-3.76143	-1.16615	.10305	-1.50039

a constant level of government spending, reduces the extent of deficit financing. Thus, the money supply (LIQ) is reduced and that has an additional downward influence on prices.

The simulation results for 1977 show a 3.86% decrease in cost of living index, a .67% decrease in money supply, a 3.7% decline in nominal disposable income but an increase of real disposable income of .10%. These figures also reflect the cumulative influence of the sustained change in tax rate in the previous periods.

6.4.6 The Impact of Technical Change in the Agricultural Sector

Technical change in production of both food and jute crops are considered in this section. Technical change is represented as an increase in output by 10%, with no change in inputs. It may be noted here that this represents a technical change of the "Hicks-neutral" type.[5] The experiment was repeated for production of both food and jute crops. The results are presented in Tables 6.12 and 6.13.

A technical change in the production of food increases prices and wages across all the sectors. The increase in prices is due to an increase in per capita real disposable income which in turn increases the demand for consumer goods. For a similar technical change in the

TABLE 6.12

THE PERCENTAGE CHANGE IN ENDOGENOUS VARIABLES DUE TO A TECHNICAL CHANGE IN THE PRODUCTION OF FOOD

YEAR	CPI	PFA	PNJM	PP	PJM	WAA	WMM	CRED
1954	6.63590	7.05687	10.07811	4.25817	-.25966	.23368	7.65807	-4.36009
1955	6.38240	6.71484	9.85488	4.17271	3.57543	4.09461	7.47951	-4.44040
1956	7.15648	7.58919	10.93342	4.62894	1.42303	5.43031	8.29188	-5.01774
1957	6.44625	6.77354	9.97798	4.18209	2.70699	4.98423	7.56660	-4.68757
1958	5.19231	5.37234	8.20961	3.31165	1.67894	4.90867	6.23039	-4.47479
1959	4.29988	4.40214	6.89320	2.72343	1.51943	3.74129	5.23439	-3.91817
1960	4.29988	4.40527	6.88251	2.71418	1.16979	3.20427	5.22492	-3.30225
1961	3.36952	3.29926	5.74285	2.05585	1.45955	2.96202	4.35413	-2.98553
1962	2.87454	2.71213	5.13867	1.67792	.72965	2.45772	3.89078	-2.62688
1963	2.34712	2.11608	4.42198	1.31558	.72361	1.83870	3.34472	-2.47876
1964	1.69419	1.35814	3.58890	.84757	.49422	1.45955	2.70596	-2.31870
1965	1.29025	.88489	3.07946	.55554	.33356	.94948	2.31438	-1.99287
1966	1.52856	1.15967	3.39020	.71857	.20521	.68534	2.55202	-2.13684
1967	1.41086	1.01613	3.25588	.63601	.36868	.76088	2.44747	-1.89580
1968	1.29329	.88590	3.09287	.55353	.24630	.73469	2.31642	-1.71905
1969	2.19985	1.95384	4.21126	1.20318	.25934	.73872	3.17331	-2.24345
1970	2.75836	2.54587	5.06510	1.57833	.75181	1.33787	3.82951	-2.27180
1971	1.62100	1.20217	3.66455	.75886	.67225	1.66674	2.75425	-1.49669
1972	2.19780	1.93040	4.26338	1.18598	.14911	1.04644	3.22078	-1.65515
1973	2.03034	1.78678	3.92196	1.11012	.55453	1.20622	2.96408	-1.29159
1974	.72159	.24831	2.30721	.16714	.36567	1.11618	1.72064	-1.40208
1975	.11106	-.46392	1.54075	-.28061	-.01600	.20421	1.12933	-1.29850
1976	.17014	-.39223	1.60372	-.23971	-.10494	-.27961	1.17391	-1.13353
1977	.25432	-.30055	1.72776	-.18283	-.07397	-.26664	1.27506	-1.14341

TABLE 6.12(CONTINUED)

