

## **Output Effects of Stabilization Policies: The Case of Pakistan**

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### **1. INTRODUCTION**

The central message of Keynesian economics is that demand management through monetary and fiscal policies can successfully stabilize output and employment in the short run, and possibly raise the average level of employment over a longer period. The Monetarists, on the other hand, have emphasized the role of monetary policy in stabilizing output and employment in the short run but have maintained that money is neutral in the long run.

The rational expectations literature seeks to explain to what extent Keynesian and Monetarist nominal demand policies can have real effects, even in the short run, when allowance is made for rational behaviour and some short-term nominal rigidities. It is generally contended that stabilization policies would have no real effects if the principles of such policies are known to private agents, that the policies are based on information that is available to the private agents as much as to the policy-maker, and the private agents interpret information available to them correctly. The argument of rational expectations theory has been that, for demand policies to be effective, in the short run, there must be some element of surprise and in the longer-run, all relevant information is not used.

This paper uses the analytical framework provided by Barro (1977) for the U.S. to empirically test the following two interrelated propositions about the scope of monetary policy in the case of Pakistan as put forth by the rational expectations theory: (a) The growth of the money supply is predictable in that it differs from a random walk with trend, and (b) that the unpredictable part of money supply growth will affect real output. While the primary focus is on the output effects of monetary policy, we test related propositions for fiscal policy, and as will become evident later, perhaps in a cursory fashion.

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These two propositions, among others, have been subject to extensive empirical tests for the U.S., U.K., Canada, and Latin American countries.<sup>1</sup> However, empirical explorations for developing countries in Asia and Africa has only begun.<sup>2</sup> This lag in empirical tests of the above-mentioned propositions may be explained superficially as due to the lack of data on the relevant series for a sufficiently long period of time for a number of these countries.

At a fundamental level it may be the case that these propositions may not be relevant to them given the types of nominal rigidities and information asymmetries that might exist so that significant Keynesian effects can still be obtained. That is an empirical question which we propose to investigate for Pakistan.<sup>3</sup>

The remainder of the paper is organized as follows. Section 2 describes the model to be used to empirically test the two propositions mentioned above for Pakistan. Sections 3 and 4 present and discuss the results obtained for the monetary growth and output equations respectively. In Section 5 we compare these estimates with estimates obtained in other studies for countries similar to Pakistan. In Section 6 the fiscal reaction equation is estimated and its effects on output are tested. Section 7 concludes this paper by summarising the main findings of this study.

## 2. DESCRIPTION OF THE MODEL

A central feature of, for example, Lucas's (1973) competitive equilibrium – rational expectations model is that output has a normal or natural level around which it fluctuates in response to current and lagged values of unanticipated monetary growth. The explanation for current unanticipated monetary growth affecting output is by now well-known: economic agents may confuse aggregate spending shifts with relative shifts. Lagged monetary "surprises" may affect output for a variety of reasons: for example, if part of the response to a monetary surprise is the running down of inventories then the desire to restore inventories to some given level will affect output in subsequent periods. Anticipated monetary growth, working through the inflationary channel, has no real effects in the short-run. This is widely known as the policy ineffectiveness proposition.

However, this leaves open the possibility that even anticipated monetary

<sup>1</sup>A third proposition is that the effects of aggregate nominal disturbances on output should be inversely related to the variability of such disturbances. Khilji and Bae are presently testing this proposition for a cross-section of 14 Asian countries.

<sup>2</sup>See Attfield and Duck (1983); Hanson (1980); Kormendi and Meguire (1984); and Sheehy (1984).

