

Theoretical Aspects of Estimate of Safe Limit of Monetary Expansion

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Determination of safe limit of monetary expansion in a period given the expected growth of real income and the tolerable rate of inflation is one of the main problems faced by the developing countries. To determine the safe limit of monetary expansion it is necessary to estimate a demand function for money which should be stable and possess excellent predictive power. In Bangladesh several studies on money demand function have been made, but none of those studies have dealt with the estimate of safe limit of monetary expansion. An attempt is made in this paper to use naive quantity theory and money demand function of Keynesian type to estimate the safe limit of monetary expansion and evaluate the relative performance of these models in Bangladesh. It is shown that one cannot make any claim about the superiority of one model over the other.

I. Introduction

The Fund-supported adjustment programs are a set of packages of policy measures designed to achieve a viable balance of payments while strengthening the conditions for achieving a satisfactory rate of long-term output growth in a non-inflationary manner. The financial programming approach starts with the accounting identity expressing the change in the money stock as the sum of the changes in its international and domestic components. The second building block of this model is the demand for money which can be specified in a variety of ways, ranging from a relation reflecting a constant income velocity of money to a general function relating the (nominal) demand for money to variables such as domestic income, prices and the opportunity costs of holding money. The final building block is a condition defining flow equilibrium in the money market which implies that the change in the demand for money is equal to the change in the actual supply of money. These three building blocks are combined to yield an expression for the change in net foreign

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assets, in which the balance of payments is given by the difference between the change in the money stock (equal to the change in the nominal demand for money from the equilibrium condition) and the change in the net domestic assets.¹ The demand for money, therefore, plays an important role for formulation of monetary policy in the Fund-supported program.

The objective of this paper is to estimate a money demand function and examine whether the estimated money demand function can be used to fix the target for monetary expansion given the expected change in real output and price. The paper is divided into five sections. Following the introductory section, specification of the money demand function is given in section II. In section III empirical results are discussed. Policy implications are given in section IV and section V ends up with the conclusions.

II. Specification of the Money Demand Function

The typical demand function for real money is specified in the following form :

$$M/P = f(Y, r) \quad (1)$$

where M is the nominal money held by the public, P is the price index used to deflate the nominal money balance, Y is the real GDP and r is the return on alternative financial assets. Thus the demand for real money is a function of real GDP and the opportunity cost of holding real money. For the purpose of estimation, the function can be expressed in linear or in log-linear form. In log-linear form the estimated coefficients of the exogenous variables will be the elasticities of those variables with respect to the demand for real money. Therefore, the demand function is expressed in the following form :

$$\log \left(\frac{M}{P} \right)_t^d = \log a + b \log Y_t + cr_t \quad (2)$$

a, b and c are the constants and to be estimated using relevant data. The signs of b and c are expected to be positive and negative

1. For details of the financial programming approach, see International Monetary Fund (1987), *Theoretical Aspects of the Design of Fund-supported Adjustment Programs*.

respectively. It may be noted that b and c stand for long-run elasticity of income and elasticity of return on alternative financial assets with respect to real money respectively. The superscript represents the desired demand.

Equation (2) explains a long-run desired stock of money which may not be satisfied in a given period of time. It is assumed that actual stock of real balances adjust towards the desired level according to the partial adjustment mechanism of the following form :

$$\log \left(\frac{M}{P} \right)_t - \log \left(\frac{M}{P} \right)_{t-1} = \lambda \left(\log \left(\frac{M}{P} \right)_t^d - \log \left(\frac{M}{P} \right)_{t-1} \right) \quad (3)$$

where λ is the adjustment coefficient, and $0 < \lambda \leq 1$

This implies that the difference between the current actual level of money stock and the past actual level is proportional to the gap between the current desired level of money stock and the past actual level. By substituting equation (2) with negative sign for cr_t into equation (3) the following is obtained.

$$\begin{aligned} \log \left(\frac{M}{P} \right)_t - \log \left(\frac{M}{P} \right)_{t-1} &= \lambda \log a + \lambda b \log Y_t + \lambda cr_t - \lambda \log \left(\frac{M}{P} \right)_{t-1} \\ \text{or, } \log \left(\frac{M}{P} \right)_t &= \lambda \log a + \lambda b \log Y_t + \lambda cr_t + \log \left(\frac{M}{P} \right)_{t-1} - \lambda \log \left(\frac{M}{P} \right)_{t-1} \\ \text{or, } \log \left(\frac{M}{P} \right)_t &= \lambda \log a + \lambda b \log Y_t + \lambda cr_t + (1-\lambda) \log \left(\frac{M}{P} \right)_{t-1} \\ \text{or, } \log \left(\frac{M}{P} \right)_t &= \beta_0 + \beta_1 \log Y_t + \beta_2 r_t + \beta_3 \log \left(\frac{M}{P} \right)_{t-1} \end{aligned} \quad (4)$$

where,

$\beta_0 = \lambda \log a$, $\beta_1 = \lambda b$, $\beta_2 = \lambda c$ and $\beta_3 = (1-\lambda)$, β_1 and β_2 are short-run elasticities

The above represents the short-run demand for money for estimation purpose.

