

## Permanent Income, Inflation Expectations and the Money Demand Function in Developing Countries

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Using the Adaptive Expectations Model and the method of minimising quadratic loss function this paper explores the relevant scale and opportunity cost variables in the money demand function of six developing countries of Asia. It is found that substitution of permanent income for measured income and of expected inflation for actual inflation does not generally improve the estimates of money demand function. Furthermore, the demand for money is found to be sensitive to changes in interest rate for some countries.

### I. INTRODUCTION

Changes in money stock are important in determining the course of economic events. A firm understanding of the money-demand function is central to the conduct of a fruitful monetary policy; for the money-demand function shows the economy's capacity to absorb increases in money supply.

Keeping in view its importance, considerable effort has been made to verify empirically the significance of the various arguments of the money-demand function. Various studies have examined such issues as the appropriate definition of money (narrow or broad), the relevant scale variable (measured or permanent income or wealth) and the variable that represents the opportunity cost of holding money; see, for instance, [1], [10], [16] and [20]. However, a number of issues still remain to be resolved, especially when dealing with developing countries. For example, it has been accepted that permanent income is the appropriate scale variable in the

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developed economies [10; 20], while in the developing economies this argument remains inconclusive. Khan [16], Laumas and Laumas [21], Adekunle [1], Mammen [23] and Liu and Fan [22] have all found that the permanent and measured income elasticities are very close to each other. They argue that in developing economies permanent income can be substituted for measured income. On the other hand, Fry [9] and Mangla [24] estimated money-demand function for ten less developed Asian countries and Pakistan respectively and found permanent income a better scale variable than measured income.

Another important influence on the demand-for-money function is that of inflationary expectations which play a major role in a situation characterized by high inflation rate and a greater variability of inflation [6; 17]. The influence of inflationary expectations on money demand has received due attention in Latin American countries [25]. For Asian countries, Fry [9] found that the substitution of expected inflation for actual inflation improved the results considerably.

Another issue which needs to be examined is that of the effect of interest rate on the demand-for-money function. In the standard money-demand function, interest rate(s) and income (permanent or measured) appear as arguments. In developed countries, the question hinges on determining which interest rate represents the true opportunity cost of holding money.<sup>1</sup> By contrast, the question in developing countries is whether interest rate or the expected rate of inflation represents the true opportunity cost of holding money. Various authors like Aghevli *et al.* [2], M. Khan [19] and Wong [30] argue that because of the relatively thin and controlled money market where interest rates are not determined by the free play of the market, interest rate does not represent the true opportunity cost of holding money. They, therefore, argue that in developing countries substitution takes place not between money and financial assets but between money and goods. Appropriate opportunity cost would, therefore, be the expected rate of inflation and not the rate of interest. On the other hand, Khan [16] and Gupta [11] found that interest rate did have a significant impact on money holding in Pakistan and India respectively. The sensitivity of the money demand to changes in interest rate in developing countries is an empirical issue, which it is difficult to decide on *a priori* grounds.

This somewhat unsettled 'state of the art' with respect to the developing countries gives us enough justification to embark on yet another empirical effort to examine the issues relating to the money-demand function for developing countries. The period chosen for analysis is 1960-78.

In Section II, we specify the function to be estimated and discuss methodological issues and data problems. The regression results are reported in Section III. The policy implications that arise from the analysis are presented in Section IV. Section V contains a brief summary of the major results and conclusions.

<sup>1</sup>The opportunity cost is measured here in terms of the interest income forgone.

