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A Rational Expectations Macro-econometric Model of Pakistan's Monetary Policy since 1970s

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I. INTRODUCTION

Since April 1985 the operations of the entire financial sector in Pakistan have been transformed into a system which is expected to conform to the laws of Islamic society. Under this system all banks and other financial institutions are supposed to conduct their borrowing and lending according to an interest-free Islamic financial system, except for past commitments which may have been carried over in accordance with original commitments.[1] With this rapid transition towards the interest-free banking system in Pakistan, the present decade has witnessed the emergence of the State Bank of Pakistan as a key participant in the area of policy formation. Indeed, the greater participation of the governor and the bank has given rise to a considerable amount of discussion and debate over Pakistan's monetary policy among the academics and politicians at home and abroad. To a large extent, this discussion and analysis has been essentially descriptive, being based upon casual observations rather than tightly formulated econometric models. From the viewpoint of understanding Pakistan's economy over the 1970s and 1980s within the framework of a complete macro model, there is a growing need to empirically establish the mechanisms of monetary policy in Pakistan and to determine its impact on such macro-economic variables as real output and employment.

The purpose of this paper is to specify and estimate a simple open economy rational expectations model of Pakistan's monetary policy over the Seventies and Eighties. To this end, we investigate the channels and timing of Pakistan's monetary

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[1] The recent national desire for the elimination of interest from the Pakistani economy was indicated as early as 1977 when the President of Pakistan asked the Council of Islamic Ideology to prepare a blueprint for the establishment of an interest-free economic system consistent with the Islamic laws. Consequently, by January 1981, the operations of the banks were partially brought under the new interest-free banking system by opening profit-loss-sharing (PLS) deposits [for more discussion on the Islamization of the banking sector in Pakistan, readers can refer to Government of Pakistan (1985)].

policy over the past two decades in a simultaneous system of equations. The model, which comprises of five interdependent equations, determines (a) the nominal money supply (M_1), (b) deviations of real output from trend, (c) the nominal opportunity cost of money balances, (d) the inflation rate, and (e) the spot exchange rate. Agents, in this model, are assumed to be rational in the sense that they take into account the behaviour of the State Bank and form expectations over nominal and real opportunity costs of money balances. The system of equations is efficiently estimated by a full information maximum likelihood generalized Errors-in-Variables (FGEV) method e.g., Wickens (1983) and Hasan (1987a) and a single equation Two-Step-Two-Stage Least Squares (2S2SLS) method e.g., Cumby *et al.* (1983) and Hasan (1987a) proposed for rational expectations macro-economic models. The quarterly data for this study covers the period 1972–1 to 1985–4. Careful consideration will be given in the estimation and testing of the dynamic structure of the model, which will ensure, among other things, that the impact delays of monetary policy are correctly measured.

The paper is divided into four sections. In Section 2 an outline of the basic framework of the model is given. Section 3 focuses on the estimation procedure and the interpretation of the results. Section 4 presents the conclusions from the study.

2. THE MODEL

In this paper, we use a small, five equation, linear dynamic open economy macro model to describe Pakistan's monetary policy over the 1970s and 1980s. Our choice of a small system of equations model stems from the fact that, over the last decade, the emphasis in macro-econometric modelling in both developed and developing countries has switched away from the large-scale models towards small, possibly non-linear ones.[2] An advantage of a small system of equations model is that it enables the researcher to analytically solve the expectations variables. Thus, the reduced form of the model can be estimated by incorporating the cross-equation rational expectations restrictions.

The five equation structural model describing the monetary policy of Pakistan is given below:

Money Demand

$$m_t - p_t = \alpha_0 + \alpha_1(y_t + \bar{Y}_t) + \alpha_2 E(i_t | \Phi_{t-i}) + \alpha_3(m_{t-1} - p_{t-1}) + \mu_{1t} \quad \ldots (1)$$

[2]One can provide many reasons for this movement. However, one important consideration is the consistency that arises when an econometrician is required to model in a systematic and coherent manner the interlinks of the various stipulated functional relations. Small systems force the researcher to focus upon those interlinks that are believed to the crucial to the particular problem at hand. [For a detailed discussion and applications of some of the small system of equations model for U.S. and Canada readers can refer to Raynauld (1981); McCallum (1976); Leiderman (1979); and Sargent (1976).]