YEAR	LIQ	QFS	QJSB	QNJM	YD	LDNJM	PRYD	FE
1954	-.96531	1.53161	.08804	-2.94283	5.09873	2.35633	-1.44151	-.28760
1955	-1.07716	1.70029	-1.32119	-2.87389	5.17338	2.31028	-1.13649	2.46309
1956	-1.04055	1.80001	-.54153	-3.16968	5.93336	2.55202	-1.14144	3.52688
1957	-1.09199	1.76438	-1.10584	-2.90400	5.34495	2.33996	-1.03461	6.51688
1958	-1.03758	1.80001	-.73628	-2.41047	5.03254	1.93957	-.15188	9.93797
1959	-.93361	1.74607	-.67372	-2.03697	4.74305	1.63827	.42490	7.21882
1960	-.92569	1.71758	-.51965	-2.03305	4.67080	1.63624	.35563	8.07222
1961	-1.13452	1.71962	-.59820	-1.70136	3.67284	1.37537	.29343	11.71955
1962	-1.25012	1.70843	-.34142	-1.52229	3.08977	1.23658	.20922	11.91706
1963	-1.27382	1.67792	-.37031	-1.31133	2.68953	1.07069	.33456	11.01088
1964	-1.36855	1.67284	-.26565	-1.06133	2.11097	.87581	.40984	14.33968
1965	-1.44249	1.65251	-.16486	-.90785	1.66064	.75584	.36567	15.39922
1966	-1.42278	1.63218	-.09895	-1.00096	1.76133	.82942	.22926	16.48695
1967	-1.46220	1.63624	-.17884	-.95937	1.61388	.79817	.20020	20.76813
1968	-1.44249	1.63929	-.12093	-.90686	1.59864	.76290	.30145	13.95868
1969	-1.25802	1.61897	-.10494	-1.24123	2.45157	1.02421	.24630	10.93255
1970	-1.39616	1.64031	-.30553	-1.49669	2.42186	1.22241	-.32746	19.43075
1971	-1.62171	1.68606	-.34540	-1.07815	1.42100	.89700	-.19681	20.66537
1972	-1.35277	1.64132	-.08796	-1.26296	2.29289	1.03330	.09304	2.22474
1973	-1.18789	1.64437	-.33145	-1.16417	2.67618	.95251	.63299	4.25070
1974	-1.43954	1.67182	-.24670	-.67372	1.46564	.57364	.73872	4.17634
1975	-1.55577	1.63624	.01300	-.43804	.75987	.39177	.64809	2.99237
1976	-1.54396	1.60576	.08504	-.45695	.73166	.40683	.56057	1.13918
1977	-1.55676	1.60372	.05502	-.49577	.72965	.43695	.47412	1.35351