In countries with well developed money and capital markets the nominal yields on reasonably liquid assets which are available as alternatives to money in wealth portfolios are the best measures of the opportunity cost of holding money. In less developed countries, capital or financial markets are narrow or practically non-existent and the interest rate on whatever limited financial assets are available is regulated by the government.

Durable goods, inventories and consumptions are typically the most important alternatives to holding money in less developed countries. Thus the rate of return on such goods, that is, the rate of inflation may be considered in such countries the most relevant, in addition to being the empirically most convenient measure of money's opportunity cost. We have thus used expected rate of inflation, denoted by \dot{p}_t^e , as a measure of the opportunity cost of holding money balances in Bangladesh.

The expected rate of inflation is unobservable, and for our empirical work this unobservable variable is to be transformed into some kind of observable variable. In order to do so it is assumed that the expected rate of inflation is generated by an adaptive expectation model :

$$\dot{p}_t^e = \gamma \dot{p}_{t-1} + (1-\gamma) \dot{p}_{t-1}^e \quad (5)$$

where γ is the coefficient of expectation, and p_{t-1} is the actual rate of inflation with one period lag. Generally the method used in estimating equation (4) is to generate several series of the expected rate of inflation by varying the coefficient of expectation γ . These series are substituted into equation (4) and the series which leads to the highest coefficient of determination in equation (4) is selected to represent the expected rate of inflation. However, for simplicity the rate of inflation with one period lag can be used as a proxy for the expected rate of inflation. This is based on the assumption that the formation of expectation is static, that is, the adjustment coefficient of the adaptive expectation hypothesis is unity. This assumption has been made in many empirical studies. The expected rate of inflation can also be formulated in terms of rational expectation hypothesis. The equation to be estimated is re-written as :

$$\log \left(\frac{M}{P} \right)_t = \beta_0 + \beta_1 \log Y_t + \beta_2 \dot{p}_t^e + \beta_3 \log \left(\frac{M}{P} \right)_{t-1} \quad (6)$$

where β_1 and β_2 are the short-run income and expected inflation elasticities of demand for real money. The long-run elasticities, as mentioned earlier, are b and c . Dividing the estimated value of β_1 and β_2 by the estimated adjustment coefficient we will get the long run elasticities. The equation is estimated using the expected rate of inflation as generated by the adaptive expectation hypothesis with the assumption that the adjustment coefficient is unity.

The money demand functions are estimated with and without lagged dependent variable using both definitions of money as dependent variable. Narrow money, abbreviated as M_1 , is defined as the sum of the currency with the public and demand deposit, and broad money, denoted by M_2 , is defined as the sum of narrow money and time deposits. Money demand function is also specified as nominal money as function of real income and price level, and estimated using the Ordinary Least Squares method. Data used in this study cover the period 1975 through 1987.

III. Empirical Results

Several forms of money demand functions have been estimated, and the results of the estimated equations with real narrow money as the dependent variable are given in Table 1. It can be observed from the results given in Table 1 that all the estimated coefficients are of the expected signs.

Table 1 : Ordinary Least Squares Estimates of Demand Function for Real Narrow Money ($\log M_1/P$)

| Equation Number. | Intercept | $\log \gamma_t$ | \dot{P}_t^e | $\log(M_1/P)_{t-1}$ | \bar{R}^2 | D.W. |
|------------------|---------------------|-------------------|--------------------|---------------------|-------------|------|
| 1. | -8.219 (-1.713) | 1.108 (1.793) | -0.001 (-0.128) | 0.272 (0.796) | 0.84 | 1.42 |
| 2 | -11.724 (-6.277) | 1.568 (7.431) | -0.001 (-0.578) | — | 0.86 | 1.23 |
| 3 | -12.832 (-8.710) | 1.692 (10.107) | — | — | 0.89 | 1.13 |
| 4 | -8.016 (-1.877) | 1.079 (1.982) | — | 0.292 (1.026) | 0.86 | 1.42 |

Note : Figures in the parentheses indicate t = values.

