

# A Monetary Model of Inflation for Bangladesh, 1974 – 1985

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A model of inflation for Bangladesh is developed and estimated for the period 1974:2–1985:4, in line with the monetary approach and based on the hypothesis that any disequilibrium in the real money-market adjusts itself through changes in the price level, but not instantaneously. Changes in the prices of traded goods in the international market, real permanent income, real money stock, one period lagged rate of inflation, and changes in the terms of trade between traded and non-traded goods are found to be the major determinants of inflation in Bangladesh.

## 1. INTRODUCTION

This paper develops and estimates a quarterly monetary model of inflation for Bangladesh for the period 1974:2–1985:4. The model is developed along the lines of a monetary approach, and is based on the hypothesis that inflation in Bangladesh is basically a monetary phenomenon, in the sense that any disequilibrium in the real money-market adjusts itself through changes in the price level, but not instantaneously. Furthermore, we maintain the assumption that other channels of adjustment to monetary disequilibrium, such as balance of payments and real output, bear a relatively small burden.

The basic tenet of the monetary approach to macro modelling is that the money-market is stable, in the sense that if there is a disequilibrium in the real money market, it initiates an automatic adjustment process which results in the attainment of monetary equilibrium in the long run. The adjustment process to monetary disequilibrium requires an aggregate private expenditure function, which depends not only on the level of income but also on a variable which measures the extent of disequilibrium in the money-market. Economic agents are assumed to spend more or less than their income depending on whether they are running down or accumulating money balances. Excess money supply positively affects the level of

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private expenditure, and excess demand for money balances results in a reduced level of private expenditure. It is through the influences of monetary imbalances on private expenditure that prices, output, and the balance of payments of the economy are affected.

The formulation of our model is in many ways similar to the Blejer model of inflation Blejer (1977). However, one basic distinction between the Blejer model and the present one is that, whereas Blejer formulates his model in terms of a flow disequilibrium in the money-market, the present model is specified within the framework of a stock disequilibrium in the money-market. The concept of stock disequilibrium in the money-market is essentially similar to the concept used by Cagan (1956) in his classic model of hyperinflation. Indeed, the analytical approach of our model is essentially similar to an inflation model developed for Australia by Jonson, Moses and Wymer (1976) and Jonson and Butlin (1977). They assume that household consumption expenditure adjusts to the long-run desired level through a partial adjustment mechanism, and that such adjustment process is importantly influenced by the gap between the actual and the desired levels of money balances, which act as buffer stocks. They also point out that money as a buffer stock implies that any disequilibrium in the money-market affects private consumption expenditure, and this effect, in their view, although analogous to the liquid asset effect in conventional consumption function, accords more precisely with economic theory. Lewis (1978) suggests that excess money balances spill into asset markets and affect interest rates. Changes in the interest rates in turn eliminate the excess money supply and bring equilibrium in the money market, but not instantaneously.

The remainder of this paper is organized as follows. Section 2 develops the inflation model. Section 3 estimates the model and analyses the results. Section 4 draws conclusions.

## **2. THE INFLATION MODEL**

The common practice of identifying the major determinants of inflation in developing countries is to estimate an inflation model derived from the money demand function in the tradition of the monetarist school. Although monetary factors remain the major determinants of inflation in most developing countries, a simple monetarist model of inflation developed in the context of a closed economy is quite inadequate for an open economy for the following reasons. First, such a model does not link international inflation to domestic inflation in a world with a flexible or controlled exchange rates system. Second, a simplified monetarist model assumes that the money-market is always in equilibrium, which is unlikely in a developing economy because of the non-existence of well-developed financial markets, and because of persistent interference by the monetary authority in the self-adjustment process to monetary disequilibrium. The weak nature of the financial

market results in an adjustment process, which requires considerable time instead of instantaneous clearance, as assumed in the Cagan model to explain the hyper-inflationary process.

The model we develop below attempts to overcome these two shortcomings. First, we specify our model by relaxing the assumption of instantaneous equilibrium in the money-market. Second, in order to show up the transmission mechanisms of international inflation into domestic inflation, we distinguish between traded and non-traded goods<sup>1</sup> transacted in an open economy, where the prices of traded goods are assumed to be determined in the international market. Effects of changes in the terms of trade between traded and non-traded goods on the prices of non-traded goods are also incorporated.

We assume that the goods transacted in an open economy can be divided into traded and non-traded goods. Domestic prices of transacted goods ( $P_t$ ) can then be defined as the weighted average of the prices of traded ( $PT_t$ ) and non-traded goods ( $PNT_t$ ) in domestic currency. We write the relationship in the following logarithmic form

$$\ln P_t = \phi \ln PT_t + (1-\phi) \ln PNT_t \quad \dots \quad \dots \quad \dots \quad \dots \quad (1)$$

where  $\phi$  is the share of traded goods in total expenditure.

For the time being, we assume that  $\phi$  is a constant.<sup>2</sup> We also maintain the

<sup>1</sup> A commodity produced in an economy can be thought of either as an exportable or as a pure non-traded good. Assume that the exportable good has a certain price in the world market. Such an exportable good becomes a non-traded good when its domestic price inclusive of transport costs is higher than the price of an identical good in the world market. An exportable good can also be non-traded because of quotas or tariffs imposed by the importing countries. Therefore, the major reasons why a particular exportable good becomes non-traded are transport costs and commercial policy obstacles. For a commodity to be imported, the foreign price inclusive of transport costs would have to be lower than or equal to the price of an identical commodity produced at home. This suggests that a rise in domestic price puts some exportable goods on the margin of becoming non-traded goods, and will push some importable goods on the margin of becoming non-tradeables. In addition, there is a group of commodities which are sufficiently sheltered to remain non-traded at all prices, such as housing and haircuts. In the case of a small-economy model, a country is assumed to be a price taker in the world market for importables and exportables alike. These two categories of commodities are then aggregated into a composite commodity called 'traded goods'. For more details see Dornbusch [(1980), Chapter 6].

<sup>2</sup> We regressed the share of traded goods in total expenditure on time trend and seasonal dummies. The estimated equation by the Beach and McKinnon maximum likelihood iterative technique is given below:

$$(NEB+NIM/NGNE)_t = 0.121 + 0.001 \text{ TIME} + \text{Seasonal Dummies} \\ (7.058) \quad (2.422)$$

where  $NEB$  = exports,  $NIM$  = imports,  $NGNE = NGNP - NEB + NIM$ , and  $NGNP = GNP$ . All variables are in current prices. The figures in parentheses are  $t$ -ratios. The estimated coefficient on time trend is positive and statistically significant. The assumption that  $\phi$  is a constant is thus found to be restrictive.

assumption of a small economy, where the prices of traded goods are determined in the international market. From the purchasing power parity proposition, it follows that

$$\ln PT_t = \ln PFE_t + \ln PW_t \quad \dots \quad \dots \quad \dots \quad \dots \quad (2)$$

where  $PT$  = prices of traded goods in domestic currency,  $PFE$  = exchange rate of domestic currency per unit of foreign currency, and  $PW$  = prices of traded goods in foreign currency.