<sup>3</sup>Hasan (1987) has modelled and estimated a rational expectation model for Pakistan. His study implicitly assumed that the propositions put forth by the rational expectations school held for Pakistan. Our study is geared to see whether these propositions do in fact hold.

growth can affect output by changing the natural level of output, in which case money is not "superneutral" (the superneutrality of money is the extended concept of the neutrality of money over time). There are a number of channels by which it might do so, for example by altering the desired quantity of capital [Buiter (1981)] or much less directly by encouraging government involvement in the setting of prices in an effort to avoid particularly awkwardly timed price changes.<sup>4</sup> Some economists have advanced counter plausible models implying that systematic monetary policy can still have short run effects.<sup>5</sup>

Following Barro's model based on flexible price expectations, aggregate demand affects real output only if the change in aggregate demand is unexpected. In this model, the quantity of money is the prime determinant of aggregate demand and therefore changes in the quantity of money affect real output only if they are unexpected. In a simplified form, the output equation can be written as:

$$Y_t = \theta Z_t + \pi (DM_t - E_{t-1} DM_t) + e_t \quad \dots \quad (1)$$

where  $Z_t$  represents a number of variables which determine the level of output;  $DM_t$  is the rate of growth of the quantity of money in period  $t$ ;  $E_{t-1} DM_t$  is the expectation of the rate of the money growth;  $\theta$  is a vector of coefficients;  $\pi$  is a positive coefficient and  $e_t$  a random error with mean zero.<sup>6</sup>

Equation (1) is merely a formal statement that if monetary growth equals the expectation of it, then output will be at its natural level. The variations in output will follow the same direction as the unexpected variations in monetary growth. If, for example, monetary growth is greater than expected, real output will be greater than its natural level. This model assumes what is sometimes called "structural neutrality", which implies that however expectations are formed, expected money growth does not affect real output. In order to derive a rational expectations model incorporating Equation (1), a process for monetary growth is specified:

$$DM_t = \phi_1 X_{t-1} + \phi_2 W_{t-1} + u_t \quad \dots \quad (2)$$

<sup>4</sup> It has also been shown that even if certain sectors of the economy have nominal rigidities, anticipated money may have significant affects on sectoral output and consequently effect the distribution of income, and the composition of output and employment but at the aggregate level anticipated money would be neutral. See Gauger and Enders (1989) for evidence on the U.S.

<sup>5</sup> For example Taylor (1975) uses the notion of incomplete information within a transition period following a change in the monetary rule; Blinder (1982) utilizes price rigidities; Fischer (1977) and Canzoneri (1980) apply contract theory.

<sup>6</sup> For an explicit derivation of the output equation the interested reader is referred to Lucas (1973) and Barro (1977).

where  $X$  and  $W$  are variables whose values in period  $t-1$  partly determine monetary growth in period  $t$ ;  $u_t$  is a random, unpredictable component of monetary growth with zero mean; and  $\phi_1, \phi_2$  are coefficients.

Equation (2) can be viewed as a policy regime; a rule by which the authorities link a policy instrument, in this case the growth of money, to the behaviour of other variables. These other variables are the lagged values of  $X$  and  $W$  which could be, for example, the level of unemployment and the inflation rate, or the balance of payments, the level of exports, or the public sector requirement, or whatever variables the policy-maker wishes. The coefficients  $\phi_1$  and  $\phi_2$  are chosen by the authorities in order, as they see it, to achieve their goals. A change of policy regime can occur either as a result of a change in the values of the coefficients, or as a change in the choice variables to which the policy instrument is linked. Specific forms and estimations of the  $DM_t$  equation will be discussed below.

Since the money growth equation is given by Equation (2) the rational expectation of  $DM_t$  must be:

$$E_{t-1} DM_t = \phi_1 X_{t-1} + \phi_2 W_{t-1} \quad \dots \quad \dots \quad \dots \quad (3)$$

Together, Equations (1) and (3) give the two-equation rational expectations model:

$$DM_t = \phi_1 X_{t-1} + \phi_2 W_{t-1} + U_t \quad \dots \quad \dots \quad \dots \quad (4)$$

$$Y_t = \theta Z_t + \pi U_t + e_t$$

This model assumes both structural neutrality (only unexpected monetary growth affects real output) and rational expectations (expected monetary growth equals the predictable component of the process determining monetary growth). The presence in the real output equation of the random component of the money growth equation,  $U_t$ , and the absence of any other component of monetary growth in that same equation reflects the imposition of both these assumptions.<sup>7</sup>