Though all the estimated coefficients are of the expected signs none of the coefficients except the income coefficients is statistically significant. The goodness of fit, as measured by coefficient of determination, \bar{R}^2 , is reasonably good. The results of the estimated equations with real broad money as the dependent variable are given in Table 2. It can be observed from the results given in Table 2 that all the estimated coefficients are of the expected signs.

Table 2 : Ordinary Least Squares Estimates of Demand Function for Real Broad Money (log M_2/P)

| Equation Number. | Intercept | Log γ_t | \dot{P}_t^e | Log(M_2/P) _{t-1} | \bar{R}^2 | D.W. |
|------------------|----------------------|-------------------|--------------------|-------------------------------|-------------|------|
| 1. | -21.934 (-14.810) | 2.811 (16.795) | -0.002 (-1.328) | — | 0.97 | 1.28 |
| 2 | -20.055 (-2.465) | 2.573 (2.503) | -0.001 (-0.946) | 0.081 (0.235) | 0.96 | 1.36 |
| 3 | -22.757 (-18.743) | 2.901 (21.030) | — | — | 0.97 | 1.47 |
| 4 | -16.440 (-2.303) | 2.108 (2.349) | — | 0.251 (0.864) | 0.96 | 1.63 |

Note : Figures in the parentheses indicate t = values.

The coefficients of determination, \bar{R}^2 , in all the estimated equations are over 0.95. The estimated coefficient of real income variable is highly significant. The estimated coefficient of expected rate of inflation is not significant at 5 percent level.

If we compare the results given in Table 1 with those in Table 2 it can be observed that the goodness of fit is good in the case of equations with both real broad money and real narrow money as dependent variables but it is better for the equation with real broad money as dependent variable than for that with narrow money as the dependent variable. As a matter of fact, the coefficient of determination, that is \bar{R}^2 which is an indicator of the goodness of fit, is as high as 0.95 to 0.97 in the case of estimated equations with real broad money as dependent variable as against 0.84 to 0.89 in the estimated equations with real narrow money as dependent variable. This implies that over 95 percent of the variation in real broad money can be explained in the model.

The equations are estimated in real terms assuming absence of money illusion. In many studies, demand function is specified in nominal terms. We have also estimated demand functions in nominal terms using both definitions of money. The estimated equations for narrow and broad money are given in Table 3. From the results given in Table 3 it is observed that income elasticity of demand for nominal broad money is greater than 3. All the estimated coefficients are statistically significant. The coefficient of price variable in case of broad money equation is not

significantly different from unity. The goodness of fit of the equations as measured by \bar{R}^2 is very good.

Table 3 : Ordinary Least Squares Estimates of Nominal Money

| Dependent Variable | Intercept | logY | log P | \bar{R}^2 | D.W. |
|--------------------|--------------------|-----------------|-----------------|-------------|------|
| log M ₁ | -20.264 (-4.67) | 2.797 (4.23) | 0.587 (2.56) | 0.98 | 1.22 |
| log M ₂ | -25.907 (-6.51) | 3.370 (5.81) | 0.825 (3.91) | 0.99 | 1.57 |

Note : Figures in the parentheses indicate t-values.

IV. Policy Implications

Many developing countries determine the "safe limit of monetary expansion" on the basis of simple money demand function which expresses that the demand for money is proportional to nominal income, i.e.,

$$M = KPY$$

where K is the inverse of income velocity of money, and Y is the real income.

Denoting $K = \frac{1}{V}$, and rewriting the equation, we get,

$$M = \frac{1}{V} \cdot PY$$

$$MV = PY \quad (6)$$

where, P is the price index, Y is the real income and V is the income velocity.

The above equation can be expressed in terms of growth as follows :

$$\dot{M} + \dot{V} = \dot{P} + \dot{Y} \quad (7)$$

Introducing time variable t , we may write equation (6) as $MV = P_t Y_t$; This t , equation is valid for any time period. Thus t ,

$$M_{t+1} V_{t+1} = P_{t+1} Y_{t+1}$$

$$\text{or, } M_t (1+\dot{M}) V_t (1+\dot{V}) = P_t (1+\dot{P}) (1+\dot{Y}) Y_t$$

$$\text{or, } (1+\dot{M}) (1+\dot{V}) = (1+\dot{P}) (1+\dot{Y}) \quad (8)$$

Where dot over a variable represents rate of growth of the variable.

If income velocity of money is assumed constant in the short-run, then the safe limit of monetary expansion, according to equation 7, is equal to the sum of the rate of inflation and the growth of real income. In Bangladesh, the safe limit of monetary expansion is determined on the basis of tolerable (expected) rate of inflation and the expected change of real income (some assumption about the change of income velocity or rate of monetization is also made). The safe limit of monetary expansion determined by the monetary authorities is given in Table 4. The implicit changes in income velocity of money according to equation 7 and 8 are also given in Table 4.