Real Output

$$y_t = \beta_0 + \sum_{i=1} \beta_{1t} y_{t-i} + \sum_{i=0} \beta_{2i} (m_{t-i} - p_{t-i}) + \beta_3 \, [E(i_t | \Phi_{t-i}) -$$

$$E(\pi_t | \Phi_{t-1})] + \sum_{i=0} \beta_{4i} \, (p_{t-1} - f_{t-i} - p^*_{t-i}) + \sum_{i=1} \beta_{5i} \, y^*_{t-i} + \mu_{2t} \quad (2)$$

Interest Rate

$$i_t = \gamma_0 + \sum_{i=1} \gamma_{1i} i_{t-i} + \sum_{i=0} \gamma_{2i} (i^*_{t-1} - i_{t-1-i}) + \sum_{i=1} \gamma_{3i} y_{t-i}$$

$$+ \sum_{i=1} \gamma_{4i} \pi_{t-i} + \sum_{i=1} \gamma_{5i} f_{t-i} + \mu_{3t} \quad \ldots \quad \ldots \quad \ldots \quad .. \quad (3)$$

Inflation Rate

$$\pi_t = \lambda_0 + \sum_{i=1} \lambda_{1i} \pi_{t-i} + \mu_{4t} \quad \ldots \quad \ldots \quad \ldots \quad .. \quad (4)$$

Exchange Rate

$$f_t = \delta_0 + \sum_{i=1} \delta_{1i} f_{t-i} + \mu_{5t} \quad \ldots \quad .. \quad \ldots \quad \ldots \quad (5)$$

where y_t is the logarithmic (log) deviation of the real output (Y_t) from its trend value ($\bar{Y}_t$), p_t is the log of the price level, p^*_t is the log of the U.S. price level, π_t is the inflation rate ($p_t - p_{t-1}$), m_t is the log of nominal money stock (M_1) i_t is the nominal rate of interest, i^*_t is the U.S. nominal rate of interest, f_t is the log of spot exchange rate, $E(i_t | \Phi_{t-i})$ is the expected value of i at time t based on the information set Φ at $t-1$, $E(\pi_t | \Phi_{t-1})$ is the expected value of π at time t based on Φ at $t-1$. μ_{1t}, μ_{2t}, μ_{3t}, μ_{4t}, μ_{5t}; ν_{1t} and ν_{2t} are the random shocks and they are assumed to be serially uncorrelated with zero mean, constant variance and are also assumed to be contemporaneously uncorrelated with each other.

Equation (1) is the money demand equation and is based upon the conventional real-partial adjustment specification. A similar kind of money demand (assuming with and without rational expectations hypothesis) has served as a basis for much of the applied research in Pakistan e.g., Mangla (1979); Khan (1980, 1982); and Hasan (1987b). Under a free competitive financial market system one would expect the increase in real income and the expected interest rate to cause real money balances to increase and decrease, respectively. Moreover, the speed of adjustment coefficient ($1 - \alpha_3$) is to be positive and less than unity. However, on the other hand, in the case of developing economies where the forces of free markets are less prevalent than those of government controls, one could in that situation obtain results that are different from the conventional ones.

Equation (2) represents the demand for real output of the economy, which can be viewed as a reduced form of the conventional IS curve. The distributed lag output variable in the equation is introduced to capture any multiplier-accelerator effect and any other sources of persistence. Wealth effects on expenditures which are expected to respond positively to the aggregate demand are captured through the current and lag values of real balances. Expected real rate of interest should cause the real output to decrease through the consumption and investment demand functions. Expectations are, of course, assumed to be formed rationally based upon the useful information set available to the agents at time $t-1$.

As for the terms of trade variable $(p_t - f_t - p_t^*)$ we have allowed an unrestricted distributed lag structure. According to economic theory, one should expect a negative effect of the terms of trade variable on the real output variable. In other words, a currency depreciation that lowers the terms of trade (i.e., raising import prices relative to export and domestic prices), shifts both domestic and foreign demand from the foreign to the domestic good, consequently raising real output. Finally, in order to take into account the openness of Pakistan's economy, we incorporate U.S. real output as a proxy for the foreign aggregate demand. One would expect a positive relationship between domestic and foreign real output through higher net export demand. The real output equation described above is similar to the closed economy aggregate demand equation.