<sup>7</sup> Mishkin (1982) argues for a joint estimation of the money growth and output equations. His point is that any covariation between  $\phi_1, \phi_2$ , and  $\theta$  across Equation (4) implies that simultaneous estimates will be more efficient than OLS estimates. Both procedures, however, yield consistent parameter estimates [see Hoffman and Shagenhauf (1987)]. Also, Mishkin (1982) finds that neutrality tests are quite robust across reasonable variations in the money growth equation specifications. We do not believe that the marginal gains in efficiency justifies a systems approach and therefore use the two step OLS procedure.

Another possible problem with Equation (4) is that this model may be observationally equivalent to a Keynesian model [see Sargent (1976)]. However for that to be the case not only must the current error term in the output equation influence monetary growth but every error term back to period  $t-n$  [see Attfield, Demery and Duck (1981)].

### 3. A MONETARY GROWTH EQUATION IN THE CASE OF PAKISTAN

The most crucial and difficult issue in testing rational expectation models is how to generate appropriate measures of anticipated and unanticipated policies. Past studies of economic determinants of monetary policies have focused albeit in an adhoc manner, on the identification of the economic variables that have had a systematic influence on the monetary authorities, involving the search for a statistically significant relationship between objectives of monetary policies which can be quantified and economic variables thought to be representative of these objectives. Theoretical and empirical work, by Bradley and Potter (1986) have augmented this earlier approach by deriving policy-maker reaction functions from an optimization procedure minimizing the policy-maker reaction function with respect to policy instruments.

In order to predict future money supply growth in Pakistan one has to consider what considerations have guided the State Bank's actions in the past. In ascertaining the important predictors of monetary growth we have employed the methodology proposed by Porzecanski (1979). Briefly, this entails first defining alternative sets of internally consistent monetary policy objectives and then estimates of the authorities reaction pattern are obtained empirically.

In the past, the foreign exchange rate in Pakistan was either fixed (1960 to 1981) or allowed to float within a certain range (1981 to the present). Given this, one would expect that the State Bank's policy would have been geared to prevent external disequilibrium i.e., if foreign reserves began to decrease, a restrictive policy would have been adopted in an effort to induce a fall in aggregate demand and a rise in interest rates. However, another preoccupation of the State Bank has been to keep the interest rate low to keep the costs of financing budget deficits low and perhaps to encourage investment in particular sectors [see Khan (1987)]. Obviously these two objectives appear to be incompatible.

This apparent incompatibility of objectives, in the case of Pakistan, is resolved by the fact that imports were restricted through selective tariffs and licensing schemes instead of through restrictive monetary policy and interest rates were kept low through credit rationing. Therefore it is reasonable to postulate the following general form of the money growth equation:

$$DM_t = m_0 + m_1 DM_{t-1} + m_2 DDC_{t-1} + m_3 DFER_{t-1} + e_t \quad \dots \quad (5)$$

where  $DM$  is the annual rate of change in the money supply ( $M_1$ );  $DDC$  is the growth in domestic credit; and  $DFER$  is the growth in foreign exchange reserves.

We expect  $m_1 < 0$  implying that monetary growth is liable to be restricted in the present if past year money growth was high;  $m_2 > 0$  indicating an expansionary

stance if domestic credit demand (including investment loans and government deficit) growth was high in the previous period in order to ease pressure on the interest rate; and  $m_3 > 0$  suggesting that if foreign reserves grew rapidly in the past, the State Bank would ease money growth in the present.

The OLS results of estimating Equation (5) over the years 1963–1986 are:<sup>8</sup>

$$DM_t = 0.006 - 0.005DM_{t-1} + 0.725DDC_{t-1} + 0.067DFER_{t-1} \dots \quad (6)$$

(0.58) (-0.04) (5.74) (3.13)

$$\text{Adj. } R^2 = 0.63 \quad D.W. = 2.29 \quad F = 14.02$$

This estimated equation has a number of satisfactory features. There is a significant positive reaction of growth of the money supply to the past growth in domestic credit and foreign reserves.