We postulate that prices of non-traded goods in an open economy change in response to disequilibrium in the money-market and as a result of variations in the terms of trade between traded and non-traded goods, such that

$$\begin{aligned} \ln PNT_t - \ln PNT_{t-1} &= \gamma_1 (\ln (M_t/P_{t-1}) - \ln (M/P)_t^d) \\ &+ \gamma_2 \ln (PT_t/PNT_{t-1}) + U1_t \quad \dots \quad \dots \quad (3) \end{aligned}$$

In this adjustment equation, monetary disequilibrium is defined in a discrete time framework, which can alternatively be written as<sup>3</sup>  $(\ln (M_t/P_{t-1}) + \ln (M/P_{t-1}) - \ln (M/P)_t^d)$ .

Equation (3) suggests that if the actual real money balances at the beginning of a period,  $\ln (M/P)_{t-1}$ , differ from the real money balances that individuals desire to hold at the end of the period,  $\ln (M/P)_t^d$ , then individuals would adjust their actual real money balances either by disposing of or by building up actual nominal money balances. This also implies that any disequilibrium in the real money market spills

<sup>3</sup> In the literature, several definitions of monetary disequilibrium are found. For a continuous model it is obvious that  $\ln (M/P)_t - \ln (M/P)_t^d$  measures the stock disequilibrium in the money market; in a discrete framework it is common practice to define disequilibrium as the difference between  $\ln (M/P)_{t-1}$  and  $\ln (M/P)_t^d$ . This is usually the case for the partial stock adjustment model. We also used such specification in a recent study of inflation in Pakistan (Hossain 1986). However, in this paper we would like to use  $(\ln (M_t/P_{t-1}) - \ln (M/P)_t^d)$  as a measure of monetary disequilibrium. This definition reduces to the commonly used definition  $\ln (M/P)_{t-1} - \ln (M/P)_t^d$  when  $\ln (M_t/M_{t-1}) = 0$ . In the context of a money demand function, Artis and Lewis (1976) postulated a partial adjustment function where changes in actual money balances are proportional not only to a discrepancy between the desired and actual money balances but also to factors which generate changes in the actual money balances during the period. By doing so, they essentially take into account the current changes in money balances in addition to the size of monetary imbalances that prevailed at the beginning of the period. In Appendix A we report the results of a comparative test to select the appropriate measure of monetary disequilibrium for Bangladesh. In order to test the comparative goodness of fit, we have used likelihood criteria, which in our case have been simply comparisons between the residual sums of squares.

into the commodity market and changes private expenditure. This change in private expenditure changes the prices of non-traded goods, and subsequently brings equilibrium in the money market. The money growth term,  $\ln (M_t/M_{t-1})$ , implicit in the adjustment function, suggests that changes in money supply during the period  $t-1$  to  $t$  also have a contemporaneous effect on the prices of non-traded goods.  $\gamma_1$  is the coefficient of elasticity of adjustment, whose value is expected to lie between zero and unity. The partial adjustment equation suggests that only a proportion ( $\gamma_1$ ) of the discrepancy between the desired and actual real money balances is eliminated within the period  $t-1$  to  $t$ .

The second term on the right-hand side of Equation (3) suggests that a rise in the prices of traded goods in the current period increases the prices of traded goods compared with the prices of non-traded goods which prevailed in the last period. A rise in the relative prices of traded goods is then likely to increase the prices of non-traded goods because of an expected increase in the demand for non-traded goods, since the relative prices of non-traded goods have lowered, and also because of an expected reduction in the supply of non-traded goods owing to the outflow of productive resources from the non-traded goods to the traded goods sector.<sup>4</sup>

However, it is also possible that a rise in the relative prices of traded goods may decrease the prices of non-traded goods. This may happen for several reasons. First, a rise in the prices of traded goods may reduce the demand for non-traded goods, and hence may lower the latter's prices. The demand for non-traded goods may fall because, given the budget constraints, consumers may spend larger shares of their incomes on traded goods if their demands are price inelastic, and as a result they will have only their residual incomes left for spending on non-traded goods. Second, when there are under-utilized productive resources in the economy, an outflow of productive resources from the non-traded goods sector to the traded goods sector may not reduce the supply of non-traded goods and, therefore, the prices of non-traded goods may not rise. Third, it is also possible that the productive resources of the non-traded goods sector can not easily be used for the production of traded goods at least in the short run, and as a result there may be only a marginal outflow of resources from the non-traded goods sector to the traded goods sector, causing no significant reduction in the supply of non-traded goods. It thus appears that the sign of the adjustment coefficient of  $\ln (PT_t/PNT_{t-1})$  is theoretically indeterminate.

In the adjustment Equation (3),  $U_1$  is the disturbance term, which allows random influences in carrying out the adjustment process and is also assumed to satisfy all the classical properties.

Take the first-order logarithmic differential of Equations (1) and (2) as follows

<sup>4</sup>See Aghevli and Sassanpour (1982) for related arguments.

$$\ln (P_t/P_{t-1}) = \phi \ln (PT_t/PT_{t-1}) + (1-\phi) \ln (PNT_t/PNT_{t-1}) \quad \dots \quad (4)$$

$$\ln (PT_t/PT_{t-1}) = \ln (PFE_t/PFE_{t-1}) + \ln (PW_t/PW_{t-1}) \quad \dots \quad (5)$$

Substitution of Equations (3) and (5) into Equation (4), and rearrangement of terms, yields the following equation

$$\begin{aligned} \ln (P_t/P_{t-1}) = & \phi (\ln (PFE_t/PFE_{t-1}) + \ln (PW_t/PW_{t-1})) \\ & + (1-\phi) \gamma 1 (\ln (M_t/P_{t-1}) - \ln (M/P)_t^d) \\ & + (1-\phi) \gamma 2 \ln (PT_t/PNT_{t-1}) + (1-\phi) U1_t \quad \dots \quad (6) \end{aligned}$$

Having specified this inflation equation by incorporating the monetary disequilibrium term, we must face the major problem of finding a suitable proxy for monetary disequilibrium for the estimation of the equation. In Lioi's (1974) study, the estimated residual of the money demand function was used as a proxy for monetary disequilibrium. However, his technique is not appropriate in our case. This is because in a complete macro model the desired demand for real money balances is an endogenous variable and, unless the coefficient of actual real money balances in the inflation equation is zero, the estimated residual cannot be used as a proxy for monetary disequilibrium. Lioi's strategy also raises major econometric problems. Leiderman (1980) and Barro and Rush (1980) point out that the equation to be estimated and the equation from which the residuals were derived must be estimated jointly if efficiency in estimation is to be obtained. Furthermore, Mishkin (1980) found that it was not just a question of efficiency but also one of invalid inferences. Pagan (1983) thoroughly examined the major econometric problems arising from the appearance of generated variables in a regression equation. He suggests that, for consistent and efficient estimates to be obtained in such a regression, stringent conditions need to be imposed, but, according to him, it is unlikely that these conditions will be met in most studies.