## II. METHODOLOGY

According to standard practice, income and interest rate are used as arguments of the money-demand function which is given as

$$m_t^d = \alpha + \beta Y_t + \gamma R_t \quad \dots \quad (1)$$

where  $m_t^d$  is the real money stock demanded at time  $t$ , while  $Y_t$  and  $R_t$  are, respectively, real income and interest rate. Various authors have used expected rate of inflation instead of interest rate in money-demand function [2; 19]. Equation (1) is then modified to include expected rate of inflation as

$$m_t^d = \alpha + \beta Y_t + \gamma \dot{P}_t \quad \dots \quad (2)$$

where  $\dot{P}_t$  is actual inflation rate. In equation (2) we assume static expectations, i.e. actual and expected inflation are equal in time  $t$ . In order to examine the issues of permanent income and inflationary expectations, equation (2) is modified further as

$$m_t^d = \alpha + \beta Y_t^p + \gamma \dot{P}_t^e \quad \dots \quad (3)$$

where  $Y_t^p$  and  $\dot{P}_t^e$  are respectively real permanent income and expected rate of inflation in time  $t$ . In the estimation of equation (3), one problem that is generally faced by the researcher is that  $Y_t^p$  and  $\dot{P}_t^e$  are unobserved. We propose to overcome this problem by the use of an Adaptive Expectations Model for both  $Y^p$  and  $\dot{P}^e$ . The Adaptive Expectations Model can be written as<sup>2</sup>

$$\dot{P}_t^e = \dot{P}_{t-1}^e + \lambda (\dot{P}_t - \dot{P}_{t-1}^e) \quad \dots \quad (4)$$

where  $0 < \lambda < 1$  and  $\dot{P}_t^e$  represents the expected annual inflation rate at time  $t$  and formed during the preceding year;  $\dot{P}_t$  represents the actual rate of inflation during year  $t$  and  $\lambda$  is the coefficient of expectations which is always positive and less than unity. For if  $\lambda = 1$  then equation (4) reduces to  $\dot{P}_t^e = \dot{P}_t$ , i.e. expected inflation is equal to actual inflation, and if  $\lambda = 0$  then  $\dot{P}_t^e = \dot{P}_{t-1}^e$ , denoting that expectations do not change from one period to the next. The Adaptive Expectations Model can be converted into a distributed lag model by successive substitution as

$$\dot{P}_t^e = \lambda \dot{P}_t + \lambda(1-\lambda)\dot{P}_{t-1} + \lambda(1-\lambda)^2\dot{P}_{t-2} + \dots \quad \dots$$

$$\text{or } \dot{P}_t^e = \lambda \sum_{i=0}^{\infty} (1-\lambda)^i \dot{P}_{t-i} \quad \dots \quad (5)$$

<sup>2</sup>The method of Adaptive Expectations has been introduced by Cagan [7] in his famous study on hyper-inflation and has been widely used by many authors in studying the demand for money under inflationary conditions. See, for example, [7; 8; 14; 17 and 18].

By a similar process we specify expected or permanent income as

$$Y_t^p = \theta Y_t + \theta (1-\theta) Y_{t-1} + \theta (1-\theta)^2 Y_{t-2} + \dots$$

$$\text{or } Y_t^p = \theta \sum_{i=0}^{\infty} (1-\theta)^i Y_{t-i} \quad (6)$$

By substitution of equations (5) and (6) into equation (3) and further manipulation we derive a 'general' money-demand function which is written as

$$m_t^d = \alpha \theta \lambda + \beta \theta Y_t - \beta \theta (1-\lambda) Y_{t-1} + m_{t-1}^d \\ \left[ (1-\theta) + (1-\lambda) \right] - m_{t-2}^d \left[ (1-\theta) (1-\lambda) \right] + \gamma \lambda \dot{P}_t - \gamma \lambda (1-\theta) \dot{P}_{t-1} \quad (7)$$