Firstly, as required, contemporaneous values of the explanatory variables are omitted from the equation since only information at time  $t-1$  is available when expectations of money growth are formed. Secondly, a sizable portion (about 62 percent) of the variation in money growth is explained. Finally, the monetary growth series is not strongly autocorrelated, as evidenced by statistical weakness of the  $T$  test associated with the lagged value of  $DM$ :  $DM_{t-1}$ . Also, the plot of the residuals of the money growth equation ( $DMR$ ) given in Figure 1 below, exhibits close to a white noise pattern.<sup>9</sup>

Assuming that Equation (6) can be regarded as a rough approximation of how the public might perceive the movements of the  $DM$  variable, its residuals can be taken as an estimate of the unanticipated growth of the money supply which we denote by  $DMR_t$ .

#### 4. ESTIMATION OF THE OUTPUT EQUATION

The general form of the output equation is expressed by the following equation:

<sup>8</sup>The data for this study have been obtained from *Pakistan Economic Survey 1987-88*, Government of Pakistan; and from *International Financial Statistics*, annual issues, International Monetary Fund.

<sup>9</sup>Another requirement is of temporal stability in order to postulate that economic agents had sufficient knowledge of the structure of money growth throughout the period. For most of the period under study i.e., 1960 to 1981, Pakistan has had fixed exchange rates and it can be argued that the structure of monetary policy-making has been stable. However starting from 1981 it went on a managed float and to test for structural stability one could divide the time period on that basis. However due to lack of sufficient observations after 1981, a Chowtest would serve no purpose. Choosing any other breaking date would be purely arbitrary.