TABLE 6.13

THE PERCENTAGE CHANGE IN ENDOGENOUS VARIABLES DUE TO A TECHNICAL CHANGE IN THE PRODUCTION OF JUTE

YEAR	CPI	PFA	PNJM	PP	PJM	WAA	WHM	CRED
1954	.33556	.37069	.46809	-.03599	-8.35795	.04001	.36065	-.13091
1955	-.83152	-.87118	-1.26592	-.62901	-3.10478	-2.98067	-.97323	.60784
1956	-.11893	-.11294	-.21277	-.26565	-6.34384	-1.56365	-.16187	.18417
1957	-.60616	-.63199	-.93064	-.51169	-4.02285	-2.43487	-.71444	.47713
1958	-.29955	-.30354	-.47885	-.34042	-5.01964	-1.79961	-.36732	.30145
1959	-.30055	-.30055	-.48880	-.31849	-4.40121	-2.00365	-.37430	.32152
1960	-.20379	-.19880	-.34540	-.26465	-4.67042	-1.76327	-.26465	.21824
1961	-.10295	-.08097	-.21976	-.19980	-4.87135	-1.79961	-.16586	.19118
1962	-.18583	-.16686	-.34939	-.23073	-4.18108	-1.82514	-.26565	.21022
1963	-.14989	-.12892	-.29357	-.20579	-4.11494	-1.60990	-.22275	.18417
1964	-.10494	-.07697	-.23572	-.16886	-3.94988	-1.56168	-.17784	.17215
1965	-.05798	-.02700	-.17085	-.14789	-4.31322	-1.47009	-.12792	.13609
1966	-.07997	-.04699	-.20679	-.15987	-4.26823	-1.58038	-.15488	.15913
1967	-.08097	-.04799	-.21178	-.15987	-4.26249	-1.57447	-.15807	.14410
1968	-.08696	-.05399	-.22275	-.16187	-4.19353	-1.57250	-.16586	.13509
1969	-.13391	-.11294	-.27163	-.22674	-5.10887	-1.55676	-.20579	.16413
1970	-.23073	-.20878	-.43007	-.27263	-4.69520	-1.93307	-.32547	.20922
1971	-.13391	-.09595	-.30653	-.17984	-3.92490	-1.81532	-.23173	.13309
1972	-.15887	-.13790	-.30553	-.19681	-3.66322	-1.48191	-.23173	.12308
1973	-.13191	-.11493	-.25667	-.18383	-3.70078	-1.40504	-.19481	.08804
1974	-.05199	-.01800	-.16287	-.11094	-3.27420	-1.39616	-.12193	.10005
1975	-.01400	.02300	-.10694	-.06798	-2.69599	-1.18888	-.07997	.08504
1976	-.01600	.01200	-.09695	-.08297	-2.94962	-.95838	-.07097	.06302
1977	-.02200	.01100	-.10994	-.08996	-3.15418	-1.05638	-.08197	.06802

TABLE 6.13(CONTINUED)

YEAR	LIQ	QFS	IJSB	QNJH	YD	LDNJH	PRYD	FE
1954	-.02900	-.00400	2.96820	-.14689	.06602	.11306	-.26864	-9.93609
1955	.14811	-.24769	1.19306	.39578	-.73727	-.30952	.09505	-7.72877
1956	.03901	-.11793	2.52946	.06502	-.30454	-.05199	-.18583	-13.05514
1957	.11106	-.19681	1.71148	.29042	-.57335	-.22674	.03301	-19.39553
1958	.07002	-.13890	2.29391	.14811	-.36633	-.11693	-.06698	-29.78813
1959	.07603	-.16287	2.02524	.15111	-.42012	-.11993	-.11993	-21.64027
1960	.06102	-.14390	2.14978	.10706	-.36135	-.08496	-.15788	-25.51442
1961	.07203	-.15089	2.07728	.06602	-.30653	-.05399	-.20379	-37.71507
1962	.10005	-.15388	2.00993	.10606	-.27961	-.08596	-.09396	-40.09978
1963	.09404	-.13391	2.16817	.08904	-.21876	-.07197	-.06898	-37.87442
1964	.10105	-.13091	2.17430	.07103	-.17285	-.05798	-.06798	-50.63880
1965	.09905	-.12492	2.19780	.05001	-.14190	-.04299	-.08396	-57.24971
1966	.10606	-.13491	2.11404	.06202	-.16187	-.05099	-.08197	-65.57864
1967	.11106	-.13491	2.12731	.06302	-.14589	-.05299	-.06498	-86.28256
1968	.11306	-.13391	2.12833	.06602	-.14090	-.05498	-.05399	-59.80700
1969	.09104	-.13191	2.14263	.08203	-.20978	-.06698	-.07597	-49.79631
1970	.12808	-.16187	1.96812	.13109	-.24869	-.10594	-.01800	-90.32661
1971	.14310	-.15089	2.07320	.09304	-.13691	-.07597	-.00300	-96.66503
1972	.10005	-.12392	2.20496	.09304	-.17684	-.07497	-.01800	-10.60595
1973	.08103	-.11693	2.26630	.07803	-.19481	-.06298	-.06298	-20.56253
1974	.10305	-.11893	2.25607	.04801	-.10594	-.04099	-.05399	-20.28621
1975	.10305	-.10295	2.32154	.03100	-.04399	-.02700	-.03000	-13.82593
1976	.08504	-.08297	2.42903	.02800	-.03299	-.02400	-.01700	-4.93313
1977	.09304	-.09096	2.37988	.03201	-.03699	-.02700	-.01500	-5.54382