Considering these factors, we prefer not to adopt Lioi's technique. Instead, we specify an equation for the desired demand for real money balances and substitute it into Equation (6) so that the determinants of the desired demand for real money balances become regressors in the inflation equation.

In Hossain (1988), we thoroughly examined the literature on money demand function for developing countries. Based on our discussion, the desired demand for real money balances for developing countries can be specified as

$$\ln (M/P)_t^d = \alpha 0 + \alpha 1 \ln RGNP_t^p - \alpha 2 p_t^e \quad \dots \quad \dots \quad \dots \quad (7)$$

where  $RGNP^p$  = real permanent income,  $p^e$  = expected rate of inflation and  $\alpha 0$ ,  $\alpha 1$  and  $\alpha 2$  are the structural parameters in the money demand function. The expected

rate of inflation can be approximated by a weighted average of the past inflation rates, such that

$$p_t^e = \sum \delta_i p_{t-1}, i = 1, 2, 3 \dots \alpha \dots \dots \dots (8)$$

where  $\delta_i$  represents the weight given to the  $i$ th period lagged rate of inflation. For Bangladesh, one period lagged rate of inflation can be used as a proxy for the expected rate of inflation, such that

$$p_t^e = \delta_1 p_{t-1} \dots \dots \dots (9)$$

Substituting Equation (9) into Equation (7) and then substituting the resulting money demand equation into Equation (6), with rearrangement of terms, yields the following equation

$$\begin{aligned} \ln(P_t/P_{t-1}) = & -(1-\phi)\gamma_1\alpha_0 + \phi(\ln(PFE_t/PFE_{t-1}) + \ln(PW_t/PW_{t-1})) \\ & + (1-\phi)\gamma_1 \ln(M_t/P_{t-1}) - (1-\phi)\gamma_1\alpha_1 \ln RGNP_t^P \\ & + (1-\phi)\gamma_1\alpha_2\delta_1 p_{t-1} + (1-\phi)\gamma_2 \ln(PT_t/PNT_{t-1}) \\ & + (1-\phi)U1_t \dots \dots \dots (10) \end{aligned}$$

Equation (10) needs further simplification in order to make it suitable for estimation using the Bangladesh data. Exchange rates in Bangladesh are controlled by the monetary authority. The present exchange rates system in Bangladesh is what is popularly called a managed float.<sup>5</sup> We, therefore, need to define a reaction function of the monetary authority to represent official intervention in the foreign exchange market.

Lipschitz (1978) suggests that the extent of official intervention in the foreign exchange market depends upon the origin of short-term shocks to the economy. He also suggests that policy decisions regarding the exchange rates of developing countries are taken following some sort of reaction function that is aimed at maximizing

<sup>5</sup>The Bangladesh Taka was until April 1976 pegged to the Pound Sterling. The monetary authority in Bangladesh altered the value of the peg on a number of occasions. Because of the volatility of the Pound's exchange rate against the US Dollar, the monetary authority shifted to a more flexible exchange rate policy from April 1976 by frequently changing the peg value, which was expected to promote a stable exchange rates system. After August 1979 Bangladesh switched over to a basket method of exchange rate determination, where the basket currencies are the Pound Sterling, the US Dollar, Japanese Yen and the West German Deutschmark. The objective of adopting this method was to impart greater stability to the exchange rates system of Bangladesh. For more details see Matin (1982).

the government's utility function. Ujii (1978) elaborates different forms of reaction function of the monetary authority.

We postulate that under a controlled exchange rates system, the monetary authority tries to maintain stable terms of trade between traded and non-traded goods through changes in the exchange rate of domestic currency against the intervention currency, such that

$$\ln PFE_t - \ln PFE_{t-1} = \gamma_3 (\ln PT_t - \ln PNT_{t-1}) \quad \dots \quad (11)$$

where the adjustment parameter  $\gamma_3$  takes a value which lies between zero and unity.

The reaction function (11) suggests that changes in the prices of traded goods in the current period change the relative prices of traded goods compared with the prices of non-traded goods which prevailed in the last period. Changes in the terms of trade between traded and non-traded goods are expected in turn to affect the production structure and subsequently the balance of payments of the country. To maintain a stable balance of payments, the monetary authority is then expected to change the exchange rate of domestic currency against the intervention currency.

Substitution of Equation (11) into Equation (10), and rearrangement of terms, yields the following estimating equation<sup>6</sup>

$$\begin{aligned} \ln (P_t/P_{t-1}) = & -(1-\phi) \gamma_1 \alpha_0 + \phi \ln (PW_t/PW_{t-1}) + (1-\phi) \gamma_1 \ln (M_t/P_{t-1}) \\ & -(1-\phi) \gamma_1 \alpha_1 \ln RGNP_t^P + (1-\phi) \gamma_1 \alpha_2 \partial_1 p_{t-1} \\ & + (\phi \gamma_3 + (1-\phi) \gamma_2) \ln (PT_t/PNT_{t-1}) + (1-\phi) U1_t \quad \dots \quad (12) \end{aligned}$$

### 3. ESTIMATION AND RESULTS

We have estimated the model by both OLS and instrumental variables approach, where the instrumental variables approach has been used to reduce any simultaneity bias that may exist in the OLS estimates. Such a possibility is suspected because real permanent income may be affected by the current rate of inflation, since real measured income is affected by the rate of inflation. The definitions of the variables used in the regression equation and the methodologies for the generation of data (and data sources) are given in Appendix B.

#### 3.1. OLS Estimated Equations

We have estimated the model by OLS in two forms: (i) with a restriction that  $\phi = \phi_t$ , and (ii) with an assumption that  $\phi$  is a constant. These two forms have been

<sup>6</sup> The equation is exactly identified with one restriction: that the adjustment coefficient in the reaction function is unity.



