

A Simultaneous Model for the Demand for Money in Bangladesh

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Abstract: This study considers a simultaneous model that represents interrelationship between nominal money and real output. The money demand equation includes wholesale price index of agricultural products, exchange rate, and volume of real output. The output model, on the other hand, considers a dichotomous variable representing the volume of aid of the affluent countries (higher or lower than commitment), investment volume and nominal money. The OLS and 2SLS estimation methods have been used to obtain the parameters of the model. The estimated results suggest that the simultaneous equation model in the present case fits the data reasonably well.

1. Introduction

The monetary authorities are often concerned to determine the rate of growth of money supply in the country. The rate of growth in money supply should be in conformity with the growth of output due to increase of acceptable price level. This induces the estimation of demand function for money to determine the appropriate rate of growth in money supply.

This study tests the stability of the demand function for the recent time period (1975-2005) using a simultaneous equation approach first proposed by Haavelmo (1943, 1944) which gained wide acceptance in economic research in the mid 50's. Further explanation about simultaneous equation may be seen in the Rothenberg (1987).

In this research it is attempted to estimate the parameters of a simultaneous money demand model for Bangladesh. Section 2 discusses the justification of variables in the model. Data and its limitations are discussed in Section 3. Section 4 contains the model specification while Section 5 includes estimation of the models, and in Section 6 the results are discussed. Finally, the paper ends with a conclusion.

2. The Model Variables

Many researchers have estimated money demand model for different economies in different points in time. These are Hossain (1986), Taslim (1983), Murty & Murty (1978), Ahluwalia (1979), Gupta (1979), Pandit (1984) taking into consideration the different combinations of economic and financial variables as regressors.

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This study incorporates exchange rate, investment volume, gross domestic product, stock of nominal narrow and broad money, growth of whole sale price index of agricultural products, and a dichotomous variable representing the influx of total aid higher or lower than committed amount by the donor countries. The reasons behind the inclusion of these variables are: It is observed that a significant amount of foreign currency is entering into the country in different years, which is earned by the migrant workers. The influx of foreign currency towards the country influences the investment initiatives of the country. The Bangladesh economy is mostly agrarian with 63.2% as labor force. The output of these sectors works as input in many ways for the other two broad sectors. Its price and volume induce the overall gross domestic product through different investment profiles. The representative measure of the price of this sector is the wholesale price index (WPI). The growth rate of WPI is used in the present study.

The Keynesian economics agrees that the economic growth for a reference period improves with the government intervention at all levels of the country. The Bangladesh government has tax constraints, and so it faces problems of financing new development projects. If the volume of tax earning is not large enough to carry on its obligatory development program, the government seeks assistance from the affluent countries, to keep up the development work, which is based on project aid. The government gets commitment for different types of aids or grants. Often the disbursements fall shorter than commitments. In the history of Bangladesh during the years 1975-2005 there are 25 (Flow of fund; Publication of planning commission) cycles, where disbursement on project loan fell shorter than commitment. This situation mostly results in sub-performance of the sectors of the economy concerned. The downsize of output for a single period results in downsize of output cumulatively for the successive periods.

3. The Data

The data on different economic series such as GDP, investment and financial series such as, growth in the wholesale price index of agricultural products (WPI) have been collected from the publication of Bangladesh Bureau of Statistics. However, the data of nominal narrow money (M1), nominal broad money (M2), were collected from the publications of Bangladesh Bank. The exchange rate data, position of ODA (Overseas Development Administration) loan to total loan for project development were collected from the Flow of External Resources into Bangladesh and Bangladesh Economic Review, published by the Ministry of Finance, Government of Bangladesh. The data for the period 1975-2005 were used for the estimation of the model. For reasons of stationarity, Kenedy

(1985) suggested to use the natural logarithmic transformation of GDP, investment, M1, M2 and exchange rate series in the analysis.

4. The Model

$$\ln(Mi)_t = \beta_1 + \beta_2 \ln(Y)_t + \beta_3 WPI_t + \beta_4 \ln(ER)_t + u_t$$

$$i = 1, 2$$

$$\ln(Y)_t = \gamma_1 + \gamma_2 \ln(Mi)_t + \gamma_3 \ln I_t + \gamma_4 d_t + U_t$$

$$i = 1, 2$$

Where,

$\ln(M)_t$ = natural logarithm of stock of nominal money aggregates,

$\ln(Y)_t$ = natural logarithm of annual real income,

WPI_t = percentage change in the wholesale price index of agricultural products,

$\ln(ER)_t$ = natural logarithm of annual exchange rate,

$\ln I_t$ = natural logarithm of annual volume of investment,

$d_t = 1$, if disbursement of ODA loan for project development is higher than commitment,