In Equation (3), we have attempted to specify the behaviour of the State Bank in setting interest rates in the 1970s and early 1980s by a reaction function. We recognize that it is very difficult to model a reaction function that should take into account all aspects of the bank in establishing interest rates. In our specification, we have taken a more intuitive and simple approach in setting up a bank's reaction function. The distributed lag values on the interest rate in Equation (3) are intended to pick up any costs of adjustments from large changes in the foreign interest rates (i.e., the U.S. rates). The difference between the current foreign (U.S.) and lag domestic interest rates and the lag exchange rate variables are used to pick up any current exchange rate considerations used by the bank in fixing the interest rates. One should expect no deviation between domestic and foreign interest rates if the capital were perfectly mobile and consequently γ_{20} would be unity and other γ_{2i}s to be zero. However, if the capital were imperfectly mobile, then the degree to which the bank takes into account exchange movements in the foreign interest rates may be measured by the values of γ_{2i}s. The presence of the lag real output and the inflation rate is intended to capture the aggregate demand conditions of the economy and the coefficients of these two variables are expected to be positive.

We have chosen to model inflation and exchange rate movements by univariate autoregressive (AR) processes. The use of pure time-series techniques is primarily due to the absence of adequate econometric specifications of these variables for Pakistan.[3]

3. ESTIMATION METHODS AND RESULTS

In this section, we discuss the derivation of the rational expectations solution of the model, the estimation strategy and the results.

Rational Expectations Solution

The rational expectations estimation of a system of equations model can be carried out consistently at both *reduced* and *structural* form levels. The estimation technique at the reduced form level is known as the Full System Substitution (FSS) Method. The two structural form estimation methods are: (a) Two-Step Two-Stage Least Squares (2S2SLS) Method proposed by Cumby *et al.* (1983) and (b) Full Information Maximum Likelihood Generalized Errors-in-Variables (FGEV) Method proposed by Wickens (1983).[4] The implementation of these estimation techniques for rational expectations models are briefly given below.

In order to estimate the model at the reduced form level using the FSS method we first need to eliminate the unobservable expected variables from the structural model. We will assume that agents are rational and that in their forecasting processes, they have knowledge of the structure of the model and that all exogenous and lagged endogenous variables are contained in the agent's information set Φ at time $t-1$. The rational expectations solution of the model requires that we take expectations of Equations (3) and (4) conditional upon Φ_{t-1}, that is;

$$E(i_t | \Phi_{t-1}) = \gamma_0 + \sum_{i=1} \gamma_{1i} i_{t-i} + \sum_{i=0} \gamma_{2i} (i^*_{t-1} - i_{t-1-i}) + \sum_{i=1} \gamma_{3i} y_{t-i}$$

$$+ \sum_{1=1} \gamma_{4i} \pi_{t-i} + \sum_{i=1} \gamma_{5i} f_{t-i} \qquad \ldots \qquad \ldots \qquad \ldots \qquad (6)$$

$$E(\pi_t | \Phi_{t-1}) = \lambda_0 + \Sigma \lambda_{1i} \pi_{t-i} \qquad \ldots \qquad \ldots \qquad \ldots \qquad (7)$$

and then substitute the resulting equations into Equations (1) and (2). This will give us two nonlinear equations with no unobservable variables:

[3] The use of pure time series representations to describe the processes generating is quite common [see, e.g., Hansen and Sargent (1982), Vandaele (1983)].

[4] A detailed discussion on these methods can be found in Cumby *et al.* (1983; 2S2SLS) and Wickens (1983; FGEV). A summary and the relative small sample efficiency for all these techniques is given in Hasan (1987a).

$$m - p = \alpha + \alpha (y + \bar{Y}) + \alpha_2 \Big\{ \gamma_0 + \sum_{i=1} \gamma_{1i} i_{t-i} + \sum_{i=1} \gamma_{2i}$$

$$(i^* - i_{t-1-i}) + \sum_{i=1} \gamma_{3i} y_{t-i} + \sum_{i=1} \gamma_{4i} \pi_{t-i} + \sum_{i=1} \gamma_{5i} f_{t-i} \Big\} +$$

$$\alpha_3 (m_{t-1} - p_{t-1}) + \mu_{2t} \qquad \ldots \qquad \ldots \qquad \ldots \qquad \ldots \qquad (8)$$