used to check whether both the restricted and unrestricted forms of the inflation model provide similar results. Also, in order to check whether narrow money ( $M1$ ) or board money ( $M2$ ) is more appropriate in the model, we estimated the model using them separately. The wholesale price index ( $WP$ ) has been used as the appropriate index of the general price level. The estimated equations for the period 1974:2–1985:4 are given below, where the figures in parentheses below the coefficients are absolute  $t$ -ratios;  $SSR$  represents the sum of squared residuals;  $SER$  represents the standard error of regression;  $DM$ ,  $DJ$  and  $DS$  are seasonal dummies ( $DM$  stands for the March quarter,  $DJ$  stands for the June quarter, and  $DS$  stands for the September quarter);  $Mean$  represents the mean of the dependent variable;  $L$  represents the maximized value of the log-likelihood function: and  $D.h$  and  $D.h4$  represent respectively the first-order and fourth-order Durbin- $h$  statistics (calculated from  $D.W.$  and  $D.W4$  statistics). Also reported are the adjusted  $R^2$  ( $R_a^2$ ) and  $F$ -statistic values:

$$\begin{aligned} \ln(WP_t/WP_{t-1}) &= 2.085 - 0.343 \ln RGNP_t^P + 0.362 \ln(PW_t/PW_{t-1}) \\ &\quad (2.109) (2.743) \quad (1.800) \\ &+ 0.305 \ln(M1_t/WP_{t-1}) + 0.292 \ln(WP_{t-1}/WP_{t-2}) \\ &\quad (4.072) \quad (2.276) \\ &- 0.158 \ln(PT_t/PNT_{t-1}) - 0.087 DM_t + 0.086 DJ_t \\ &\quad (2.625) \quad (0.382) \quad (3.886) \\ &+ 0.077 DS_t \\ &\quad (3.627) \end{aligned}$$

$Mean = 0.023$ ;  $SSR = 0.099$ ;  $SER = 0.051$ ;  $R_a^2 = 0.565$ ;  $F = 8.472$ ;  $D.h = 1.083$ ;  $D.h4 = 0.178$ ; and  $L = 78.167$ .

$$\begin{aligned} \ln(WP_t/WP_{t-1}) &= 3.570 - 0.221 \ln RGNP_t^P + 0.424 \ln(PW_t/PW_{t-1}) \\ &\quad (2.164) (2.388) \quad (1.977) \\ &+ 0.221 \ln(M2_t/WP_{t-1}) + 0.301 \ln(WP_{t-1}/WP_{t-2}) \\ &\quad (3.064) \quad (2.191) \\ &- 0.107 \ln(PT_t/PNT_{t-1}) - 0.011 DM_t + 0.085 DJ_t \\ &\quad (1.755) \quad (0.433) \quad (3.555) \\ &+ 0.074 DS_t \\ &\quad (3.214) \end{aligned}$$

$Mean = 0.023$ ;  $SSR = 0.114$ ;  $SER = 0.055$ ;  $R_a^2 = 0.499$ ;  $F = 6.721$ ;  $D.h = 0.657$ ;  $D.h4 = 0.073$ ; and  $L = 74.848$ .

### 3.2. OLS Estimated Equations Imposing a Restriction that $\phi = \phi_t$

We have estimated the model imposing one restriction: that the coefficient of  $\ln(PW_t/PW_{t-1})$  is equal to  $\phi_t$  ( $\phi = \phi_t$ ), which we have calculated as the share of

traded goods in total expenditure. Such *a priori* information about the coefficient of an explanatory variable has some econometric advantages in reducing the variances of other estimated coefficients (Kmenta 1986). The estimated equations are given below:

$$\begin{aligned} \ln(WP_t/WP_{t-1}) - \phi_t \ln(PW_t/PW_{t-1}) &= 3.062(1-\phi_t) - 0.485(1-\phi_t) \ln RGNP_t^P \\ &\quad (2.876) \quad (3.571) \\ &+ 0.409(1-\phi_t) \ln(M1_t/WP_{t-1}) \\ &\quad (4.806) \\ &+ 0.374(1-\phi_t) \ln(WP_{t-1}/WP_{t-2}) \\ &\quad (2.695) \\ &- 0.190(1-\phi_t) \ln(PT_t/PNT_{t-1}) \\ &\quad (2.788) \\ &+ 0.007 DM_t + 0.083 DJ_t + 0.072 DS_t \\ &\quad (0.301) \quad (3.882) \quad (3.523) \end{aligned}$$

Mean = 0.022; SSR = 0.099; SER = 0.050;  $R_a^2 = 0.557$ ;  $F = 9.217$ ;  $D. h = 1.334$ ;  $D. h4 = 0.795$ ; and  $L = 78.090$ .

$$\begin{aligned} \ln(WP_t/WP_{t-1}) - \phi_t \ln(PW_t/PW_{t-1}) &= 5.417(1-\phi_t) - 0.711(1-\phi_t) \ln RGNP_t^P \\ &\quad (3.031) \quad (3.241) \\ &+ 0.322(1-\phi_t) \ln(M2_t/WP_{t-1}) \\ &\quad (3.778) \\ &+ 0.404(1-\phi_t) \ln(WP_{t-1}/WP_{t-2}) \\ &\quad (2.702) \\ &- 0.122(1-\phi_t) \ln(PT_t/PNT_{t-1}) \\ &\quad (1.795) \\ &+ 0.013 DM_t + 0.057 DJ_t + 0.029 DS_t \\ &\quad (0.524) \quad (2.268) \quad (1.210) \end{aligned}$$

Mean = 0.022; SSR = 0.116; SER = 0.054;  $R_a^2 = 0.482$ ;  $F = 7.118$ ;  $D. h = \text{undefined}$ ;  $D. h4 = \text{undefined}$ ; and  $L = 74.492$ .

Section 3.3 reports the unrestricted estimated equations by an instrumental variables approach (IV). In Section 3.4, the estimated results obtained in the restricted and unrestricted forms of the model are compared and analysed.

### 3.3.IV Estimated Equations

The major problem in using an instrumental variables approach for the estimation of Equation (12) has been to find an appropriate instrument for real permanent income, since all other predetermined variables in the estimating equation can be used as their own instruments. Following the principles suggested by Kmenta (1986), it can be argued that in the absence of a first-order autocorrelation, one period-lagged

real permanent income can be used as an instrument for current real permanent income, given that  $E(\ln RGNP_t^p, U1_t) = 0$ , and that a high degree of correlation exists between  $\ln RGNP_t^p$  and  $\ln RGNP_{t-1}^p$ . Since the OLS estimated equations in both restricted and unrestricted forms do not show any autocorrelation problem, and since the correlation coefficient between  $\ln RGNP_t^p$  and  $\ln RGNP_{t-1}^p$  is found to be 0.95, we have used one period-lagged real permanent income as an instrument for current real permanent income. The estimated equations are given below:

$$\begin{aligned} \ln (WP_t/WP_{t-1}) &= 2.185 - 0.356 \ln RGNP_t^p + 0.352 \ln (PW_t/PW_{t-1}) \\ &\quad (2.162) \quad (2.783) \quad (1.755) \\ &+ 0.311 \ln (M1_t/WP_{t-1}) + 0.293 \ln (WP_{t-1}/WP_{t-2}) \\ &\quad (4.091) \quad (2.284) \\ &- 0.159 \ln (PT_t/PNT_{t-1}) - 0.087 DM_t + 0.086 DJ_t \\ &\quad (2.639) \quad (0.381) \quad (3.877) \\ &+ 0.077 DS_t \\ &\quad (3.625) \end{aligned}$$