= 0, otherwise,

β, γ are parameters,

u 's = stochastic disturbance terms with the basic assumptions which are as follows:

(i) u_t is normally distributed (ii) $E(u_t) = 0$, (iii) $E(u_t^2) = \sigma_u^2$, (iv) $E(u_t u_j) = 0, t \neq j$

5. Estimation of the model

The specified money demand and output models in question seem to be interdependent. To ascertain whether the endogenous regressors are interdependent with each other, test of simultaneity has been done. In this regard, prior information about the possibilities of expected solution is required to be determined. Hausman (1976) developed a specification which was used by Durbin and Nakamura (1981) for testing the relationship among several specification errors. It is to note that the Hausman test is applicable on exactly identified equation(s). But, both the specifications under the present study were over-identified. Therefore the two-stage-least-squares (2SLS) method developed by Theil (1953) and Basman (1957) has been used here which dealt with over-identified model(s).

The test procedure for testing the null hypothesis of the gross domestic product has no effect on narrow money or broad money. The test is performed following the steps of estimations.

Step I: Regress gross domestic product (GDP) on all other predetermined variables in the system and estimate GDP.

Step II: Regress nominal narrow money and broad money on the predicted series of GDP estimated by applying step I and test the coefficient of GDP at 5% level of significance. The results of the OLS estimation for step I and step II are given below:

Results of step I

$\ln(Y)_t$	= 1.418	+ 0.0006 d_t	+ 0.241 $\ln(ER)_t$	+ 0.480 $\ln I_t$	+ 0.0008 WPI_t
t	= 7.087	0.057	2.807	4.903	1.817
p	= (0.000)	(0.955)	(0.011)	(0.000)	(0.085)
R^2	= 0.860	DW =	2.180	F(4,23) =	28.103
					(0.000)

Results of step II

$\ln(\hat{M}1)_t$	= -8.360 + 2.506 $\ln(\hat{Y})_t$	$\ln(\hat{M}2)_t$	= -5.030 + 3.446 $\ln(\hat{Y})_t$
t	= -7.683 17.478	t	= -10.267 18.780
p	= (0.000) (0.000)	p	= (0.000) (0.000)
R^2	= 0.930, DW = 1.274	R^2	= 0.941, DW = 2.379

The estimated value of the coefficient of $\ln(Y)_t$ in case of nominal narrow money (M1) and broad money (M2) are highly significant. Hence, we may reject the null hypothesis that the gross domestic product has no effect on money demand function for Bangladesh.

Thus, it is established that the money demand function and the output function are interdependent. When simultaneity is explicitly taken into account, the real income variable becomes less significant with narrow money than broad money. The parameters of the interrelated money demand and output model are estimated by using the 2SLS technique.

Table 1 presents the results of the estimated parameters.

Table 1: The two-stage least squares (2SLS) estimates of the model equations

Variables	Dependent Variables			
	$\ln(M1)_t$ Eq.(1.4.1 at i=1)	$\ln(M2)_t$ Eq.(1.4.1 at i=2)	$\ln(y)_t$ Eq.(1.4.2 at i=1)	$\ln(y)_t$ Eq.(1.4.2 at i=2)
Constant	-30.889	-41.126	1.426	1.487
t	4.197	-6.447	6.872	6.533
p	(0.000)	(0.000)	(0.000)	(0.000)
d_t	-	-	-0.034	-0.005
t	-	-	-2.280	-0.433
p	-	-	(0.000)	(0.670)
WPI_t	-0.003	-0.005	-	-
t	-1.429	-2.287	-	-
p	(0.168)	(0.033)	-	-
$\ln I_t$	-	-	0.297	0.320
t	-	-	2.110	2.259
p	-	-	(0.048)	(0.035)
$\ln(ER)_t$	0.201	0.304	-	-
t	0.446	0.779	-	-
p	(0.660)	(0.445)	-	-
$\ln(Y)_t$	3.154	3.991	-	-
t	4.197	6.768	-	-
p	(0.000)	(0.000)	-	-
$\ln(M1)$	-	-	0.229	-
t	-	-	3.294	-
p	-	-	(0.004)	-
$\ln(M2)$	-	-	0.160	-
t	-	-	-	3.112
p	-	-	-	(0.005)
R^2	0.983	0.992	0.840	0.834
Adjusted R^2	0.980	0.990	0.816	0.809
F(3,20)	-	-	34.940	33.467
	-	-	(0.000)	(0.000)
F(3,21)	394.400	872.520	-	-
	(0.000)	(0.000)	-	-
FPE	0.022	0.016	-	-
AIC	0.022	0.016	-6.823	-7.458
BIC	0.027	0.020	-6.632	-7.655
Mallow's CP	4.000	4.000	4.000	4.000
DW	1.501	2.274	2.194	2.291

Note: Values in the parentheses are the corresponding p values.

