Money Multiplier As a Determinant of Money Supply: The Case of Pakistan

S.M. MAZAHIR HASNAIN HAMDANI*

Introduction

Monetary policy is an important instrument for pursuing growth and stability in a less developed economy. However, it can yield desired results if and only if it is judiciously formulated and properly implemented. An appropriate formulation of monetary policy requires two basic relations to hold: (1) the demand function for money must be reasonably stable and empirically available to the monetary authorities and (2) the stock of money must be subject to control by the monetary authorities and the mechanism through which money supply is quantitatively determined in an economy should be clear to the policy-makers.

In an economy where the banking structure is a developed one, money supply is determined not only by the central bank, but also by commercial banks which create deposits. The behaviour of commercial banks is crucial to the estimation of the likely magnitude of total money supply in the economy. Since creation of deposits depends on reserves, the minimum reserve requirements as stipulated by the central bank, prevailing interest rate and many other factors—all changing overtime—there is need to estimate the relationship between total money supply inclusive of deposits and the monetary base in an economy.

In Pakistan, more attention has been paid to the demand side of money [1,2,10]. However, the supply side of money seems to have been more or less neglected, the only exception being R.C. Porter's study [12]. No attempt has been made to relate Pakistan's monetary base to money supply inclusive of

*Mr. Hamdani is a Staff Economist at the Pakistan Institute of Development Economics (PIDE), Islamabad. He is highly grateful to A.R. Kemal, Research Economist, PIDE, for his valuable guidance from the commencement to the completion of the paper. He is also indebted to Sarfraz Khan Qureshi, Chief of Research, PIDE, who made certain useful comments on the earlier draft of the paper. Thanks are also due to Sheikh Zahid Saeed, Malik Mohammad Ashraf and Sabur Ghayur, for their friendly discussions and assistance in the paper. However, responsibility for any errors or omissions, rests with the author alone.

deposits. Money multipliers have been extensively used in the United States to estimate this very relation [3,5,9]. Recently, Oyejide [11] has estimated this relationship for Nigeria. In this paper, an attempt will be made to estimate the relationship between money supply and the monetary base in Pakistan. Section I briefly discusses money multipliers; section II presents the results; and section III concludes the paper.

I. Money Multiplier in the Static and Dynamic Monetary Base Models

Money multiplier relates money supply to monetary base i.e.

$$M_1 = m_1 . B_1 \quad (1)$$

where money supply (M_1) is defined as,

$$M_1 = C+PDD+PTD+GDD \quad (2)$$

C = Currency,
PDD = Private demand deposits,
PTD = Private time deposits,
GDD = Government demand deposits,

and monetary base (B_1) is defined as

$$B_1 = C+BR \quad (3)$$

BR = Bank reserves,
m_1 is the money multiplier.

Thus, if monetary base and the money multiplier are known in an economy, one can determine the stock of money. It has been shown [3,4,9], that

$$m_1 = \frac{(1+d+t+k)}{[r(1+d+t)+k]} \quad (4)$$

where $k = \frac{C}{PDD}$

$d = \frac{GDD}{PDD}$

$t = \frac{PTD}{PDD}$

$r = \frac{BR}{D}$

and $D = PDD+PTD+GDD$

As can be seen from equation (4), m_1 reflects both the behaviour of commercial banks which can change the ratio of reserves to deposits and the behaviour of public as it can change ratio of deposit to currency. Since the multiplier is affected by the behaviour of commercial banks and the public, they are not, in general, expected to be constant. Thus, it is argued that the money multipliers cannot be used to determine the stock of money.[1] Moreover, multiplier is not unique at a point of time. Since the value of money multiplier depends on the choice of definition of money supply, the resultant multipliers will vary with different measures of money supply.

[1]For criticism of money multiplier approach along these lines, see [6, 7].

The objection that multipliers are static, not useful for prediction, may be overcome by introducing dynamic elements in the model. The dynamic model [3,4,9], has been recently applied to Nigerian economy by Oyejide [11], a summary view of which follows. Another objection relates to a general question: what should be included in money stock? This is essentially an empirical question and should be treated empirically.