*Mean* = 0.023; *SSR* = 0.099; *SER* = 0.051;  $R_a^2$  = 0.566; *F* = 8.469; *D.h* = 1.133; and *D.h4* = 0.593. Instruments: *C*,  $\ln RGNP_{t-1}^p$ ,  $\ln (PW_t/PW_{t-1})$ ,  $\ln (WP_{t-1}/WP_{t-2})$ ,  $\ln (M1_t/WP_{t-1})$ ,  $\ln (PT_t/PNT_{t-1})$ ,  $DM_t$ ,  $DJ_t$  and  $DS_t$ .

$$\begin{aligned} \ln (WP_t/WP_{t-1}) &= 3.320 - 0.522 \ln RGNP_t^p + 0.405 \ln (PW_t/PW_{t-1}) \\ &\quad (2.307) \quad (2.521) \quad (1.876) \\ &+ 0.239 \ln (M2_t/WP_{t-1}) + 0.303 \ln (WP_{t-1}/WP_{t-2}) \\ &\quad (3.166) \quad (2.201) \\ &- 0.109 \ln (PT_t/PNT_{t-1}) - 0.010 DM_t + 0.084 DJ_t \\ &\quad (1.785) \quad (0.428) \quad (3.517) \\ &+ 0.073 DS_t \\ &\quad (3.202) \end{aligned}$$

*Mean* = 0.023; *SSR* = 0.114; *SER* = 0.055;  $R_a^2$  = 0.498; *F* = 6.710; *D.h* = 1.401; and *D.h4* = 0.575. Instruments: *C*,  $\ln RGNP_{t-1}^p$ ,  $\ln (PW_t/PW_{t-1})$ ,  $\ln (WP_{t-1}/WP_{t-2})$ ,  $\ln (M2_t/WP_{t-1})$ ,  $\ln (PT_t/PNT_{t-1})$ ,  $DM_t$ ,  $DJ_t$  and  $DS_t$ .

### 3.4. Analysis of the Results

The estimated results of Equation (12) in both restricted and unrestricted forms show that all the coefficients are consistent with prior expectations and (except for one or two seasonal dummies) are statistically significant. It is also important to note that the coefficients of both the restricted and unrestricted forms of the estimated equations are not significantly different in terms of their signs and magnitudes, except for the coefficient of  $\ln RGNP_t^p$ , whose value is much higher in the restricted form of the model. The size of the coefficient of  $\ln RGNP_t^p$  is also

much higher in the IV estimated equation, compared with its value in the OLS estimated equation. Since the overall results of the model with narrow money are quite stable in both restricted and unrestricted forms, and also in both OLS and IV estimated equations, we use the unrestricted form of the IV estimated equation for the interpretation of results.

The coefficient of real permanent income bears a negative sign and is also statistically highly significant. The estimated coefficient shows that a one-unit increase in real permanent income reduces the rate of inflation by 0.346 percentage point. An implication of this result is that as the level of real permanent income increases, the demand for real money balances also increases which, given the stock of real money supply, reduces the demand pressure in the commodity market by reducing private expenditure. This subsequently reduces the price level.

The coefficient of the one period-lagged rate of inflation (as a proxy for the expected rate of inflation) bears a positive sign and is also statistically highly significant. The estimated coefficient is consistent with the hypothesis that the expected rate of inflation is an appropriate proxy for the opportunity cost of holding money in a developing country like Bangladesh; also the expected rate of inflation can be approximated by a very recent lagged rate (or rates) of inflation.

The coefficient of  $\ln(M1_t/WP_{t-1})$  bears a positive sign and is statistically highly significant. This result is consistent with the hypothesis that if the actual real money supply at the beginning of a period exceeds the desired demand for real money balances at the end of the period, then individuals dispose of actual nominal money balances by increasing private expenditure. This in turn increases the price level, which may bring equilibrium in the money market. The estimated coefficient also indicates that there is the contemporaneous effect of an increase in money supply on the price level.

The coefficient of the terms of trade between traded and non-traded goods is statistically significant. The coefficient bears a negative sign<sup>7</sup> which implies that an increase in the relative prices of traded goods (i.e., the prices of traded goods in the current period relative to the prices of non-traded goods prevailing at the beginning of the last period) reduces the rate of inflation.

We have indicated above that a negative coefficient of the terms of trade implies that, following an increase in the relative prices of traded goods, the demand for non-traded goods may decrease because consumers have less to spend on non-traded goods, given their budget constraints: that is, the income effect outweighs the substitution effect. This also indicates that productive resources in the non-

<sup>7</sup> However, in an earlier study for Pakistan (Hossain 1986), we found that the coefficient of  $\ln(P T_t/PNT_{t-1})$  was positive. This result, therefore, reflects a basically different economic structure in Bangladesh from that of Pakistan.

traded goods sector cannot easily be used for the production of tradeable goods, at least in the short run. This finding is quite consistent with the theoretical model for an open economy developed by Dornbusch [(1980), p. 100], who writes that

... a rise in the relative price of traded goods, given E [a measure of real spending in terms of traded goods], reduces demand for traded goods both on account of the income and substitution effect. A rise in the relative price of traded goods has an ambiguous effect on home goods demand. The substitution effect raises home goods demand whereas the income effect reduces demand.

The  $R_a^2$  value is not very meaningful as a test of the explanatory power of the estimated equation when an instrumental variables approach is used for estimation. Simulation results, however, may be used to provide some evidence about the goodness of fit of the model. We conducted a dynamic simulation test of the model.<sup>8</sup> The actual and the simulated values of the price level are plotted in Chart 1. The simula-

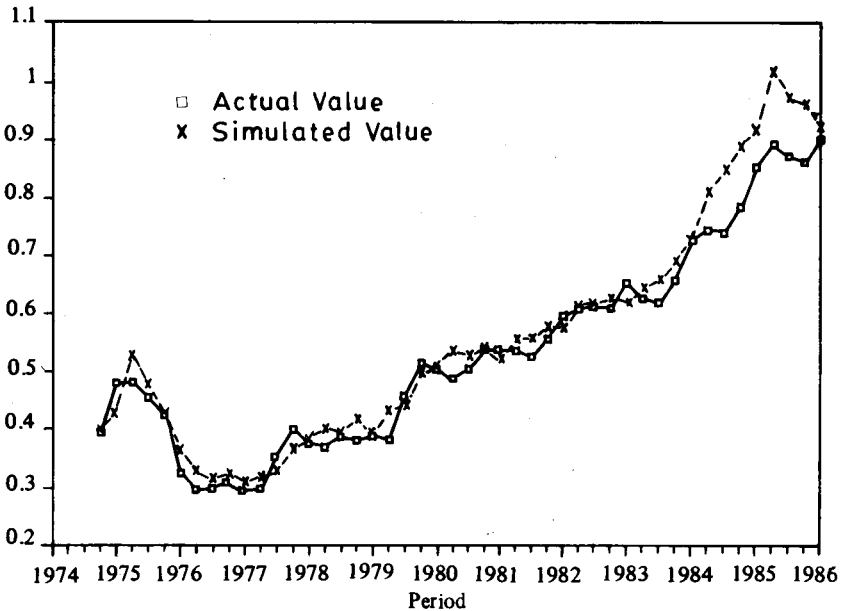


Chart 1. Comparison of Actual and Simulated Values of the Price Level for the Period 1974:3–1985:4