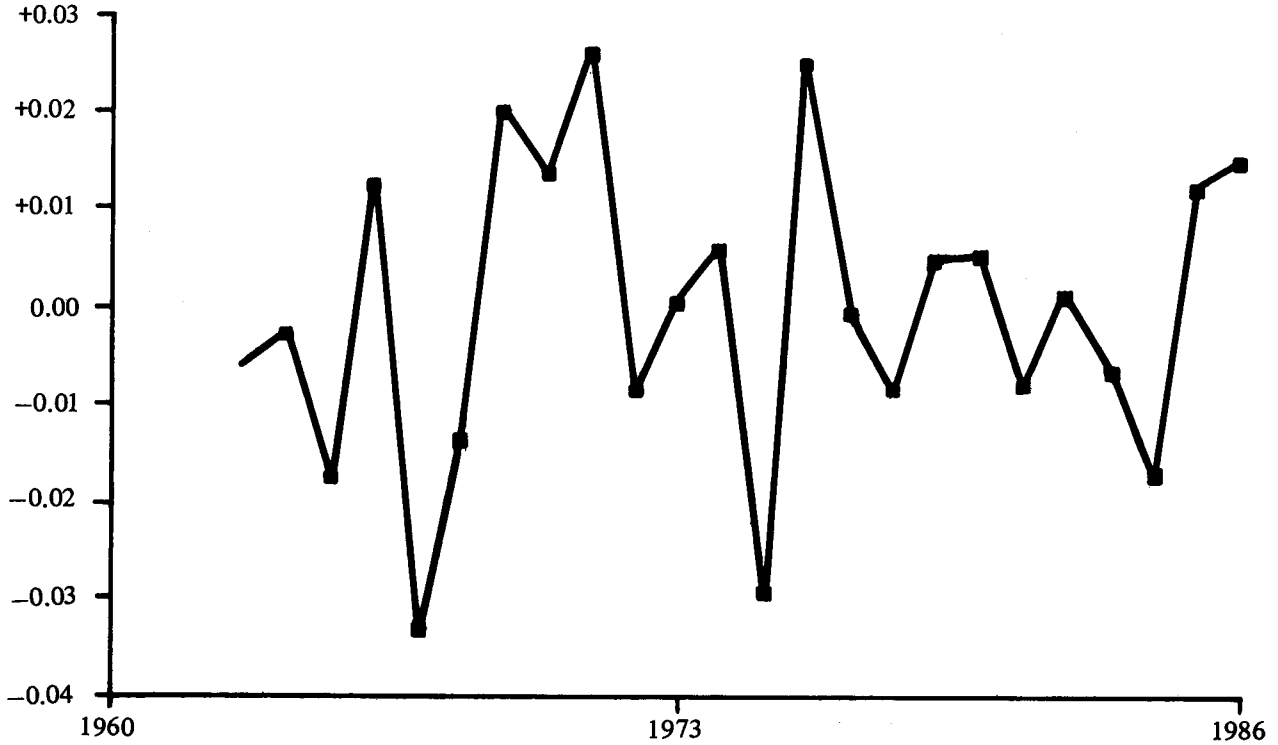


Fig. 1. Pattern of Residuals of the Money Growth Equation (6).

$$DY_t = B1(L)DMA_t + B2(L)DMR_t + B3(L)DG_t + e_t \quad \dots \quad (7)$$

$DY$  is the log of real output.  $DMA$  is the anticipated money supply growth in period  $t$  predicted by Equation (6).  $DMR$  is the unanticipated money supply growth in period  $t$  which is obtained as the residual of the money growth Equation (6).  $DG$  is the log of real value of government purchases at time  $t$ .  $B1(L)$ ,  $B2(L)$ , and  $B3(L)$  are defined as  $\sum_{i=0}^{N_1} B1_i L^i$ ,  $\sum_{i=0}^{N_2} B2_i L^i$ ,  $\sum_{i=0}^{N_3} B3_i L^i$  respectively, where  $L$  is the lag operator and  $N_1$ ,  $N_2$ , and  $N_3$  are assumed to be finite. The real value of government purchases presumably has an important role in influencing aggregate demand and thereby in affecting output and employment.

Several variants of Equation (7) were estimated by imposing different lag structures on the explanatory variables. In all these estimated versions the salient and robust finding was that unanticipated money growth had either insignificant effects on output or that it had a negative effect. On the other hand anticipated money growth appeared to have significant and positive effects on real output. We report below the most satisfactory estimated output equation for the period 1965 to 1986:

$$\log Y_t = 0.072 + 0.687DMA_t - 1.11DMR_t + 0.738DG_t \quad \dots \quad (8)$$

(0.41)    (5.30)            (-2.06)            (2.66)

$$\text{Adj. } R^2 = 0.9976 \quad D.W = 1.85 \quad F = 662.45$$

## 6. COMPARISON WITH OTHER STUDIES

Since Barro's earlier work on the effects of unanticipated changes in output and prices, numerous studies have attempted either to support or to refute Barro's basic conclusion using data for the U.S., U.K., Canada, Italy, Mexico individually. More recent studies such as the ones by Atfield and Duck (1983); Sheehy (1984); Kormendi and Meguire (1984), use data from a range of countries to test the proposition that monetary growth affects real output only if it is unanticipated. After having examined most of the studies, if not all, we have found that they differ widely in terms of time periods, data frequency, statistical techniques, and the types of independent and dependent variables used. In light of the conflicting results there appears to be no clear evidence in support of the hypothesis that anticipated money has no real effects and that unanticipated money growth does.

Our intention here is not to resolve the controversy on the neutrality hypothesis, but to see how our results compare with results of countries similar to Pakistan. In this respect we compare our results to the ones obtained for Korea, Sri Lanka, Philippines, and Turkey by Kormendi and Meguire (1984, 1985) in their



study of 47 countries. Whereas we find that part of the money supply growth in Pakistan is predictable in that it differs from a random walk with trend, in the case of the Philippines and Turkey the growth in money supply was a random walk with trend, and for Sri Lanka and Korea there was no predictable component.