$$y_t = \beta_0 + \sum_{i=1} \beta_{1i} y_{t-i} + \sum_{i=0} \beta_{2i} (m_{t-i} - p_{t-i}) + \beta_3 \Big\{ \gamma_0 + \sum_{i=1} \gamma_{1i} i_{t-i}$$

$$+ \sum_{i=0} \gamma_{2i} (i^*_{t-1} - i_{t-1-i}) + \sum_{i=1} \gamma_{3i} y_{t-i} + \sum_{i=1} \gamma_{4i} \pi_{t-i} + \sum_{i=1} \gamma_{5i} f_{t-i}$$

$$+ \lambda_0 + \sum_{i=1} \lambda_{1i} \pi_{t-i} \Big\} + \sum_{i=0} \beta_{4i} (p_{t-i} - f_{t-i} - p^*_{t-i}) + \sum_{i=1} \beta_{5i} y_{t-i} + \qquad (9)$$

The above system of Equations [(8) and (9)] along with Equations (3), (4), (5), and (6) can be efficiently estimated by a Zellner's Seemingly Unrelated Regression method.

The 2S2SLS method is a single equation technique which estimates the parameters of the structural equations one at a time. With this method the unobserved rational expectations variables in the structural model are replaced by their actual value, thereby creating an errors-in-variables problem. The equation is then estimated by an instrumental variables method.

On the other hand, FGEV is a full information method which, though obviously more complex, is conceptually simple. It is easier to describe the FGEV method as a generalized 'instrumental variable" method. Like 2S2SLS, the FGEV method is also a structural form estimation method. The unobserved expectations variables in this method are replaced by the actual observed variables in the system, thereby creating errors in the variables.

Estimation Strategy

As we can see, the rational expectations hypothesis imposes complicated cross-equation nonlinear restrictions on the reduced form model. The above FSS method is feasible in estimating the reduced form model but it is computationally much more difficult and costly to implement than the other two methods. Hence, for this study we will use the two structural forms of the rational expectations methods discussed earlier.

The specific lag structure of each equation comprising the system was determined on the basis of the ordinary least squares (OLS) method. In particular, we set the lag length at four (since we have quarterly data) and then, on the basis of a t-test, the actual lag was established.

Results

Utilizing the methods described above, the model was estimated for Pakistan's economy using seasonally adjusted quarterly data over the period 1972-1 to 1984-4.[5] All data were collected from the various issues of the *International Financial Statistics* published by the International Monetary Fund.

Table 1 presents the 2S2SLS estimates for the model. For each equation, a set of four period lag exogenous and endogenous variables were used as an instrument set for the right-hand-side endogenous variable. The insignificant lags are not reported in the table. The 2S2SLS results can be summarized as follows:

(a) The estimated parameters of all the coefficients in the money demand equation have the expected sign. However, the coefficient of the expected interest rate variable is insignificant. A similar type of result was also found by Hasan (1987b) in an earlier study. One of the economic reasons given for the justification of this kind of result is that there is a lack of broader and competitive financial markets in the country. One other reason that could also be given for getting such an insignificant interest rate coefficient may relate to the behaviour and the constraints of the economic agents within which they operate in the economy. From the religious and social point of view, the interest rate is considered to be an undesirable thing by a good majority of people in the country.

(b) It is also interesting to note that although the coefficient of the expected real rate of interest in the real output equation has the right negative sign, the variable itself is statistically insignificant. These results may suggest that not only the interest rate is unimportant for the holders of financial assets (as found in the money demand equation) but it is also equally unimportant for the investors of goods and services. The demand for real output depended significantly on the positive lagged values of real output and money supply and on the negative values of terms of trade variable. However, the increase in the foreign (U.S.) demand for real output did not significantly increase the real output for Pakistan. Such a result can be justified on the basis of the import quotas and trade restrictions imposed by the government on various occasions in the past.

(c) The lagged domestic exchange rates, interest rates and the lagged U.S./Pakistan interest rate differentials were important in setting the domestic interest rates. This evidence may suggest that the open economy considerations were important factors in designing the domestic interest rates.

(d) Finally, the exchange rate movements were captured by a second order AR process while the inflation rate followed an AR (1) process.