<sup>8</sup> For simulation purposes we set the simulation equation as follows:

$$\begin{aligned}
 WP_t = & \exp(\ln WP_{t-1} + 2.185 - 0.356 \ln RGNP_t^p + 0.352 \ln (PW_t/PW_{t-1}) \\
 & + 0.311 \ln (M1_t/WP_{t-1}) + 0.293 \ln (WP_{t-1}/WP_{t-2}) \\
 & - 0.159 \ln (PT_t/PNT_{t-1}) + 0.087 DM_t + 0.086 DJ_t \\
 & + 0.077 DS_t).
 \end{aligned}$$

tion results show that the model is able to track the fluctuations of the price level and, most importantly, the inflation explosion during 1974 is clearly predicted by the model.

#### 4. SUMMARY AND CONCLUDING REMARKS

In this paper we have developed and estimated a quarterly monetary model of inflation for Bangladesh for the period 1974:2–1985:4. The model has been developed along the lines of a monetary approach and is based on the hypothesis that any disequilibrium in the real money market adjusts itself through changes in price level, but not instantaneously. In order to accommodate the outbreak of worldwide inflation in the 1970s and to capture its influence on the generation and acceleration of inflation in Bangladesh, the basic monetary model has been extended to make it more suitable for an open economy, where the prices of traded goods are assumed to be determined in the international market.

Bhalla (1981) mentioned three channels through which international inflation may be transmitted to the domestic economy: international trade, external prices, and external reserves. Our model links the external price level to the domestic price level through the price index of traded goods and also through the terms of trade between traded and non-traded goods. The effect of changes in foreign reserves on domestic inflation is captured by the real stock of money balances. Changes in the prices of traded goods in the international market, real permanent income, real money stock, one period-lagged rate of inflation, and changes in the terms of trade between traded and non-traded goods have been found to be the major determinants of inflation in Bangladesh. In order to test the goodness of fit, we conducted a dynamic simulation test within the sample period 1974:3–1985:4. The simulation results suggest that the model is able to track the fluctuations of the price level and, most importantly, the inflation explosion during 1974 is clearly predicted by the estimated equation.

The model developed in this paper has strong theoretical and policy implications. In popular literature too much emphasis is usually given to crop failure as the major cause of inflation in a country like Bangladesh (Ahmed 1984). It is our view that a stable crop loss may increase the domestic price level but is in itself unlikely to generate a self-sustaining inflationary process over a long period of time unless crop losses are followed by expansionary fiscal and monetary policies, which are not necessarily the passive responses of the fiscal and monetary authorities. The hypothesis postulated in this paper provides the general mechanism of the inflationary process in Bangladesh, which can even evaluate the effects of crop losses on current and future prices, allowing for fiscal and monetary phenomena.

In the monetary model it is argued that any discrepancy between the demand for and supply of money stock gives rise to an adjustment process which occurs

through changes in price level. Further, it is assumed that the demand for real money balances is a stable function of real permanent income and the expected rate of inflation; and that it is the money demand function which in an open economy constraints the equilibrium size of the money supply (Mussa 1978). The money supply, on the other hand, can be considered exogenous or endogenous depending on how far one is interested in extending the basic inflation model. In an open economy, money supply is related to the foreign exchange reserves of the banking system, which can be considered as the net result of export earnings, import payments, and the net inflow and outflow of foreign capital. Money supply can also be related to domestic credit, where the latter is related to the government's fiscal deficits.

Any crop loss is just a special case of the above scenario implied in the monetary model. When there is a crop loss, real permanent income falls through the reduction of current income. The demand for real money balances falls due to the reduction in real permanent income as well as due to the rise in the expected rate of inflation following crop failure. On the other hand, crop losses cause an increase in the size of fiscal deficits either due to a rise in government expenditure or due to a fall in government revenue; and this, when financed by borrowings from the banking system and from foreign sources as aid and loans, increases the money supply. This results in an increase in excess money supply, which leads to a rise in the price level. However, whether such an increase in price level will persist or not depends upon the behaviours of economic agents and their expectations of actions by the monetary authority in the future. It is our view that expansionary monetary and fiscal policies adopted to reduce real costs created by crop failure will generate a self-sustaining inflationary process, which may not be the case in the absence of an increase in money supply.

### A COMPARATIVE TEST TO SELECT THE APPROPRIATE MEASURE OF MONETARY DISEQUILIBRIUM IN BANGLADESH

In this appendix we choose an appropriate definition for monetary disequilibrium for discrete data from three alternative specifications usually found in the literature. For such experiments we use OLS for estimation. An instrumental variables approach may be very sensitive to a specification error.

We will test whether  $(\ln(M/P)_t - \ln(M/P)_t^d)$ ,  $(\ln(M/P)_{t-1} - \ln(M/P)_t^d)$  or  $(\ln(M_t/P_{t-1}) - \ln(M/P)_t^d)$  measures disequilibrium in the money-market in a better way when discrete data are used for estimation. For our purposes, the problem can be simplified by testing the following unrestricted alternative reduced-form inflation equations. We consider them as null  $H_0$  and alternative hypotheses  $Ha1$  and  $Ha2$ , where  $\pi$ 's are the reduced-form coefficients.

$$\begin{aligned} H_0: \ln(WP_t/WP_{t-1}) &= \pi_{10} + \pi_{11} \ln RGNP_t^P + \pi_{12} \ln(PW_t/PW_{t-1}) \\ &+ \pi_{13} \ln(M/WP)_t + \pi_{14} \ln(WP_{t-1}/WP_{t-2}) \\ &+ \pi_{15} \ln(PT_t/PNT_{t-1}) + U_{2t} \end{aligned}$$

$$\begin{aligned} Ha1: \ln(WP_t/WP_{t-1}) &= \pi_{20} + \pi_{21} \ln RGNP_t^P + \pi_{22} \ln(PW_t/PW_{t-1}) \\ &+ \pi_{23} \ln(M/WP)_{t-1} + \pi_{24} \ln(WP_{t-1}/WP_{t-2}) \\ &+ \pi_{25} \ln(PT_t/PNT_{t-1}) + U_{3t} \end{aligned}$$

$$\begin{aligned} Ha2: \ln(WP_t/WP_{t-1}) &= \pi_{30} + \pi_{31} \ln RGNP_t^P + \pi_{32} \ln(PW_t/PW_{t-1}) \\ &+ \pi_{33} \ln(M_t/WP_{t-1}) + \pi_{34} \ln(WP_{t-1}/WP_{t-2}) \\ &+ \pi_{35} \ln(PT_t/PNT_{t-1}) + U_{4t} \end{aligned}$$