TABLE 6.14

THE PERCENTAGE CHANGE IN ENDOGENOUS VARIABLES DUE TO A 10% INCREASE IN IMPORT PRICE OF MANUFACTURED GOODS

TIME	CPI	PFA	PNJM	PP	PJM	WAA	WMM	CRED
1972	-1.22741	-2.02423	-7.41379	-1.25407	.03501	-.81962	-5.54059	2.29698
1973	-1.00294	-1.78979	-7.09753	-1.13056	-.65385	-1.19678	-5.29278	1.97118
1974	.69843	.22826	-5.20277	.11807	-.35537	-1.10683	-3.79703	2.17941
1975	1.44839	1.10304	-4.32661	.66520	.11607	.10405	-3.10962	1.98953
1976	1.46868	1.10304	-4.25291	.66923	.22726	.71051	-3.05341	1.70436
1977	1.47172	1.09798	-4.22802	.66621	.22024	.74879	-3.03596	1.67894

TABLE 6.14(CONTINUED)

YEAR	LIQ	QFS	QJSB	QNJM	YD	LDNJM	PRYD	FE
1972	1.87537	-.01500	-.02100	2.26016	-1.50161	-1.93699	-.27761	-30.11747
1973	1.81324	-.02900	.39277	2.15182	-1.59908	-1.85655	-.60218	-58.39639
1974	2.23869	-.06798	.24028	1.50014	.15412	-1.38137	-.54053	-63.64145
1975	2.38397	-.01800	-.09895	1.20723	1.02320	-1.16219	-.41912	-57.02309
1976	2.31847	.01800	-.18283	1.18497	.96765	-1.14242	-.49378	-28.03617
1977	2.28675	.02200	-.16287	1.17687	.89599	-1.13649	-.56738	-36.48372

production of jute, real disposable income and prices fall. If there is a technical change in the production of jute, supply of jute increases, the price of jute in both the world and the domestic markets falls, export earnings and incomes decline. As a result, real disposable income falls and, consequently, prices of final goods fall.

6.4.7 The Impact of Changes in the Import Price of Manufactured Goods

In this experiment the consequences of a 10% increase in the import price of non-jute manufactured goods are examined. For a change occurring at the beginning of the sample period the model gives an unstable solution. Because of this problem, simulations were performed over a later part of the sample period. The results in 1977, indicate that an increase in the import price of manufactured goods by 10% increases the cost of living index by 1.47% and reduces the per capita disposable income by .56%. The price of non-jute manufactured goods also declines by 4.2%. These results are presented in Table 6.14.

6.5 Conclusion

In addition to the simulation experiments mentioned above, one more simulation was tried, to examine the effects of rural-urban migration. The model did not generate a stable solution.

The simulation results presented in this chapter highlight the nature of the response of endogenous variables to changes in exogenous variables. While some simulation experiments support well known hypothesis some do not.

Higher government expenditure and deficit financing result in higher prices. Increases in tax revenues through direct taxation, with government expenditure fixed, naturally result in a lower price level. There is nothing new in these. The same is true for the results of a higher rate of growth of population. Prices are higher for a higher rate of growth of population.

The unexpected results are those of simulations examining the effects of a higher amount of foreign aid, of larger quantities of imported raw materials, and of technical change in the agricultural sector. Increases in foreign aid do not increase the price level, but rather reduce it. Also larger quantities of imported raw materials reduce prices. Technical change in the production of food produces a higher price level and technical change in the production of jute produces a lower price level. Both of these results are surprising.

Because of the chronic shortage of foreign exchange, developing countries cannot import an adequate quantity of raw material to produce necessary manufactured goods. This leads to a higher price level for manufactured goods in particular and consequently higher prices for other goods in general. Also higher prices of imported manufactured goods contribute to a higher domestic price level.

As a whole, the results of our simulation experiments help identify important sources of pressure on the price level.

FOOTNOTES TO CHAPTER SIX

1. For an excellent discussion of simulation with econometric models, see Pindyck, R.S. and Rubinfeld, D.L., Econometric Models and Economic Forecasts, New York: McGraw-Hill Book Company, 1976; chapters X – XII and XVI.