[5]The model was estimated using econometric package programmes called TSP, RATS and another written by Cumby and Huizinga (1984). TSP was used to implement the FGEV method, while the Cumby and Huizinga programme handled the 2S2SLS method. The ARIMA model and the forecasts were made by using RATS.

Table 1

Two-Step Two Stage Least Squares (2S2SLS) Estimates of the System

Money Demand:

$$m_t - p_t = \underset{(2.05)}{0.6082} + \underset{(5.56)}{0.1792}(y_t + \bar{Y}_t) - \underset{(0.71)}{0.01233}\,E(i_t|\Phi_{t-1}) + \underset{(14.14)}{0.6639}(m_{t-1} - p_{t-1}) \qquad R^2 = 0.958$$

Real Output:

$$y_t = \underset{(2.65)}{-1.7181} + \underset{(2.45)}{0.3464}y_{t-1} + \underset{(3.49)}{0.7401}(m_t - p_t) - \underset{(0.84)}{0.01563}[E(i_t|\Phi_{t-1}) - E(\pi_t|\Phi_{t-1})]$$

$$- \underset{(4.71)}{0.8276}(p_t - f_t - p_t^*) + \underset{(1.21)}{0.2876}y^*_{t-1} \qquad R^2 = 0.786$$

Interest Rate:

$$i_t = \underset{(1.97)}{0.3246} - \underset{(2.46)}{0.3301}i_{t-2} + \underset{(2.51)}{0.1754}(i_t^* - i_{t-1}) + \underset{(2.48)}{2.9788}y_{t-1} + \underset{(1.89)}{10.7539}\pi_{t-2}$$

$$\underset{(2.34)}{-5.5568}f_{t-2} \qquad R^2 = 0.556$$

Inflation Rate:

$$\pi_t = \underset{(3.55)}{0.01992} + \underset{(2.03)}{0.2849}\pi_{t-1} \qquad R^2 = 0.080$$

Exchange Rate:

$$f_t = \underset{(1.95)}{-0.1031} + \underset{(5.55)}{0.2282}f_{t-1} - \underset{(2.10)}{0.2743}f_{t-2} \qquad R^2 = 0.950$$

Notes: The notations and explanation of different variables are presented in the text. Figures in parentheses are absolute *t*-values.

Table 2

Full Information Maximum Likelihood Errors in Variables (FGEV) Estimates of the System

Money Demand : $m_t - p_t = \underset{(2.38)}{0.5023} + \underset{(5.56)}{0.2931}(y_t + \bar{y}_t) - \underset{(0.48)}{0.0112}E(i_t|\Phi_{t-1}) + \underset{(2.88)}{0.941865}(m_{t-1} - p_{t-1})$

Real Output : $y_t = \underset{(3.07)}{-1.1655} + \underset{(2.45)}{0.55201}y_{t-1} + \underset{(3.49)}{0.3265}(m_t - p_t) - \underset{(0.61)}{0.0796}[E(i_t|\Phi_{t-1}) - E(\pi_t|\Phi_{t-1})]$

$\underset{(2.61)}{-0.1402}(p_t - f_t - p^*_t) + \underset{(1.62)}{0.5409}y^*_{t-1}$

Interest Rate : $i_t = \underset{(1.89)}{0.3246} - \underset{(3.15)}{0.3301}i_{t-2} + \underset{(2.35)}{0.1754}(i^*_t - i_{t-1} + \underset{(3.75)}{2.9788}y_{t-1} + \underset{(2.17)}{10.7539}\pi_{t-2}$

$\underset{(2.42)}{-5.5568}f_{t-2}$

Inflation Rate : $\pi_t = \underset{(3.72)}{0.01992} + \underset{(1.98)}{0.2849}\pi_{t-1}$

Exchange Rate: $f_t = \underset{(2.36)}{-0.1031} + \underset{(4.34)}{0.2282}f_{t-1} - \underset{(2.31)}{0.2743}f_{t-2}$

Notes : The notations and explanation of different variables are presented in the text. Figures in parentheses are absolute *t*-values.

After estimating the model by 2S2SLS we then simultaneously estimated the complete model at the structural level by the FGEV method. The results of FGEV are reported in Table 2. The results of FGEV are qualitatively similar to that of the 2S2SLS method.