Since the hypotheses  $H_0$  and  $Ha1$  are non-nested, we cannot conduct a likelihood ratio test by defining a composite equation where the hypothesis under test can be embedded in a straightforward manner. However, we can discriminate between the hypotheses  $H_0$  and  $Ha1$  by comparing the maximized values of their likelihood functions. When the error terms are normally distributed, a comparison of the values of maximized likelihood functions is, in another way, a comparison between the residual sums of squares (Harvey 1981). The hypothesis  $Ha2$  can be expressed in the following composite form:

$$\begin{aligned} \ln(WP_t/WP_{t-1}) &= \pi_{30} + \pi_{31} \ln RGNP_t^P + \pi_{32} \ln(PW_t/PW_{t-1}) \\ &+ \pi_{33} \ln(M/WP)_{t-1} + \pi_{33} \ln(M_t/M_{t-1}) \\ &+ \pi_{34} \ln(WP_{t-1}/WP_{t-2}) + \pi_{35} \ln(PT_t/PNT_{t-1}) + U_{4t} \end{aligned}$$



The above composite equation suggests that *Ha2* reduces to *Ha1* with one restriction: that the coefficient of  $\ln (M_t/M_{t-1})$  is not statistically different from zero. *Ha2* specified as above, on the other hand, should uphold one restriction: that the coefficients of  $\ln (M/WP)_{t-1}$  and  $\ln (M_t/M_{t-1})$  have the same sign and are equal in magnitude. We can conduct a likelihood ratio test to discriminate between *Ha1* and *Ha2*.

$$\begin{aligned} \ln (WP_t/WP_{t-1}) &= 1.848 - 0.312 \ln RGNP_t^P + 0.477 \ln (PW_t/PW_{t-1}) \\ &\quad (1.894) \quad (2.535) \quad (2.407) \\ &+ 0.297 \ln (M1/WP)_{t-1} + 0.270 \ln (WP_{t-1}/WP_{t-2}) \\ &\quad (3.885) \quad (2.065) \\ &- 0.147 \ln (PT_t/PNT_{t-1}) - 0.012 DM_t + 0.060 DJ_t \\ &\quad (2.436) \quad (0.498) \quad (2.479) \\ &+ 0.062 DS_t \\ &\quad (2.857) \end{aligned}$$

Mean = 0.0227; SSR = 0.102; SER = 0.052;  $R_a^2 = 0.553$ ; *D. h* = 0.891; *D. h4* = -0.189; *F* = 8.113; and *L* = 77.520.

$$\begin{aligned} \ln (WP_t/WP_{t-1}) &= -1.016 - 0.098 \ln RGNP_t^P + 0.587 \ln (PW_t/PW_{t-1}) \\ &\quad (0.818) \quad (0.602) \quad (2.527) \\ &- 0.018 \ln (M1/WP)_t + 0.323 \ln (WP_{t-1}/WP_{t-2}) \\ &\quad (0.017) \quad (2.077) \\ &- 0.047 \ln (PT_t/PNT_{t-1}) + 0.014 DM_t + 0.094 DJ_t \\ &\quad (0.073) \quad (0.522) \quad (3.638) \\ &+ 0.073 DS_t \\ &\quad (2.680) \end{aligned}$$

Mean = 0.0227; SSR = 0.142; SER = 0.061;  $R_a^2 = 0.375$ ; *D. h* = undefined; *D. h4* = undefined; *F* = 4.456; and *L* = 69.658.

$$\begin{aligned} \ln (WP_t/WP_{t-1}) &= 2.085 - 0.343 \ln RGNP_t^P + 0.362 \ln (PW_t/PW_{t-1}) \\ &\quad (2.109) \quad (2.743) \quad (1.800) \\ &+ 0.305 \ln (M1_t/WP_{t-1}) + 0.292 \ln (WP_{t-1}/WP_{t-2}) \\ &\quad (4.072) \quad (2.276) \\ &- 0.158 \ln (PT_t/PNT_{t-1}) - 0.087 DM_t + 0.086 DJ_t \\ &\quad (2.625) \quad (0.382) \quad (3.886) \\ &+ 0.077 DS_t \\ &\quad (3.627) \end{aligned}$$

Mean = 0.0227; SSR = 0.099; SER = 0.052;  $R_a^2 = 0.565$ ;  $D. h = 1.083$ ;  $D. h4 = -0.178$ ;  $F = 8.472$ ; and  $L = 78.167$ .

$$\begin{aligned} \ln (WP_t/WP_{t-1}) &= 2.087 - 0.344 \ln RGNP_t^P + 0.380 \ln (PW_t/PW_{t-1}) \\ &\quad (2.084) \quad (2.713) \quad (1.736) \\ &+ 0.308 \ln (M1/WP)_{t-1} + 0.254 \ln (M1_t/M1_{t-1}) \\ &\quad (3.996) \quad (1.041) \\ &+ 0.380 \ln (PW_{t-1}/PW_{t-2}) - 0.159 \ln (PT_t/PNT_{t-1}) \\ &\quad (1.736) \quad (2.583) \\ &- 0.048 DM_t + 0.081 DJ_t + 0.075 DS_t \\ &\quad (0.167) \quad (2.561) \quad (3.010) \end{aligned}$$

Mean = 0.0227; SSR = 0.099; SER = 0.052;  $R_a^2 = 0.554$ ;  $D. h = 0.562$ ;  $D. h4 = 0.083$ ;  $F = 7.348$ ; and  $L = 78.197$ .

The sum of squared residuals in the estimated equation having  $\ln (M1/WP)_{t-1}$  is much lower than the sum of squared residuals having  $\ln (M1/WP)_t$ , which is also clearly reflected in the maximized values of the likelihood functions of the estimated equations. The major drawbacks of the estimated equation having  $\ln (M1/WP)_t$  are the presence of severe multicollinearity and autocorrelation. Milbourne (1985) suggests that these problems may be due to poor specification of the model. The null hypothesis  $H_0$  is thus overwhelmingly rejected in favour of the alternative hypothesis  $Ha1$ . A comparison of the estimated equations of  $Ha1$  and  $Ha2$  shows that  $Ha2$  is better than  $Ha1$  on the basis of all available test statistics. The estimated composite equation shows that the coefficient of  $\ln (M1_t/M1_{t-1})$  bears a positive sign but is not very significant. The point estimate of the coefficient of  $\ln (M1_t/M1_{t-1})$  is very close to the point estimate of the coefficient of  $\ln (M1/WP)_{t-1}$ . The likelihood ratio test, however, does not statistically reject  $Ha1$  in favour of  $Ha2$ . As the latter specification  $Ha2$  appears quite satisfactory in all normal test results, and as the  $t$ -ratio of the coefficient on  $\ln (M1_t/M1_{t-1})$  exceeds unity, we will consider  $Ha2$  as appropriate for Bangladesh. It appears that, for discrete data,  $(\ln(M1_t/WP_{t-1}) - \ln (M1/WP)_t^d)$  measures the extent of monetary disequilibrium in a better way for Bangladesh than the alternative specification  $(\ln (M1/WP)_{t-1} - \ln (M1/WP)_t^d)$ , although still not conclusively.