Turning to the estimation of the real output effects of unanticipated money supply changes, the results obtained for all four countries were similar to ours in that the coefficients on the unanticipated money growth variable were not statistically significant. Therefore it appears from our findings that there are short-run effects of even anticipated money growth in the case of Pakistan. This may be explained by the structural and institutional rigidities peculiar to Pakistan such as price credit and foreign exchange controls.

## **7. THE RELATIONSHIP BETWEEN OUTPUT AND GOVERNMENT SPENDING**

The previous sections focused on the relation between output and money growth, which is one of the two topics of this study. We also want to evaluate the output response to government spending for Pakistan, with special emphasis on the distinction between permanent and temporary spending.

In his paper on the economic effects of government purchases, Barro (1981a) carried the concept of neutrality further in his attempt to focus on the distinction between what can be conceived as temporary versus permanent government purchases. Similar analyses of the effects of government spending, in different contexts have been undertaken by Ahmed (1986) and Leon (1987).

Barro (1981) reexamines the typical macroeconomic analysis result that assigns government purchases an important role in influencing aggregate demand within the context of an equilibrium model. His empirical test of the hypothesis on government spending consisted of first separating U.S. government purchases into three components: a temporary military spending component, a permanent military spending component, and a nondefense government purchases component, and then ascertaining the differential impacts of these components on output. Barro found empirical evidence that temporary movements in defense purchases — associated primarily with wartime — produce a larger response in output than similar permanent shifts in defense purchases. The effects of nondefense purchases were found to be imprecisely determined.

In his study for the U.K. Ahmed (1986) found that there was substantial crowding out of private spending by government spending, that government spending is a significant productive input into the production process, and that permanent changes in government spending lead to a negative wealth effect. For France, Leon (1987) found that the output effects of both temporary and permanent government spending to be statistically insignificant.

In the present study we have made a preliminary attempt to test the hypothesis that temporary government expenditures have larger output effects than permanent government expenditures. To obtain the temporary component of government spending, we use a similar method to the one used previously in this study to obtain the unexpected component of money growth. As with money growth, the decomposition of the real growth of government expenditures into its anticipated (permanent) and unanticipated components (temporary) can only be achieved if changes in fiscal policy can be characterized by a relatively "stable" stochastic process.

We attempted to obtain a quantitative explanation of the growth of real government expenditures in terms of its own lagged values (by imposing different lag schemes) and lagged values of other relevant variables such as employment, per-capita income, trend, lagged rate of inflation, and the like without much success. The most satisfactory equation for the period 1963 to 1986 was:

$$DG_t = 0.024 + 0.641DG_{t-1} - 0.047DG_{t-2} \quad \dots \quad (9)$$

(2.20)    (3.09)            (-0.22)

$$\text{Adj. } R^2 = 0.35; \quad D.W. = 2.07; \quad F = 7.15$$

where  $DG$  is the annual rate of change in real government expenditures. Although a great deal of the variation in the  $DGR$  variable is still left unexplained by Equation (9), it is noteworthy in that it verifies the view that there is a tendency for real government expenditures to persist as verified by the significant coefficient of lagged  $DG$ . The plot of the residuals in Figure 2 is indistinguishable from a white noise pattern.

Assuming that Equation (9) can be regarded as a rough approximation of how the public perceives the movement of real growth of government expenditures, its residual can be regarded as temporary or unanticipated real growth of government expenditures which is denoted by  $DGR$ .