If we assume  $\lambda = 1$  and  $\theta = 1$ , i.e. no expectations, then this 'general' equation becomes the conventional money-demand function  $m_t^d = \alpha + \beta Y_t + \gamma \dot{P}_t$ . As mentioned above the expected rate of inflation ( $\dot{P}^e$ ) and permanent income ( $Y^p$ ) are non-observable variables. However, to proceed any further it is necessary to find a way of generating time-series observations for these two variables. The expected inflation and permanent income have been expressed as a weighted sum of past (actual) inflation and measured income in our distributed lag model in equations (5) and (6) respectively. To obtain the estimates of these two variables we ought to estimate the weights given in equations (5) and (6). Following Nugent and Glezakos [28] we proceed further to compute the weights by using the quadratic loss function given as<sup>3</sup>

$$L = \sum_{t=1}^n \left[ \dot{P}_t - \dot{P}^e_t \right]^2 = \sum_{t=1}^n \left[ \dot{P}_t - \lambda \sum_{i=0}^n (1-\lambda)^i \dot{P}_{t-i} \right]^2 \dots \quad (8)$$

<sup>3</sup>An alternative method to compute the adjustment coefficients  $\lambda$  and  $\theta$  is suggested by a referee. The method is given as

$$L = \sum_{i=1}^n (\dot{P}_t - \lambda \dot{P}_{t-1})^2$$

Minimizing the loss function  $L$  with respect to  $\lambda$  we have

$$\frac{\partial L}{\partial \lambda} = \sum_{i=1}^n 2(\dot{P}_t - \lambda \dot{P}_{t-1}) (-\dot{P}_{t-1}) = 0 \text{ or } \lambda (\dot{P}_{t-1})^2 = \dot{P}_t \dot{P}_{t-1} \\ \lambda = \frac{\sum_{i=1}^n (\dot{P}_t \dot{P}_{t-1})}{\sum_{i=1}^n (\dot{P}_{t-1})^2}$$

Similarly

$$\theta = \frac{\sum_{i=1}^n Y_t Y_{t-1}}{\sum_{i=1}^n (Y_{t-1})^2}$$

We estimated the adjustment coefficients  $\lambda$  and  $\theta$  with this method and found the coefficients exactly 0.9. We, therefore, retained the method given in the text.

We selected that value of adjustment coefficients,  $\lambda$  and  $\theta$ , which minimizes the average loss from forecasting error in the quadratic loss function.<sup>4</sup> In finding the value of  $\lambda$  that minimizes the quadratic loss function, the number of terms in equation (5) is restricted to three (including the current period) to economize on degrees of freedom.<sup>5</sup> With intervals of 0.1 from the parameter space 0 to 1 we search for the value of  $\lambda$  that minimizes the quadratic loss function. By substituting the optimally chosen value of  $\lambda$  from equation (8) into equation (5) we generated a time-series observation for the expected rate of inflation for each country included in our sample. By a similar process we chose the optimal value of  $\theta$  from equation (8), and substituting this value in equation (6) we generated a time series of values for permanent income.

Since one of the issues to be explored in this paper is that of sensitivity of money market in developing countries to interest, we use interest rate as an opportunity-cost variable in money-demand function for the countries included in our sample.

The countries included in our sample are Pakistan, India, Malaysia, Thailand, Korea and Sri Lanka. These countries have been selected purely to give a broad representation to the developing countries of the Asian region. All the data used in this paper are annual observations of the variables for the period from 1960 to 1978 and are at the constant prices of 1960 or 1960-61 depending upon the country. The data regarding the money stock for Pakistan are from Kemal *et al.* [15] while for the remaining countries under consideration these have been gathered from different issues of the *International Financial Statistics (IFS)*. The data regarding national income of Pakistan have been taken from different issues of the *Pakistan Economic Survey* while for the rest of the countries, except India, they have been taken from the *Year Book of National Income Accounts*.<sup>6</sup> The Consumer Price Index (CPI) for all the countries except Pakistan have been taken from the *International Financial Statistics (IFS)*.<sup>7</sup> The data on interest rates for Pakistan, India and Sri Lanka have been collected respectively from different issues of the monthly *Bulletin* of the State Bank of Pakistan, Gupta [13] and the *Central Bank of Ceylon Bulletin* (June 1981).<sup>8</sup> For Thailand and Korea these informations were obtained from the Bank of Thailand and Korea respectively.<sup>9</sup>

<sup>4</sup>For details of quadratic loss function, see Nugent and Glezakos [28].