The dynamic model is given thus,

$$M_t = m_o + m_1 . B_t^* \qquad (5)$$

where B_t^* is the desired or expected value of monetary base at time-period "t". B_t^* is not directly observable and hence a partial adjustment mechanism relating actual to desired value is postulated as,

$$B_t^* = (1-b) B_t + b_o B_{t-1}^*; \quad 0<b<1 \qquad (6)$$

by substituting (6) into (5), it can be shown that:

$$M_t = a_o + a_1 B_t + a_2 M_{t-1} \qquad (7)$$

where $a_o = m_o (1-b)$

$a_1 = m_1 (1-b)$

and $a_2 = b$

Similarly, expectations and a partial adjustment mechanism could be introduced into the components of monetary base by postulating,

$$C_t = c . D_t^* \qquad (8)$$

$$R_t = r_o + r_1 D_t^* \qquad (9)$$

and $$D_t^* = (1-d) D_t + d D_{t-1}^* \qquad (10)$$

It can be shown that

$$M_t = b_o + b_1 B_t + b_2 R_{t-1} + b_3 C_{t-1} \qquad (11)$$

where $$b_o = \frac{r_o (d-1-c-cd^2-2cd)}{(r_1+c)(1-d)}$$

$$b_1 = \frac{(1+c-cd)}{(r_1+c)(1-d)}$$

$$b_2 = \frac{r_1 (cd-c-1)}{(r_1+c)(1-d)}$$

$$b_3 = \frac{c (r_1-r_1 d-1)}{(r_1+c)(1-d)}$$

and D_t^* = is the expected or desired value of deposits.

II. Estimation of Money Multipliers in Pakistan

From the above discussion, it is clear that money multiplier models can be modified to take into account expectations and lags in adjustment. Six relations are postulated, three with each definition of monetary base. They correspond to equations (1), (7) and (11).

$$M_t = F_1(B_{1t}) \quad (1,a)$$
$$M_t = F_2(B_{2t}) \quad (1,b)$$
$$M_t = F_3(B_{1t}, M_{t-1}) \quad (7,a)$$
$$M_t = F_4(B_{2t}, M_{t-1}) \quad (7,b)$$
$$M_t = F_5(B_{1t}, R_{t-1}, C_{t-1}) \quad (11,a)$$
$$M_t = F_6(B_{2t}, R_{t-1}, C_{t-1}) \quad (11,b)$$

where M_t = C+D
B_{1t} = C+BR
B_{2t} = B_{1t}+TB
and TB = Treasury bills.

Since quarterly data is used here and money supply is expected to be affected seasonally due to the predominance of agriculture in the economy, we have used three seasonal dummy variables to abstract seasonality effect from the impact of other explanatory variables. The data have been taken from State Bank of Pakistan's Bulletins and cover the period 1972-74. The results are given in Table 1.

As may be observed from Table 1, the signs of coefficients relating to B_{1t}, M_{t-1}, R_{t-1} and C_{t-1} are as expected. The negative sign of C_{t-1} may seem improper at first sight but the structure of model leads to negative sign of C_{t-1}. Except for dummy variables, all the co-efficients are statistically significant at five percent level. Barring last two equations, dummy variables are statistically insignificant. S_2 pertains to the second quarter for the period April-June, in which economic activity increases and there is a need for more liquidity. The bank response through creating deposits raises money supply. S_2 has (expected) positive and statistically significant sign in the last two regressions. Adjusted R^2 is very high implying that there are no left-out variables.

In the first dynamic model where partial adjustment mechanism is introduced directly into the monetary base, the regression co-efficients are not statistically significant. This may be due to multi-collinearity problem. The data suffered from serial correlation and thus an auto-regressive model of first degree has been used to estimate the coefficients in the first two and the last two regressions. It is noticeable that a model incorporating expectations and partial adjustment gives a much better fit than the other, since $\bar{R}^2$ increases from 0.59 to 0.99.

To assess the predictive power of the models, prediction errors have been calculated. The second dynamic model where partial adjustment mechanism is incorporated into the components of base-money, has the least prediction error and thus, in general, is preferable to the other two formulations. Similarly, percentage deviation between predicted and actual values of money supply is very low for this model. Using the model, money supply for the first quarter of 1975 is predicted. It is found that the predicted value is not statistically different from the observed value. Table 2 epresents prediction variances and percentage deviations.