6. Results and discussion

The results obtained for different model equations are explained in this section.

- (i) The estimated real output has shown positive and significant relationship for nominal narrow money. However, the price level of agricultural products shows negative and insignificant effect. This indicates that the increase in output and the depreciation of the local currency will increase the demand for nominal narrow money, while with the increase of the price level of agricultural products the demand for nominal narrow money decreases.
- (ii) The output and the growth rate in the WPI indicate significant relationship in the demand function for nominal broad money. However, the price level of agricultural products shows negative and significant effect. This indicates that the increase in the output level increases the demand for nominal broad money. On the other hand, the demand for nominal broad money decreases significantly at the increase of WPI.
- (iii) The nominal narrow money, investment volume and the ODA loan to total loan (when disbursement is higher than commitment) influence the real output significantly. But, the incidences of inflow of ODA loans to total loan (when disbursement is higher than commitment) influence the output negatively and significantly. On the other hand, the nominal broad money and the investment volume influence the output positively and significantly. In this case, the dichotomous variable, d_t , is showing positive but insignificant relationship in the output model.

7. Conclusion

- (i) The demand function for nominal narrow money and the nominal broad money delineate high level of coefficients of determination. The variables WPI, $\ln(ER)$ and the estimated output have significant joint influence in the demand functions. These two-demand functions are compared according to the estimated values of the criteria such as AIC, BIC, FPE, and Mallow's C_p criteria. The estimated values of these criteria suggest that the demand for nominal broad money is more stable than the demand function for nominal narrow money at the influence of other predictors in the system.
- (ii) Two output models are also estimated on nominal narrow money and nominal broad money. These two models, likewise, show very strong degree of determination. They are compared according to the minimum values of the criteria AIC, BIC and Mallow's C_p . The estimated values of these criteria suggest that the real output model with nominal broad money is more stable.

- (iii) The recorded values of dichotomous variable (d_t) are found to take value 1 during the years 1986/87, 1990/91, 1992/93, 1994/95 and 1996/97. These are the years of natural calamities, which take huge number of lives, tress and upset production and infrastructures. This indicates influx of ODA loan for project development which, of course, never equaled the line of commitment. It resulted in sub-performance of the economy as a whole.

Policy implications

In order to develop the stable monetary policy and fiscal policy the wholesale price index of agricultural products, exchange rate, investment volume, the ratio of ODA loan for project development need to be taken proper care of.

8. References

1. Ahluwalia, I.J. 1979. Behavior of Prices and Output in India: A Macro-economic Approach. *Macmillan Company of India*.
2. Basmann, R.L. 1957. A Generalized Classical Method of Linear Estimation of Co-efficient in a Structural Equation, *Econometrica*, **25**: 77-89
3. Durbin, Wu and Hausman 1981. On the Relationship Among Several Specification Error Tests, *Econometrica*, **49**: 1583-1588.
4. Gupta, S.B. 1979. Monetary Planning for India, *Oxford University Press*.
5. Gujarati, Damodar N. 1995. *Basic Econometrics*. McGraw-Hill, Inc, New York, 663-705.
6. Haavelmo, T. 1943. "The Statistical Implications of a System of Simultaneous Equation", *Econometrica*, **11**: 1-12.
7. Hossain, M.A. 1986. "The Short-Run Demand for Real Money Balance in Bangladesh Economy," A Theoretical and Empirical Analysis, *Discussion Paper, 8/86, School of Economics, La Trobe University, Australia*.
8. Hausman, J.A. 1976. Specification Tests in Econometrics, *Econometrica*, **46**: 1251-1271.
9. Kennedy, P. 1985. A Guide to Econometrics, 2nd Edition, *The MIT Press*, Cambridge. p.156.
10. Maddala, G.S. 1992. Introduction to Econometrics, Macmillan, 2nd ed., New York. Pp.389-395.
11. Murty & Murty 1978. The Functional Form of the Demand for Money in Bangladesh, *The Bangladesh Development Studies*, **6**: 443-460.
12. Pandit, V. 1984. Macro-Economics Adjustments in a Developing Economy: A medium Term Model of Output and Prices in India, *Indian Economic Review*.
13. Rothenberg, T.J. 1987. "Simultaneous Equation Models," in the New Palgrave: A Directory of Economics, New York, *Stockton Press*: 344-347.
14. Taslim, M. 1983. "Aid-Elasticity of Demand for Money in Bangladesh, *Indian Economic Review*, **18**(2): 285-291.
15. Theil, Henri. 1953 (Mimeographed). Repeated Least-Squares Applied to Complete Equation Systems, The Hague, *The Central Planning Bureau*.