2. See K.M. Brown, "A Quadratically Convergent Newton-like Method Based Upon Gaussian Elimination", SIAM Journal of Numerical Analysis, Vol. 6(4), pp. 560-569.

3. MAPE is defined as

$$\text{MAPE} = \frac{1}{T}\sum_{t=1}^{T}\frac{|y_t - \hat{y}_t|}{y_t}$$

where, y_t, $\hat{y}_t$ and T are the actual value, predicted value and the number of time periods respectively.

4. This is true for almost all developing countries excluding a few oil-exporting developing countries.

5. Hicks-neutral technical change is a form of disembodied technical change. It obtains when the production function shifts by a uniform displacement of the whole function.

CHAPTER SEVEN

SUMMARY AND CONCLUDING REMARKS

7.1. Introduction

In this study a disaggregated econometric model has been used to study the behaviour of prices in a developing country, Bangladesh. This study provides statistical estimates of the basic structural parameters of the Bangladesh economy, from which inferences about price behaviour are drawn. The behaviour patterns of the main variables under different simulation experiments give evidence of built-in-stability in the Bangladesh economy. The model developed above may be used to answer a large variety of questions of interest to planners, researchers and politicians. In this chapter a brief summary of the work, its strengths and weaknesses, scope for further improvement, and the future direction of research in this field are discussed.

A summary of the work, emphasizing both its strengths and weaknesses is presented in section 7.2 and section 7.3 provides a discussion of future direction of research and concluding comments.

7.2 Summary of the Present Study

This is one of a very few studies of price behaviour in developing countries which uses a detailed econometric model to study the problem.[1] To the best of our knowledge this is the first comprehensive study of price behaviour in the Bangladesh economy.

The sectoral submodels, which incorporate the aggregated behavioural relationships of individual firms and households, help us to understand the working of the relevant markets and how the interplay of demand and supply determines equilibrium price and quantity in the respective sectoral markets.

One interesting aspect of the present model is its emphasis on the supply side. This is in sharp contrast with a large number of macroeconometric models of developing countries which derive their basic framework from Keynesian-type demand determined models.[2] In these Keynesian-type demand determined models, the supply side is represented only through the use of a production function to determine the labour demand function.

The importance of foreign trade and aid cannot be understated. The present study incorporates these features in a more realistic way than do other econometric models of Bangladesh.[3] Also, treatment of the financial sector is an improvement over the existing models of Bangladesh economy.[4] The financial sector has been introduced in our model in a very novel way compared to other models of developing countries.[5] Because of the presence of various rigidities in the financial market, the rate of interest fails to rise enough to clear the market. In this situation, there is always an excess demand for loanable funds and the supply of loanable funds (more specifically the supply of credit ~~to the~~ private sector) dominates the market.

The estimated model provides structural information on the Bangladesh economy which was used for simulation analysis. Usually, simulation analysis is carried out with a pure 'mathematical' (mechanical) model, or an econometric model, whose parameters are either assumed or borrowed from other independent studies. In this respect our approach of first estimating the parameters of an econometric model and then performing simulation exercises is novel. This approach has yielded results which are significant for policy formulation. Some of the important results of this study are discussed below.

It is clear from the supply of food equation that there is a very high degree of supply rigidity. The estimated supply elasticity with respect to one period lagged price was .07. This finding is consistent with the finding of a similar study done by Marwah(1964) for the Indian economy. In her study of price behaviour in India, Marwah found the supply elasticity of food with respect to lagged price to be .06.[6]

The elasticity of the supply of food with respect to land is .53, which is much higher than the price elasticity of supply. This suggests that an increase in the availability of cultivable land can help to solve the problem of food shortage. Given the physical limitation on the availability of land, the production of food can only be increased by adopting better irrigation facilities, flood control, use of improved seed and fertilizer. These measures will allow the farmers to cultivate two to three crops a year instead of the present one to two crops a year. This will have an effect equivalent to increasing the availability of land.