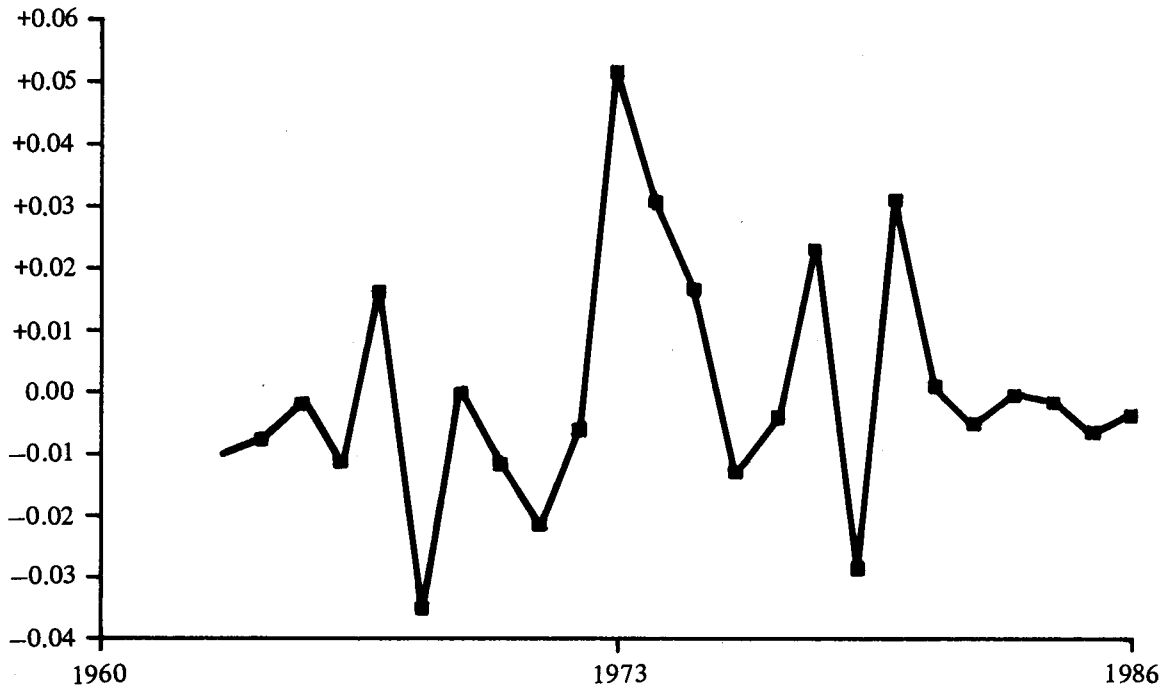
The results of the estimation of the output equation for the period 1963 to 1986 are as follows:

$$\text{Log } Y_t = 0.12 + 0.166DG_t + 0.845DGR_t + 0.844\text{Log}Y_{t-1} \quad \dots \quad (10)$$

(1.95)    (2.79)            (5.78)            (13.52)

$$\text{Adj. } R^2 = 0.99; \quad D.W. = 1.31; \quad F = 9049$$

interestingly both the coefficients of the anticipated and unanticipated real government spending are statistically significant. However, the sizes of the coefficients suggest that unanticipated (temporary) real government spending has more pro-



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**Fig. 2. Pattern of Residuals of Growth in Government Expenditures Equation (9).**

nounced effects than permanent real government spending. Our findings for Pakistan are similar to Barro's findings for the U.S. in this respect.

## 8. SUMMARY AND CONCLUSIONS

In this paper we examined the structural neutrality proposition of the New Classical School for Pakistan using annual data for the period 1960–1986 or thereabouts. The monetary growth equation was found to depend primarily on lagged domestic credit growth, lagged growth in foreign exchange reserves, and a lagged monetary growth term. Given the statistical significance of the result it was concluded that monetary growth in Pakistan is to some extent anticipated.

Defining unanticipated money growth as the residuals from the money growth equation, there was no evidence to indicate that only unanticipated money growth has real output effects. Our results for the output equation were found to be similar to results for other developing countries.

Moreover it was found that the anticipated component of money growth was significant in explaining changes in real output indicating Keynesian type effects of stabilization policies for Pakistan. It is quite possible that there are some other variables that could prove to be better predictors of money growth which, if included, would produce a series for *DMR* supporting the hypothesis that only unanticipated money matters.

On the other hand, in terms of fiscal policy, our findings for Pakistan support the view that temporary government expenditures have more pronounced effects on output in contrast to permanent real government expenditures.