<sup>5</sup>In an empirical study, Toyoda [29] found that current price expectations are formed on the basis of the most recent actual price movement.

<sup>6</sup>I am grateful to Prof. N. Bhattacharya and Dr. (Mrs.) Bina Roy of the Indian Statistical Institute, Calcutta for supplying me the relevant data of National Income Accounts for India.

<sup>7</sup>Since Consumer Price Index (CPI) series separately for West Pakistan are not available for the period 1960-61 to 1970-71, our analysis has been carried out with GNP deflator as the relevant variable for inflation.

<sup>8</sup>I am grateful to the First Secretary of the Embassy of Republic of Sri Lanka in Islamabad for providing this *Bulletin* to me.

<sup>9</sup>The help of Mr. Chang-Ki-Whang of the Research Department of the Bank of Korea and of Mrs. Prapapim Sakuntabhaya of the Bank of Thailand in providing to me relevant information regarding the interest rates is most sincerely acknowledged. It may be pointed out here that despite our several efforts we could not get consistent-time series data or interest rate for Malaysia.

## III. RESULTS

Various issues relating to money-demand function in developing countries and a theoretical framework for examining those issues have been discussed at length in the preceding sections. In this section we report empirical results regarding the appropriate scale and opportunity cost variables for six Asian developing countries. In so doing we estimated equations (1), (3) and (7) with the use of Cochrane-Orcutt technique. The purpose of using this technique was to take care of the problem of serial correlation.

Before we go into details, a few words regarding the quadratic loss function (equation 8) are in order. It should not surprise anyone to know that the optimal value of  $\lambda$  and  $\theta$  is 0.9. There are many reasons to believe that the optimal value of  $\lambda$  and  $\theta$  should be close to unity [1]. One reason that accounts for the size of the adjustment coefficients ( $\lambda$  and  $\theta$ ) is the length of the economic horizon [27]. It is argued that the length of the economic horizon in developing countries is shorter compared to that in the developed countries. Hence the shorter the economic horizon the larger the adjustment coefficients [3,4]. With the optimal value of  $\lambda$  and  $\theta$ , we constructed time-series estimates of  $\dot{P}^e$  and  $Y^p$  for each country considered in our sample for the years from 1960 to 1978.

Regression results for the countries under consideration are presented in Tables 1 and 2. We discuss first the results corresponding to the  $m_1$  definition of money reported in Table 1. Both the permanent income and measured income elasticities are statistically significant at the traditional level with expected positive sign. There is virtually no difference between the estimated coefficients of measured income and permanent income except for Sri Lanka where the elasticity of demand for money with respect to permanent income is 0.66 while that with respect to measured income is as low as 0.13. In this case, the substitution of permanent income for measured income has improved the results significantly.<sup>10</sup>

The income elasticities of the demand for money for Pakistan, India and Korea are greater than unity while those for Malaysia, Thailand and Sri Lanka are less than unity. In the former case, it suggests the absence of economies of scale while in the latter case it suggests the presence of economies of scale in money holdings. In particular, the income elasticities of Pakistan and India are very close to each other and are around 1.6. In a recent study, Naqvi *et al.* [26] have also found for Pakistan an income elasticity of the demand for money greater than unity. These income elasticities have an important role to play in formulating the monetary policy of a country. It is to be noted that in our analysis different countries experience

<sup>10</sup>It may be noted that when measured income was used with other explanatory variables, the adjusted  $R^2$  remained as low as 0.19 and Durbin-Watson statistic was also low, showing a mis-specification of the model. When permanent income was used with other explanatory variables, the adjusted  $R^2$  rose to 0.81 and Durbin-Watson statistic was high enough to show a correct specification of the model.