It is also worth noting that the elasticity of demand for food with respect to population is close to unity (.91) and is much larger than the elasticity of demand for non-jute manufactures with respect to population (.53). The implication of this finding is straightforward. Given a very high rate of growth of population, demand for food grows at a much faster rate than demand for manufactured goods.

The price elasticity of supply of non-jute manufactured goods is almost four times higher than that of food. In general, one can conclude from our estimation results that supply rigidity is not as acute in the manufacturing as in the agricultural sector.

In terms of the contribution to the cost of living index and the general price level, nothing is as important as the food price. Thus rigidity in food supply, coupled with a growing population and food demand, has contributed substantially to inflation in Bangladesh.

The state of the agricultural sector in all developing countries is deplorable. Serious research should be carried out to bring about technical change in the agricultural sector. In the context of the agricultural sector of Bangladesh, two separate simulations were run to compare the effects of technical change in production of both food and jute crops. It has been found that a technological advancement in the production of food which increases the supply of food, consequently increases per capita real disposable income. An increase in the supply of food reduces import requirements and releases foreign exchange, which may be used to import raw materials and capital goods. Our simulation experiment shows that an increase in import of raw materials boosts production of non-jute manufactured goods, thus lowering their price and increasing per capita real disposable income.

On the other hand, if technical change takes place in production of jute, per capita real disposable income declines. This is due to the fact that an increase in supply of jute by Bangladesh lowers the price of jute in the world market and, as well, in the domestic market. In the face of declining world demand for jute, an increase in the supply of jute resulting from improved technology does not pay off. If technical change takes place in the production of jute, the government should induce farmers to allocate more land to the production of food and other crops instead of jute, so that jute supply does not increase by a substantial amount in the world market.

It was mentioned at the very outset that the objective of this work is to study the process of price formation. To this end a multi-sectoral econometric model of the Bangladesh economy has been built which reflects the basic structure of the economy. The diverging views of structuralists and monetarists have been considered while building the model and have been examined in the various simulation experiments.

A comparision between two views of inflation in developing countries is only justified if all the elements of each view are properly identified and appropriately quantified. It is very difficult to test all the hypotheses of the structuralists, because some of these are not straightforward enough to quantify.[7] Still, the results of our study may be used to find support for both structuralist and monetarist views of price behaviour in Bangladesh.

The monetarist position is well supported by our simulation results of increased money supply via deficit financing. An increase in money supply has considerable positive effects on the price level.

The presence of agricultural supply rigidity, especially supply rigidity of food, supports the structuralist position. Also the high growth rate of population, exerting upward pressure on food price and other prices; the deflationary effect of imported raw material; and the failure to increase real disposable income by increasing the supply of the exportable agricultural commodity (jute) lend support to the structuralist position. The inelasticity of tax revenue with respect to GDP, which becomes evident from the data collected for this study, compels the government to resort to deficit financing. This piece of evidence also lends support to the structuralist position.

7.3 Scope for Improvement and Future Direction of Research

Even though many significant behavioural relationships have been identified through this work, the model may be improved in many ways. One way of improving the model would follow from building a stock adjustment mechanism into the food, jute and jute manufacturing sectors. Since data on stock variables in these sectors could not be obtained, the stock adjustment phenomenon could not be built into this model. Stocks of these commodities certainly play a very important role in influencing the respective prices.

The market for food is the single most important market in the Bangladesh economy. Import and distribution of food by the government at a price lower than the market price, mainly among the urban population, has a very important impact on the food price. Distribution of imported food at a price lower than the market price constitutes a subsidy to the recipients of this food. Through this food subsidy redistribution of income in favour of the higher-income urban population is taking place. A closer examination of the food price subsidy in order to evaluate its effects on income distribution, the price of food and the supply of food would be important for assessing the effectiveness of this programme.

A further extension could involve a comparative study of the costs and benefits of subsidizing the consumer of food versus subsidizing the producers of food. If the present subsidy on food consumption is withdrawn, and the funds released thereby are used to distribute better seeds and fertiliser at a subsidised price, or to improve irrigation facilities, then the supply of food may increase in the long run, resulting in a lower price of food in particular and a lower cost of living index in general. Increased production of food has another important implication for the Bangladesh economy, that is the import of food will decline in response to a higher domestic production. This will release much needed foreign exchange to import raw materials and capital goods. The model may be extended to examine this impact.