4. CONCLUSIONS

The conclusions of this paper are summarized in this section. In this paper we specified and estimated a small system of an open economy rational expectations model for Pakistan's monetary policy during the period covering the 1970s and early Eighties. Although it is very difficult to capture all aspects of the behaviour of the State Bank, a simple but intuitive interest rate setting equation was modelled in this paper. The proposed model does appear to fit well Pakistan's economy and the 2S2SLS method, in general, performed better than the FGEV method.

The results of this paper may have important implications in formulating Pakistan's monetary policy in the light of the present transition towards an interest-free banking system in the country. Our results suggest that, in the past, economic agents (both investors and the holders of financial assets) paid little or no attention to the government controlled interest rates. Consequently, a PLS type of banking system, as adopted by the banking sector recently could be a more viable alternative than the earlier system in promoting a healthy and strong economy in the long run.

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Comments on
"A Rational Expectations Macro-econometric Model of Pakistan's Monetary Policy Since 1970s"

This paper by Dr Hasan is a good example of competent and useful applied macro-economic analysis on Pakistan. The paper does two things. First, it provides a quantitative examination of Pakistani monetary policy since the 1970s. Aside from some studies on money demand, there has been surprisingly little effort made to test basic monetary hypotheses on data for Pakistan. Second, it formulates a small aggregate model that utilizes a rational-expectations framework. Model builders in Pakistan have been enamoured with large-scale econometric models that often only they understand. Such large-scale models have fallen into some disrepute, and there is an increasing trend in economics towards constructing small models that have a clear theoretical foundation. Dr Hasan's model is fairly transparent and thus easy to understand, and it explicitly incorporates rational expectations, which have been one of the major theoretical and empirical advances that have taken place in the last decade or so. The rational expectations "revolution" has now been imported into Pakistan by Dr Hasan's capable efforts.

I commend the author for his attempt in both putting rigor where once only descriptive analysis – of the type produced regularly in the Pakistan Economic Survey – ruled, as well as in using state-of-the-art technology. However, I am certain that Dr Hasan would acknowledge that what he has done is at best only a first step. Being that, there are weaknesses and problems in the paper that I would like to bring out and discuss. The remainder of my Comment will deal first with the specification of the model, and then turn to the empirical analysis.

Specification of the Model

Before getting into a discussion of the individual equations in the model, I have a general point to make on Pakistani monetary policy that is not captured by the model developed in this paper. While the interest rate (specifically the discount rate of the State Bank) is a policy instrument, it is not the principal one. In Pakistan, monetary policy is conducted within the framework of a credit plan. In this credit plan, ceilings are set on the expansion of overall bank credit, and selective credit policies are used to allocate credit towards the desired sectors. The relevant model is, therefore, neither one in which interest rates are controlled and credit (money supply) is endogenous, nor one in which credit is controlled and interest rates are free. What we are really looking at is a credit-rationing world in which the State Bank is attempting to fix both the price and quantity of credit. If one wants to accurately represent the financial system of Pakistan, my own preference would be to go the credit-rationing route rather than trying to apply classical models that have worked well for developed economies.

Coming now to the five equations in the model, I have the following points:

(a) In the money demand equation it would seem that the expected rate of inflation, π^e, should also be included. In developing countries, such as Pakistan, substitution can and does take place between money and real assets as well as between money and financial assets. As π^e rises one would expect that the demand for real money balances would decline and the demand for real assets, such as jewellery, real estate, consumer durables, etc., would increase.

(b) I was surprised to find no role for government expenditures in the *real output equation.* I think the author is being too ultra-classical here. One does not have to be a Keynesian to acknowledge that government spending has a direct effect on consumption and investment. In fact, I would go further and argue that government capital expenditures have done quite a lot to stimulate both short-term and long-term growth in Pakistan. A second point relating to output determination is the effect of the variable $(p_{t-i} - f_{t-i} - p^*_{t-i})$. It is argued in this paper that this picks up the terms of trade effect. But this variable is more properly defined as the real exchange rate, and if one takes the expected signs at face value one would argue that a real appreciation raises output. There is, however, considerable controversy in the literature as to whether a devaluation raises or lowers output, and as the issue is essentially an empirical one I would leave the sign ambiguous.[1]