*Appendix B*

**DEFINITIONS OF THE VARIABLES AND GENERATION OF DATA**

**A. Computation of Real Permanent Income**

In order to estimate the model, we need quarterly a real permanent income, which we do not have. There is also no easy approach for the construction of such data. In the case of developing countries, researchers sometimes use measured income as a proxy for permanent income. From a theoretical point of view, this approach is highly controversial and is, in fact, against the spirit of the Friedmanite demand theory model. For the estimation of a quarterly macro model, we constructed a quarterly income data by a methodology discussed in Hossain (1989). Given the data availability, we will follow a more formal approach to construct real permanent income for use in the model.

According to Friedman [(1959), p. 337], permanent income (or what is sometimes defined as expected income) can be defined as a weighted average of past incomes, where the weights decline exponentially. Friedman followed the adaptive expectations model to analyse the process by which economic agents form their expectations about expected income. He suggests that the value of expected income is revised over time at a rate that is proportional to the difference between the expected and the actual income.

Assume that  $RGNP^P$  is the expected income and  $RGNP$  is the actual income, then, following the adaptive expectations hypothesis, we can write

$$RGNP_t^P - RGNP_{t-1}^P = \Theta (RGNP_t - RGNP_{t-1}^P) \quad \dots \quad \dots \quad (1)$$

where  $\Theta$  is the coefficient of adjustment and its value is expected to lie between zero and unity. Equation (1) can be written as

$$RGNP_t^P = \Theta RGNP_t + (1-\Theta) RGNP_{t-1}^P \quad \dots \quad \dots \quad (2)$$

Equation (2) can be converted into a distributed lag model by successive substitutions, such that

$$RGNP_t^P = \Theta RGNP_t + \Theta (1-\Theta) RGNP_{t-1} + \Theta (1-\Theta)^2 RGNP_{t-2} + \dots \quad \dots \quad \dots \quad (3)$$

In equation (3)  $\Theta$  is unknown. However, if  $\Theta$  is known, then  $RGNP_t^P$  can be calculated. One common approach to estimate  $\Theta$  is to define a quadratic loss function of predicting error, and then calculate the value of  $\Theta$  that minimises the loss function.

We will follow this approach. We define a simple quadratic loss function of the following form suggested by Nugent and Glezakos (1979) and Khan (1982), such that

$$LF = \sum (RGNP_t - \Theta RGNP_{t-1})^2 \quad (t = 1, 2, 3 \dots n) \quad \dots \quad (4)$$

Differentiate  $LF$  with respect to  $\Theta$  and set it equal to zero:

$$\delta LF / \delta \Theta = \sum 2(RGNP_t - \Theta RGNP_{t-1})(-RGNP_{t-1}) = 0$$

or

$$\Theta = \sum RGNP_t RGNP_{t-1} / \sum (RGNP_{t-1})^2$$

Using the above formula, we have calculated the value of  $\Theta$ , which we have found to be 1.0105. This estimated value is not statistically different from unity. This implies that  $\Theta = 1$  minimises the loss function. For our purposes, we have used seasonally adjusted data where four-periods unweighted moving average method has been used. Therefore, we can write  $RGNP_t = \Theta RGNP_t$ , where  $\Theta = 1$  and  $RGNP_t$  = four quarters unweighted moving average of actual real incomes.

## B. Price Index

We have two price series which can be used to compute the rate of inflation in Bangladesh: (i) the consumer price index (CPI) of middle class government employees in Dhaka, and the wholesale price index in Bangladesh (WP). One shortcoming of CPI is that the prices of food items, housing, fuel, and other essential household goods which are used to compute CPI are institutionally determined and, therefore, do not reflect the prices which would otherwise be generated under market forces. The consumer price index is also relevant only for government employees in Dhaka, but not for the country as a whole. When some other price index is available, which is representative of the price level of the whole country, the CPI should not be used as a proxy for the general price level. For our purposes, the wholesale price index is found to be more appropriate, because it covers the open market prices of all agricultural and industrial goods throughout the country. This is despite one shortcoming of this price index: that it does not cover housing prices. Assuming that housing prices bear a high degree of positive correlation with the wholesale prices, we have used the wholesale price index to compute the rate of inflation.

## C. Prices of Traded and Non-traded Goods

The price index of traded goods (PT) has been computed as the weighted average of import and export price indices in Bangladesh, where the weights are the proportions of imports and exports to total trade in Bangladesh. In order to compute the price index of traded goods in the international market (PW) the following

formula has been used:

$$PW = (PT/IPFEB)*100$$

where  $PT$  is the price index of traded goods in the domestic market (1972-73 = 1.00), and  $IPFEB$  is the index of the exchange rate of the Bangladesh Taka against the US Dollar (1972-73 = 1.00). In order to compute the price index of non-traded goods, we first computed the value of non-traded goods at current (and constant) prices by subtracting exports from the GNP at current (and constant) prices; then the price index of non-traded goods ( $PNT$ ) was defined as the ratio of the value of non-traded goods at current prices to the value of non-traded goods at constant prices (1972-73 = 1.00).

### DATA SOURCES

$M1$  = Narrow money, which equals currency plus demand deposits (excluding inter-bank items). Millions of Taka at current prices. Unweighted average of three monthly figures. Source: *Economic Indicators of Bangladesh (EIB)*, Bangladesh Bureau of Statistics (BBS).

$M2$  = Broad money, which equals  $M1$  plus time deposits. Millions of Taka at current prices. Unweighted average of three monthly figures. Source: *EIB*, BBS.

$WP$  = Wholesale price index. Unweighted average of three monthly figures. Source: *EIB*, BBS.

$RGNP^p$  = Estimation method has been discussed above. Quarterly real income data have been directly estimated by the author using disaggregated output-income approach. Agricultural income has been estimated by a production function approach, where the annual outputs of 25 crops have been used to allocate annual output into four quarters in a fiscal year. The manufacturing production index, which is available in the *Economic Indicators of Bangladesh*, has been used to allocate the annual manufacturing income into four quarters in a fiscal year. The services sector income has been interpolated quarterly by Gandolfo's (1981) methodology. National income then represents the sum of agricultural income and income from the rest of the economy. The detailed estimation procedure is documented in Hossain (1989).

$PT$  and  $PNT$  = Estimation methods have been discussed above. Sources: Basic data for exports, imports and their price indices are taken from the *Economic Indicators of Bangladesh*.

$PFEB$  = Exchange rate of the Bangladesh Taka with the US Dollar. Unweighted average of three monthly figures. Source: *International Financial Statistics*. International Monetary Fund, Washington, D.C.

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