The estimates of safe limit of monetary expansion on the basis of actual inflation rate and growth of real income and the theoretical formulation discussed earlier are given in table 5. It can be observed from Table 5 that the estimated money demand functions provide better estimates of monetary expansion in each of the first three years, while the quantity theory formulation yields better results in each of the last three years. Therefore, it is not possible to make any recommendation about the form of money demand function to be used for formulation of monetary policy in Bangladesh. One of the main problems of using money demand function for estimate of safe limit of monetary expansion is the instability of money demand function. As a crude measure, one can use the quantity theory of money as the theoretical basis and make certain assumptions about the movement of income velocity of money on the basis of its recent trend and estimate the safe limit of monetary expansion.

Table 4 : Estimate of Safe Limit of Monetary Expansion Using the Quantity Theory Approach (Figures are in Percentage)

| Peroid | \dot{P}_t^e | \dot{Y}_t^e | \dot{M}_t^P | \dot{V}_1 | \dot{V}_2 |
|---------|---------------|---------------|---------------|-------------|-------------|
| 1976-77 | 7.0 | 5.5 | 13.5 | -1.0 | -0.5 |
| 1977-78 | 11.0 | 8.0 | 15.5 | 3.5 | 3.8 |
| 1978-79 | 5.0 | 5.5 | 10.5 | 0.0 | 0.2 |
| 1979-80 | 9.0 | 5.5 | 14.5 | 0.0 | 0.4 |
| 1980-81 | 5.0 | 7.1 | 12.1 | 0.0 | 0.3 |
| 1981-82 | 10.0 | 7.0 | 17.0 | 0.0 | 0.6 |
| 1982-83 | 13.0 | 6.0 | 19.0 | 0.0 | 0.7 |
| 1983-84 | 12.0 | 6.7 | 18.7 | 0.0 | 0.7 |
| 1984-85 | 12.0 | 5.5 | 16.5 | -1.0 | 1.4 |
| 1985-86 | 10.0 | 5.5 | 15.9 | 0.4 | 0.1 |
| 1986-87 | 10.0 | 5.7 | 15.7 | 0.0 | 0.5 |

Note :

 \dot{P}_t^e = Assumed rate of inflation. \dot{Y}_t^e = Expected growth of real income. \dot{M}_t^P = Estimated growth of money supply. \dot{V}_1 = Implicit growth of income velocity according to equation 7. \dot{V}_2 = Implicit growth of income velocity according to equation 8.

Table 5 : Estimated Monetary Expansion (Figures are in Percentage)

| Period | Actual Monetary Expansion | Rate of Inflation | Growth of Real Income | Estimated Monetary Expansion using Nominal Demand | Estimated Monetary Expansion using Real Demand Function(3) | Estimated Monetary Expansion using Equation (7) | Estimated Monetary Expansion using Equation (8) |
|---------|---------------------------|-------------------|-----------------------|---|--|---|---|
| 1981-82 | 29.67 | 16.29 | 1.4 | 18.15 | 20.35 | 18.69 | 17.21 |
| 1982-83 | 42.17 | 9.93 | 3.4 | 19.65 | 19.79 | 13.33 | 12.88 |
| 1983-84 | 25.62 | 9.67 | 4.2 | 22.13 | 21.85 | 13.87 | 13.48 |
| 1984-85 | 17.12 | 10.94 | 3.9 | 22.17 | 22.25 | 13.84 | 13.67 |
| 1985-86 | 16.33 | 9.95 | 4.4 | 23.04 | 22.71 | 14.35 | 14.67 |
| 1986-87 | 16.09 | 10.35 | 3.9 | 21.67 | 21.66 | 14.25 | 14.08 |

V. Conclusions

Estimates of safe limit of monetary expansion given the expected growth of real income and the rate of inflation have been made, using the naive quantity theory and the money demand function of Keynesian type. It is shown that one cannot make any claim about the superiority of one model over the other. One of the main reasons for uncertainty about the predictive performance of these models is the instability of income velocity of money. The monetary authorities in Bangladesh can, therefore, adopt either of the two approaches for formulation of monetary policy. They can use the quantity theory framework and estimate the safe limit of monetary expansion on the basis of assumption made by taking into consideration the recent movement of income velocity of money. Alternatively they can use the money demand function of Keynesian type estimated by using the latest available data and make projection of the monetary aggregates.

References

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