Table 1

Estimates of Money Demand Function:  $m_1$  Definition

| Countries | Constant (C)      | Measured Income  | Permanent Income | Interest Rate    | Expected Inflation | $\bar{R}^2$ | DW   | F      |
|-----------|-------------------|------------------|------------------|------------------|--------------------|-------------|------|--------|
| Pakistan  | -6.89<br>(3.76)*  | 1.61<br>(7.84)*  |                  | -0.42<br>(2.72)* |                    | 0.97        | 1.93 | 260.56 |
|           | -7.13<br>(3.95)*  |                  | 1.63<br>(8.22)*  | -0.44<br>(2.94)* |                    | 0.97        | 1.89 | 282.02 |
| India     | -9.11<br>(3.12)*  | 1.63<br>(6.68)*  |                  | -0.09<br>(1.46)  |                    | 0.77        | 1.86 | 25.09  |
|           | -10.12<br>(3.46)* |                  | 1.71<br>(7.05)*  | -0.10<br>(1.72)* |                    | 0.78        | 1.89 | 26.61  |
| Malaysia  | -0.20<br>(0.33)   | 0.84<br>(13.02)* |                  |                  | -0.004<br>(0.23)   | 0.94        | 1.93 | 105.75 |
|           | -0.30<br>(0.52)   |                  | 0.86<br>(13.73)* |                  | -0.006<br>(0.39)   | 0.94        | 1.89 | 117.21 |
| Thailand  | 1.93<br>(7.55)*   | 0.93<br>(25.28)* |                  | -1.55<br>(7.30)* |                    | 0.99        | 2.54 | 549.03 |
|           | 1.92<br>(7.67)*   |                  | 0.94<br>(25.80)* | -1.58<br>(7.55)* |                    | 0.99        | 2.42 | 572.17 |
| Sri Lanka | 6.24<br>(9.35)*   | 0.13<br>(1.73)*  |                  |                  | 0.006<br>(0.14)    | 0.19        | 0.68 | 1.62   |
|           | 1.41<br>(1.80)*   |                  | 0.66<br>(7.61)*  |                  | -0.05<br>(2.04)*   | 0.81        | 1.81 | 29.43  |
| Korea     | -4.38<br>(5.60)*  | 1.20<br>(20.84)* |                  |                  | -0.20<br>(2.35)*   | 0.97        | 1.39 | 221.29 |
|           | -4.33<br>(5.58)*  |                  | 1.20<br>(21.73)* |                  | -0.22<br>(2.63)*   | 0.97        | 1.48 | 240.40 |

Note: All the equations are estimated in the log-linear form. The t-values are given in parentheses and a star (\*) indicates that coefficients are statistically significant at the 95-percent confidence level.

Table 2

Estimates of Money Demand Function:  $m_2$  Definition

| Countries        | Constant<br>(C)   | Measured<br>Income | Permanent<br>Income | Interest<br>Rate | Expected<br>Inflation | $\bar{R}^2$      | DW   | F      |
|------------------|-------------------|--------------------|---------------------|------------------|-----------------------|------------------|------|--------|
| Pakistan         | -2.19<br>(2.49)*  | 1.13<br>(13.04)*   |                     |                  | -0.05<br>(1.79)*      | 0.92             | 1.98 | 86.62  |
|                  | -2.22<br>(2.60)*  |                    | 1.13<br>(13.49)*    |                  | -0.05<br>(1.93)*      | 0.92             | 1.94 | 92.16  |
|                  | -7.01<br>(3.52)*  | 1.64<br>(7.51)*    |                     | -0.37<br>(2.22)* |                       | 0.97             | 1.70 | 275.10 |
|                  | -7.27<br>(3.76)*  |                    | 1.67<br>(7.87)*     | -0.39<br>(2.42)* |                       | 0.97             | 1.68 | 296.81 |
|                  | 13.82<br>(4.83)*  | 2.05<br>(8.50)*    |                     | -0.06<br>(0.90)  |                       | 0.88             | 2.02 | 52.76  |
| India            | 14.76<br>(5.31)*  |                    | 2.13<br>(9.12)*     | -0.07<br>(1.18)  |                       | 0.89             | 2.04 | 55.71  |
|                  | Malaysia          | -3.06<br>(6.04)*   | 1.23<br>(22.08)*    |                  |                       | -0.007<br>(0.42) | 0.98 | 1.76   |
| -3.19<br>(6.53)* |                   |                    | 1.25<br>(23.22)*    |                  | -0.01<br>(0.68)       | 0.98             | 1.69 | 376.74 |
| Thailand         | -5.82<br>(9.36)*  | 1.60<br>(16.96)*   |                     | -1.13<br>(2.26)* |                       | 0.98             | 1.93 | 334.43 |
|                  | -5.83<br>(10.08)* |                    | 1.62<br>(18.28)*    | -1.23<br>(2.63)* |                       | 0.98             | 1.91 | 387.46 |