(c) The modelling of a government reaction function is always a difficult task, because one is really trying to get into the minds of the government authorities. Furthermore, as the authorities change the variables they look at, and alter the weights they assign to the variables, the reaction functions are also likely to change. These problems are well known, but no reference is made to them. I still believe that a credit reaction function would have been more appropriate for Pakistan than the *interest rate equation,* but let me make a few observations on the latter. The State Bank's discount rate policy has been guided by several factors that are not present in the specification. First, it can be argued that the State Bank has kept the interest rate low to keep the borrowing costs of the Government of Pakistan on the sale of its bonds down. Second, many observers feel that in recent years there has been a deliberate attempt to keep the spread between rates on savings deposits and PLS accounts fairly wide to facilitate the use of the latter. Finally, and perhaps more

[1] This point will be taken up again in the discussion of the empirical results.

importantly, the level of foreign reserves has guided the actions of the State Bank. Looking at the history of macro-economic policy-making in Pakistan if there is one thing that stands out it is the government's preoccupation with external imbalances and its stock of international reserves. Surely interest rate policy would be geared to the difference between desired and actual stocks of foreign reserves.

(d) While it is simple and customary to model the *inflation rate* as an AR process, it obviously begs a lot of economic questions. In Pakistan foreign inflation has had a significant effect on domestic inflation – the bursts of inflation in 1974–76 and 1979–81 were associated with the dramatic increases in international oil prices. This autoregressive (AR) model also implies that inflation is independent of domestic real and monetary shocks. I doubt whether anyone would seriously argue that factors such as crop failures or deficit-financing by the government have no inflationary impact on the economy.

(e) The *exchange rate equation* is also specified as an AR process. Here again I would argue that variables such as foreign interest rates, exchange rates of competitor countries, the inflow of remittances, etc., have an important effect on exchange rate policy in Pakistan. There is also an inconsistency here – how can interest rates be endogenous to foreign variables while the exchange rate is exogenous? Surely the State Bank uses both instruments in response to external shocks. Finally, since the exchange rate was fixed between 1974 and 1981, and it was only after the delinking in January 1982 that it started to move against the U.S. dollar, the parameters of the AR model are an average of the two sub-periods. In the first sub-period the AR1 parameter was obviously unity and it seems pointless to estimate it. At least one could use intervention analysis to pick up that break in the process if one did not want to estimate the equation only from the first quarter of 1982.

Results

While the empirical findings are generally sensible and indicate that rational expectations models have a place in Pakistan, I still have certain reservations about a few particular results that are obtained.

(a) The average lags in adjustment of real money balances seem excessively long For example, the mean time lag calculated from the results reported in Table 2 is about five years! My guess is that the equation is misspecified and that the lagged dependent variable is picking up the effect of a missing variable (perhaps).

(b) It would have been useful to present Q-statistics in the results. As it stands we have no idea whether there is any serial correlation in the errors of the estimated equations.

(c) In the real output equation results the partial derivatives of output (y) with respect to the exchange rate (f) and the stock of real money balances (m-p) seem very large. If these estimates are to be believed then a devaluation of 10 percent would cause output to rise by over 8 percent in the same quarter (remember that prices are unaffected). I am not sure the Pakistani authorities are that optimistic about the expansionary effects of devaluation. In fact, there is a fear that devaluation would be contractionary, at least in the short run.

(d) Given that the financial system has changed in recent years with the move towards Islamization, I wonder if the same model is applicable now as it was in the 1970s. Since we know of the change in regime, it would be only natural to test for stability of the regression equations. One could then proceed to adjust for shifts in the equations if needed.

(e) It is interesting to note that the 4th order lag coefficients are statistically significant in the ARIMA models for both real output and real money balances (Appendix). This may be because seasonally adjusted data is being used. In other words, if the data are smoothed by some filter to eliminate seasonality, and then an ARIMA model is fitted this model will capture the parameters of the original filter. The more normal procedure is to use raw data, ensure stationarity, and then estimate the ARIMA model. This way you simultaneously get the estimates of the lag parameters and seasonal factors.

Conclusions

It may appear that this Comment is simply a litany of the errors and problems I found in Dr Hasan's paper. This impression, however, has to be set against the fact that Dr Hasan has taken on a difficult task that has befuddled many economists, careful modelling of developing countries is not child's play and for the amateur. My own feeling is that such modelling has to proceed in stages, building gradually to a more accurate representation of the economy. Dr Hasan's paper is the first stage and my suggestions are directed more at future efforts, including I hope those of Dr Hasan, in this very fruitful area.

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