It would be useful to test the hypotheses for other similarly placed developing countries before making any broad generalizations from our results.

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## Comments on “Output Effects of Stabilization Policies: The Case of Pakistan”

I am happy to see that economists are still struggling and working in the area of *Rational Expectations* in Pakistan. When I presented my earlier paper [Hasan (1987)] at the *Fourth PSDE Annual Conference* in 1987, I thought that it would be the first and last paper in the area of *Rational Expectations* on Pakistan's economy, not because it was a seminal paper but more importantly, in my opinion, because there are many misconceptions and misgivings about the interpretation and application of this topic on developing economies. I am glad to see that Professors Khilji and Leon have competently attempted to clarify some of the ambiguities about the *Rational Expectation Hypothesis* (REH) that perhaps was not evident in my earlier paper.

At the most general level, REH implies that economic agents forecast in such a way so as to minimize forecast errors [ $(X_t - X_{t,t-1}^e)$ ] subject to the information and decision-making costs that confront them. The idea behind REH hypothesis is simply that the agents do the best they can, under the circumstances, in forecasting activities. Under no circumstances does it mean that agents make no forecast errors.

As pointed out by the authors, Lucas (1972) started the so-called *RE revolution* in macroeconomics, but it was only after Sargent and Wallace (1975, 1976) used the hypothesis in their work on optimal monetary policy that the idea became more well-known. Much of the attention in the RE literature that followed, unfortunately, was directed on the issue of the *irrelevance of government policies* in affecting the aggregate demand even in the short-run. Taylor (1975); McCallum (1980) and others, however, have demonstrated analytically that such policy irrelevance results do not depend on the assumption of RE at all. In fact, the stabilization policy issues remain legitimate and provide useful solutions when one presumes that agents are rational.

The paper by Professors Khilji and Leon is another study in this direction, in which they have empirically shown that stabilization policies can still matter even for a developing country like Pakistan.

The analytical part of the paper is standard and common to the literature in other areas of macroeconomics. For example, this sort of analytical model has been extensively used to test the efficiency of the financial markets [e.g., Taylor (1975);

Urich (1982); Roley (1983); Mishkin (1983) and Hasan and Moussa (1990)]. Since the analytical model used by the authors seems appropriate and consistent, my comments are mostly focused on the empirical part of the paper.

### Policy Reaction Function

In the introduction of the paper, the authors have rightly argued that the monetary policy in Pakistan has been generally accommodating in nature, in that it takes into account factors like changes in the level of GNP, inflation rate, budget surplus or deficit and, to a lesser extent, unemployment domestic credit and foreign exchange reserves. This information is publicly available to the agents at least at time  $t-1$ . However, in forming expectations about money growth rate ( $DM$ ) in Equation (6), the authors have taken into account only a part of the larger publicly available information set. In my opinion, this could be the cause of the low explanatory power ( $R^2$ ) in forecasting ( $DM$ ). More importantly, in order to be consistent with REH, the agents should be forming expectations with all the available information.

### Generating Unanticipated $DM$ Values

In order to generate the unanticipated or anticipated values of  $DM$ , authors have only incorporated the autoregressive ( $AR$ ) components [i.e.,  $DM_{t-1}$ ,  $DM_{t-2}$  ...]. However, it is now well-known in the literature that the unanticipated values may also be influenced by the moving average ( $MA$ ) factors as well. Thus, by using an ARIMA process, the authors can easily generate the anticipated  $DM$  values and such a process is also consistent with REH [e.g., Urich (1982)].

### Lagged $DMA_{t-1}$ and $DMR_{t-1}$

I could not understand the authors' rationale for using the lagged values of  $DMA_{t-1}$  and  $DMR_{t-1}$  in Equation (8). Presumably, the lagged values of  $DMA_{t-1}$  and  $DMR_{t-1}$  are known at period  $t$ . If the REH is correct then it is the contemporaneous values of these variables that are unknown and the rational agents would forecast such variables rather than the lagged values.

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