Notes: (i) All the equations are estimated in the log-linear form. The t-values are given in parentheses and a star (\*) indicates that coefficients are statistically significant at the 95-percent confidence level.

(ii) Since expected rate of inflation and interest rate turned out to be the significant variables representing opportunity cost of holding money stock we report four equations for Pakistan.

different income elasticities. The differences are mainly because of different stages of their development and differences in their institutional frameworks. In a country with a high income elasticity, the demand for money rises at a faster rate than income because of the monetization of the economy over time, limited opportunities to economize on cash balances and non-availability of different financial assets in which to hold saving [2].

We also examined the effect of expected rate of inflation in the demand-for-money function in these countries. Some authors take the actual inflation rate as a good proxy of the expected inflation rate. However, it can be argued that expectations may be adaptive or rational. In this study we have used adaptive expectations; and in order to show that this does represent the expected inflation rate, we have also examined the effect of actual inflation rate. It is found that substitution of expected inflation for actual rate of inflation did not improve the results in all the countries except Sri Lanka. The inclusion of expected rate of inflation with permanent income improved the estimates of the demand-for-money function. However, the effect of expected rate of inflation on money demand has been found statistically significant in the case of Sri Lanka and Korea but statistically insignificant in the case of Pakistan, India, Malaysia and Thailand only, with the  $m_1$  definition of money. As an alternative to the actual or expected rate of inflation we use interest rate as an opportunity-cost variable. Contrary to the general consensus that because of the thin and controlled money market, interest rate should not be used as an opportunity-cost variable in developing countries [2; 19; 30], it is found that money demand in Pakistan, Thailand and, to some extent, India is sensitive to interest rate. The rate of interest on time deposits ( $r_T$ ) is found statistically significant in Pakistan and Thailand while interbank call money rate ( $r_c$ ) is found significant in India. However, interest rate did not perform well in the cases of Korea and Sri Lanka.<sup>11</sup> It is now clear that no negative generalization can be made regarding the role of interest rate in money-demand function. Each country should be examined on its own merit.

The results corresponding to the broader,  $m_2$  definition of money are reported in Table 2 and it is found that these results are not very much different from those of the narrow  $m_1$  definition of money. The permanent income and measured income elasticities are very close to each other with the expected positive sign. Hence, there is nothing to choose between these two variables as a relevant scale variable. It may be noted that the measured income and permanent income elasticities corresponding to the  $m_2$  definition are greater than those corresponding to the  $m_1$  definition. This is because money, according to the  $m_2$  definition, is more akin to savings.<sup>12</sup> The income elasticities corresponding to the  $m_2$  definition of money for Pakistan, India,

<sup>11</sup>We did not use interest rate in the case of Malaysia for reasons given in footnote 9.

<sup>12</sup>I am grateful to an anonymous referee for this point.

Malaysia and Thailand are greater than unity, suggesting an absence of economies of scale of money holdings.<sup>13</sup> The monetary authorities of these countries should know that the demand for money rises at a faster rate than the national income. In the case of India, with a one-percent rise in the real national income, the demand for money rises by more than two percent (Table 2). It gives a lot more freedom to the monetary authorities of India because they can increase the supply of money by more than two percent to meet the demand for money in the economy. As with the  $m_1$  definition of money, so with the  $m_2$  definition also, India has higher income elasticity among all the countries. One of the reason for high income elasticity may be the impact of growing monetization of the economy. It may be noted that in India, monetization of the economy is increasing by one percent per annum [13].