While future research on the problem of price behaviour in Bangladesh should be extended to examine and include input subsidies, urban food subsidies, income distribution and stock adjustment mechanisms.

This study has pointed out the major factors which determine sectoral prices and, consequently, the general price level and the cost of living index. The study also suggests that the structuralist and the monetarist views on inflation are not competitive but complementary; and that the problem of price behaviour is most effectively studied within the framework of a multi-sectoral econometric model which takes the structure of the economy into explicit consideration.

FOOTNOTES TO CHAPTER SEVEN

1. Other studies which use a macroeconometric model include Corbo(1974) and Marwah(1972).

2. See, for example, Corbo(1974), Bhuiyan(1971), Marwah(1972) and Otani(1976).

3. See, for example, S. Ahmed(1978) and F. Ahmed(1974), in which the recognition of foreign trade and aid is sketchy.

4. See, for example, S. Ahmed(1978). However, Ahmed(1978) examines the processes of development and rural-urban migration, which is better done in terms of real variables.

5. See, for example, Corbo(1974), in which disequilibrium in the money market has been measured by taking the difference between actual demand for money and the fitted demand for money. In Marwah(1964, 1972) a quantity theory of money has been used to determine the price level. The money supply has been treated as an exogenous variable in Marwah's study.

6. See Marwah(1964), p283.

7. For example, it is difficult to find a measure of sectoral demand shift or to quantify the impact of the land tenure system.

APPENDIX A

THE REDUCED FORM PRICE EQUATION UNDER PERFECT COMPETITION AND MONOPOLY

Under perfect competition there are a demand equation, a supply equation and a market clearing condition for the industry in question. Under monopoly there is no supply equation. The equilibrium price-quantity configuration observed in a market under monopoly is attained through equation of marginal cost and marginal revenue. However, the reduced form equations for price and quantity are functions of the same set of variables under both monopoly and perfect competition.

Let us postulate the following demand and supply functions for our non-jute manufacturing industry under perfect competetition.

$$QNJMD = f(PNJM, PFA, YD, LIQ, POP), \text{ and} \quad (1)$$

$$QNJMS = g(PNJM, WMM, KNJM, IMR) \quad (2)$$

The market clearing condition is

$$QNJMD = QNJMS \quad (3)$$

From the above structural equations, the reduced form equations for price, PNJM, and quantity QNJM can be derived.

$$PNJM = h(PFA, YD, \text{~~LIQ~~}, POP, WMM, KNJM, IMR) \qquad (4)$$

$$QNJM = I(PFA, YD, LIQ, POP, WMM, KNJM, IMR) \qquad (5)$$

Under monopoly the demand function has the same form as (1). Instead of the supply function, however we have a cost function. form equations for quantity and price are determined through equality of marginal cost and marginal revenue. The cost function is as below.

$$C = c(QNJMS, WMM, KNJM, IMR) \qquad (6)$$

$$MC = \frac{\partial c}{\partial (QNJMS)}$$

$$\text{or, } MC = c(QNJMS, WMM, KNJM, IMR) \qquad (7)$$

Inverting the demand function (B1), we have the following expression.

$$PNJM = j(QNJM, PFA, YD, LIQ, POP) \qquad (8)$$

The total revenue of the firm (in this case the firm is the industry) is as below.

$$TR = PNJM.QNJMD \qquad (9)$$

$$MR = \frac{\partial (TR)}{\partial (QNJMD)}$$

or, $MR = PNJM + QNJMD(\partial PNJM/\partial QNJMD)$ (10)

Solving for PNJM from MC = MR and then substituting the value of PNJM into the demand equation, we get the following equations.

$$PNJM = k(PFA, YD, LIQ, POP, WMM, KNJM, IMR) \quad (11)$$

$$QNJMD = l(PFA, YD, LIQ, POP, WMM, KNJM, IMR) \quad (12)$$

Thus, in both the cases, PNJM is a function of the same set of variables.