CHAPTER - VI

ANTICIPATED AND UNANTICIPATED MONEY SUPPLY : EFFECT ON OUTPUT VARIATION

6.1 INTRODUCTION :

The introduction of rational expectatioins to a macro-economic model affects dramatically the ability of a government or a Central Bank to control economic policy. In presence of rational expectations, real variables (such as relative prices, unemployment rate and real output) are independent of changes in the Anticipated Monetary Policy. Rational expectationists like Sargent, Lucas and N. Wallace hold that change in money supply, if it is already anticipated by the agents, affects only inflation but it has no effect on real output and employment. This is the famous "Invariance Proposition" put forth by the rational expectationists. This proposition asserts that any predictable part of money supply would have no effect on output, employment or any other real variables in the economy. Only unpredictable money supply changes can affect output level, employment or any other real variables in the economy.

The idea of 'Invariance Proposition' can be clearly explained following Lucas. Let real output level (y_t)[38] be regressed on anticipated money supply (M_t^e) and unanticipated money supply (UM_t). Such that

$$Y_t = Y_p + \beta_1 M_t^e + \beta_2 UM_t + V_t \quad \text{.....} \quad (6.1)$$

Here Yp is the capacity or existing output level.

$$\text{So } Y_t - Y_p = \beta_1 M_t^e + \beta_2 UM_t + V_t$$

$$\text{or, } y_t = \beta_1 M_t^e + \beta_2 UM_t + V_t \quad \text{.....} \quad (6.2)$$

where y_t represents the variation in output around its capacity level. The 'Invariance Proposition'holds that $\beta_1 = 0$ and $\beta_2 \neq 0$. Thus output fluctuates randomly around the existing (or capacity) level (Y_p) following unanticipated fluctuations in the money stock only. The behavioiur of output level, therefore, is independent of any predictable counter-cyclical (or even procyclical) policy by the monetary authorities. Any predictable rule for monetary policy is as good as any other rule so far as output determination is concerned. The behaviour of prices will, however, reflect the choice of the feedback rule.

---

38. Here $y_t = Y_t - Y_p$. However, Y_p is proxied through $\overline{Y}$. Please see chapter IV (section 4.2) for the rationale behind the use of $\overline{Y}$ for Y_p.

We seek to examine if such invariance proposition holds in Indian Economy. In Chapter-IV we have observed that output level has responded over time to money supply. It is a matter of interest to know if such positive response is varied in anticipated or unanticipated part of money supply. This chapter seeks to address this issue.

6.2 THE MODEL

The model used for estimation in this chapter is basically Lucas type model such that

$$Y_t = Y_p + \beta_1 M_t^e + \beta_2 UM_t + V_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (6.3)$$

Through transformation, we get

$$y_t = \beta_1 M_t^e + \beta_2 UM_t + V_t . \qquad [y_t = Y_t - Y_p] \ldots\ldots\ldots\ldots (6.4)$$

However, because of estimation of constraints[39] the equation (6.4) is modified accordingly as follows :

$$y_t = \alpha + \beta_1 M_t^e + \beta_2 UM_t + V_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (6.5)$$

It may again be noted that, in case of estimation of this equation, the Vectors of M_t have been used as the data set for M_t^e. Similarly, for the data set of UM_t the vectors of ε_t have been used. These vectors of M_t^e and UM_t derived through the use of the equation 5.10 in Chapter - V and shown in the table-6.1.

39. Please see chapter-IV (section 4.2) for the estimation of constraint concern and the rationale behind such transformation.

TABLE-6.1

ANTICIPATED(M^e_t) AND UNANTICIPATED (UM_t) PARTS OF MONEY SUPPLY[40]

Year	M^e_t (in billion of Rs.)	UM_t (in billion of Rs.)
1951	1.366	-0.04218
1952	1.354	-0.03987
1953	1.344	-0.01978
1954	1.354	0.001016
1955	1.386	0.01610
1956	1.435	-0.001328
1957	1.466	0.008856
1958	1.509	0.007872
1959	1.552	0.01502
1960	1.604	-0.01384
1961	1.627	-0.02343
1962	1.641	0.002412
1963	1.682	0.005070
1964	1.727	-0.0005678
1965	1.767	0.004212
1966	1.813	0.004293
1967	1.861	-0.004264
1968	1.90	-0.004577
1969	1.941	0.01009
1970	1.998	0.002651
1971	2.048	0.02067
1972	2.118	0.01258
1973	2.1820	0.02605
1974	2.261	-0.003163
1975	2.313	0.002529
1976	2.371	0.03904
1977	2.469	0.01766
1978	2.547	0.02277
1979	2.633	0.003192
1980	2.705	-0.0004592
1981	2.771	0.003457
1982	2.843	0.0009479
1983	2.914	-0.002053
1984	2.983	0.0001767
1985	3.057	-0.005698
1986	3.126	-0.003768
1987	3.20	-0.02213
1988	3.256	0.00513
1989	3.342	-0.01735
1990	3.407	-0.02151
1991	3.470	-0.01090