Table 1

Estimated Relations between Money Supply and the Monetary Base in Pakistan (*Continued*)

Equation	Constant Terms	Independent				
		B_{1t}	B_{2t}	M_{t-1}	R_{t-1}	C_{t-1}
(1, a)	634.62	+1.33 (3.50)	—	—	—	—
(1, b)	430.76	—	+1.68 (3.46)	—	—	—
(7, a)	613.64	+0.14 (0.09)	—	+0.78 (1.27)	—	—
(7, b)	554.44	—	—0.35 (—0.32)	+1.0 (1.87)	—	—
(11, a)	728.79	+3.05 (7.47)	—	—	+8.55 (4.66)	—2.06 (—6.20)
(11, b)	1292.41	—	+2.35 (5.43)	—	10.73 (4.88)	—2.12 (—4.51)

Variables						
	S_1	S_2	S_3	$\bar{R}^2$	F	D.W.
	—24.39 (—0.41)	+20.52 (—0.28)	—38.14 (—0.59)	0.59	4.14	1.92
	—45.24 (—0.88)	—6.57 (—0.11)	—1.37 (—0.02)	0.61	4.41	1.85
	—50.78 (—0.56)	—127.59 (—0.91)	—125.35 (—0.84)	0.88	14.11	1.46
	—55.19 (—0.60)	—174.97 (—1.18)	—160.35 (—1.36)	0.88	14.34	1.73
	+30.49 (+0.43)	+249.78 (4.95)	+128.40 (1.66)	0.99	165.55	1.42
	+61.14 (0.73)	+318.45 (4.15)	+48.30 (0.55)	0.98	92.37	1.63

"t" statistics are given in parentheses.

Table 2

Prediction Variances and Percentage Deviations

Sub-equations \ Equations		1	7	11
a	Variances	33,384	120,656	29,023
	% Deviations	4.82	4.24	0.91
b	Variances	39,743	116,431	41,952
	% Deviations	6.62	5.79	1.91

III. Conclusions

This paper has estimated the functional relationship between money supply and the monetary base in Pakistan. Equations incorporating expectations and an adjustment mechanism as to how expectations are revised in the light of realized expectations provide an extremely good fit to the data.

Monetary authorities exercise control over the monetary base. The regression equations presented here can be used to estimate the stock of money when the monetary base has been determined by the monetary authorities. This is an important information for use by the policy makers. If optimal money supply consistent with developmental objectives is known, the estimated equations would help the authorities generate the volume of monetary base consistent with the already known level of optimal money supply.

References

1. Abe, Fry *et al.*, "The Demand for Money in Pakistan: Some Alternative Estimates." *Pakistan Development Review*. Summer 1975.

2. Akhtar, M.A. "The Demand for Money in Pakistan." *Pakistan Development Review*. Spring 1974.

3. Anderson, Leonall C. "Three Approaches to Money Sotck Determination." *Review of Federal Reserve Bank of St. Louis*. August 1968.

4. Burger, A.E. *The Money Supply Processes*. California: Wadsworth, 1971.

5. Cagan, Phillip. *Determinants and Effects of Changes in the Stock of Money*, 1875-1960. Princeton: University Press, 1965.

6. Gibson and Kaufman: *Monetary Economics. Readings on Current Issues*. New York; McGrawhill, 1971.

7. Johnson, Harry G. "Monetary Theory and Policy" in his *Essays in Monetary Economics*. II Edition. London: Allen and Unwin, 1969.

8. Johnston, J. *Econometric Methods.* II Edition. Tokyo: McGraw-hill, 1972.

9. Jordon, Jerry L. "Elements of Money Stock Determination." ***Review of Federal Reserve Bank of St. Loius***, October 1969.

10. Khan, Muhammad Zubair. "Income Velocity of Money: A Case Study of Pakistan." *Pakistan Development Review.* Summer 1974.

11. Oyejide, T.A. "Controlling Money Supply in Less Developed Countries: The Case of Nigeria." *The Bangladesh Development Studies.* July 1974.

12. Porter, R.C. *Liquidity and Lending: The Volume of Bank Credit in Pakistan.* Pakistan Institute of Development Economics. Monograph No. 10. March 1963.