The effect of expected rate of inflation on the demand for money has also been examined. It is found that the expected rate of inflation has significant impact on money demand in Pakistan, Korea and Sri Lanka but not in India, Malaysia and Thailand. It may be noted that the values of the coefficient of actual and expected rates of inflation are the same, and both the variables are statistically significant with the expected sign in Pakistan. This is certainly an improvement on our earlier work [16].<sup>14</sup> This result implies that either actual or expected inflation may be considered an opportunity cost variable in Pakistan.

As an alternative to the actual or expected inflation we used interest rate as an opportunity-cost variable. The underlying purpose of doing this exercise was to find out the role of interest rate in the demand for money in developing countries. It is found that interest rate does have a significant impact on money demand in Pakistan and Thailand. We used interest rate on time deposits ( $r_T$ ) as an opportunity-cost variable for both the countries and it turned out to be statistically significant.<sup>15</sup> Keeping in view the goodness-of-fit, rate of interest on time deposit should be used

<sup>13</sup>We did not report the results with  $m_2$  definition of money for Korea and Sri Lanka because the money-demand function did not perform well with broader definition of money. The D.W. statistic besides the use of first order autoregressive scheme and the Cochrane-Orcutt technique to remove the serial correlation remained low. We used different specification of money-demand function but at no time was the D.W. statistic high enough to show the absence of serial correlation.

<sup>14</sup>One of the reasons may be that we did not apply the first-order autoregressive process to take care of the serial correlation in our earlier work.

<sup>15</sup>In the money-demand function with the broader definition of money,  $m_2$ , the use of time deposit rate as an opportunity cost variable has been questioned by various authors, including Goldfeld [10], on the ground that time deposits are one of the components of the  $m_2$  definition of money and, therefore, the sign of the interest rate coefficient may be ambiguous. It may be noted that time deposits constitute 30 percent of the  $m_2$  definition of money in Pakistan. The use of interest on time deposits will not affect the sign of the coefficients as the  $m_1$  definition components constitute about 70 percent of those in the  $m_2$  definition. However, there is a possibility that because of the substitution effects between the  $m_1$  definition of money and time deposits the coefficient of interest rate in the  $m_2$  definition money equation will be somewhat smaller than with the  $m_1$  definition. I am grateful to Prof. V.K. Chetty of the Indian Statistical Institute for a discussion on this point.

as relevant opportunity-cost variable in these two countries. Unlike with  $m_1$  definition of money interbank-call money rate ( $r_c$ ) did not turn out to be statistically significant in India. Since expected rate of inflation performed better than interest rate in money-demand function in Korea and Sri Lanka the former should be considered a relevant opportunity-cost variable in these countries.

In terms of goodness-of-fit, the function performed well. Almost all the variations in money demand have been explained by income and interest rate/expected inflation. Durbin-Watson statistics show the absence of serial correlation.

#### IV. POLICY IMPLICATIONS

To conduct an appropriate monetary policy it is essential that the supply of money should grow in time with the demand for it. This can be achieved by determining the economy's capacity to absorb increased money supply with the changes in the national income, interest rate and expected inflation. Once the economy's capacity to absorb real money stock is determined, the monetary authorities can then adjust the increase in money supply accordingly. The present study examines the money-demand function for six Asian countries. The long-run income and interest rate elasticities which have a key role to play in the formulation of monetary policy are presented in Table 3.

Table 3

*The Long-run Income and Interest Rate Elasticities of Demand for Money in Six Asian Countries*

| Countries | $m_1$     | $m_2$     | $r$       | $\dot{p}^e$ |
|-----------|-----------|-----------|-----------|-------------|
| Pakistan  | 1.61–1.63 | 1.64–1.67 | 0.39–0.44 |             |
| India     | 1.63–1.71 | 2.05–2.13 | 0.09–0.10 |             |
| Malaysia  | 0.84–0.86 | 1.23–1.25 |           |             |
| Thailand  | 0.93–0.94 | 1.60–1.62 | 1.13–1.58 |             |
| Korea     | 1.20      |           |           | 0.22        |
| Sri Lanka | 0.66      |           |           | 0.05        |

With the help of the elasticities given in Table 3, the task of the policy-makers is to determine the level of money required in the economy. To meet this demand,

monetary authorities should increase the supply of money according to the so-called money-supply growth rule<sup>16</sup>

$$\dot{g}_m = \dot{g}_y \quad \dots \quad \dots \quad (9)$$

where  $\dot{g}_m$  and  $\dot{g}_y$  are the rates of growth of real money stock and real national income respectively. Equation (9) assumes that income elasticity of money demand is unity. In our case, however, we found that income elasticity varied from less than unity to greater than unity. To incorporate the income elasticity of money demand in equation (9), we have

$$\dot{g}_m = \alpha \dot{g}_y \quad \dots \quad \dots \quad (10)$$

where  $\alpha$  is the income elasticity of demand for money. By equation (10), the real money stock should grow by  $\alpha$  times the growth rate of national income.

In this study we have also used interest rate and the expected rate of inflation as an opportunity-cost variable. To incorporate its estimated elasticities, the money-supply growth rule can be re-stated as

$$\dot{g}_m = \alpha \dot{g}_y - \beta \dot{g}_r \quad \dots \quad \dots \quad (11)$$

where  $\beta$  represents the interest rate or expected inflation rate elasticities and  $\dot{g}_r$  is the growth rate of interest rate or expected inflation. We have the value of  $\alpha$  (income elasticity) and  $\beta$  (interest rate or expected inflation rate elasticities) and also of  $\dot{g}_y$  and  $\dot{g}_r$ . On the basis of the rule given by equation (11), the policy-makers can set a target for the expansion of money supply in future which would be consistent with the requirements of money stock in the economy.<sup>17</sup> This target can be achieved by forecasting the variables that affect money holdings such as real income, interest rate and expected inflation. Once these variables are predicted with high degree of precision, then with the help of the elasticities mentioned above the monetary target can be achieved [2]. The achievement of the target would depend upon how accurately the factors affecting money demand, such as real income, interest rate and expected inflation, have been forecasted [2]. The failure to satisfy the relation given by equation (11) may create complications in both the short run and the long run.

<sup>16</sup>Details regarding the money-supply growth rule can be found in Gupta [12] and Branson [5].

<sup>17</sup>For a detailed discussion of setting monetary targets in formulating monetary policy, see Aghevli *et al.* [2].

## V. CONCLUSIONS

The purpose of this paper has been to study the demand for money in six Asian developing countries. Various issues needed to be studied rigorously, such as the appropriate scale variable (measured or permanent income), the role of inflation expectations and interest rate in determining the demand for money in developing countries. An adaptive Expectations Model has been used to calculate the influence of permanent income and expected inflation on demand for money. Also, the optimal values for the adjustment coefficient have been estimated by minimizing the quadratic loss function to generate time series on permanent income and expected inflation, which are essentially non-observable variables.

However, it has been shown that with the substitution of permanent income for measured income and of expected inflation for actual inflation the estimates of the demand-for-money function do not improve significantly for the countries included in our sample, except for Sri Lanka. As to the effect of expected inflation on money demand it has been found to be statistically significant in the case of Pakistan, Sri Lanka and Korea. One of the major contributions of this paper has been to find the role of interest rate in money-demand function in developing countries. Contrary to the widely held view that interest rate should not be used as an opportunity-cost variable in developing countries, the present study shows that interest rate has played a significant role in determining the size of money holdings in Pakistan, Thailand and, to some extent, India. It follows that no generalizations should be made regarding the role of interest rate in money demand in developing countries. The issue has to be examined for each country separately.

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