40. The data set on Met and UMt are presented upon log- transformation. These add up to total money supply (stationary). Stationarity in the total money supply is ensured through First Differencing. This accounts for the beginning of the data set at 1951.

6.3 ESTIMATION AND FINDINGS :

The GLS estimation of the equation [41]-

$$\hat{y}_t = 0.226598 + 0.65303M_t^e + 0.10351UM_t \quad \text{..... (6.6)}$$
$$(0.0141688)(0.12864) \quad (0.48192)$$
$$[15.9927] \quad [50.761] \quad [0.2536]$$

$R^2 = 0.603523$ D.F. = 37

$F^* = 8.065$ D.W. = 1.99

It is observed from the equation that

(i) the equation is good fit at 1% level since $F^* = 8.065$;

(ii) the equation is free from auto-correlation since D.W. = 1.99 ;

(iii) the regression constant ($\hat{\alpha}$) ;and the regression co-efficient ($\hat{\beta}_1$) are significant even at 5% level and

(iv) the other regression co-efficient ($\hat{\beta}_2$) is not significant even at 1% level.

6.4 IMPLICATIONS OF THE FINDINGS :

These findings have several implications. First, $\hat{\beta}_1 > 0$ is significant and $\hat{\beta}_2$ is insignificant even at 1% level. It, therefore, appears that output variation around its capacity levels is mainly due to the changes in anticipated part of money supply. Output level seems to rise above its capacity level when money supply is anticipated to rise. Similarly, output level seems to have gone down below its capacity level (Y_p) in response to an anticipated fall in money supply.

It, therefore, appears that the positive response of output level to changes in money supply as observed in section 4.4(Chapter-IV) indicates basically the positive response $\hat{\beta}_1 > 0$ of output variation around its capacity level (Y_p) to the changes in anticipated part of money supply only.

---

41. The OLS estimation of this equation is shown in table-6.2 as the estimated alternative model - 5.

Second, $\hat{\beta}_2$ is not significant even at 1% level. It indicates that surprize part of money supply variation has no bearing on output variation over the period concerned (1950-91).

Third, $\hat{\beta}_1 > 0$ and insignificant $\hat{\beta}_2$[42] bear no testimony to the 'Invariance Proposition' as put forth by the rational expectationists.

Fourth, $\beta_1 > 0$ indicates that any monetary policy which is designed to affect the anticipated part of money supply can affect output level. It may be noted that monetary policy formulations, which affect money supply, can only control the anticipated part of money supply. Consequently, monetary policy seems to have a significant role in Indian Economy over the period of study.

Any counter cyclical or pro-cyclical monetary policies designed to control money supply is systematic and, therefore, known to market participants. That is why, the market participants take due note of these policy parameters while forming their anticipation for money supply. $\beta_1 > 0$ indicates that changes in these policy parameters mights have significant bearing on output variation around its capacity level over the period concerned (1950-91). Several alternative models have been estimated as shown below :

---

42. In order to confirm if $\beta_2 = 0$, the equation (6.5) is further estimated with the following modification where UM_t is the only independent variable :

$$y_t = \delta + \beta_2 UM_t + w_t$$

The GLS estimation of the equation is

$$\hat{y}_t = -0.0041209 + 0.086891 UM_t$$
$$(0.0039412) \quad (0.2623)$$
$$[-1.0456] \quad [0.3311]$$

$R^2 = 0.0032132$ D.F. = 37
$F^* = 0.1096$ D.W. = 1.52

It is observed that
(i) the estimated equation is not good fit since R^2 and F^* are very small ;
(ii) the equation is free from auto-correlation at 1% level.
(iii) $\hat{\beta}_2$ is not significant even at 1% level.

This further indicates that unanticipated money supply bears no effect on the variation of output around its capacity level (Yp) over the period concerned (1950-91).

6.5 ESTIMATION OF ALTERNATIVE MODELS : COMMENTS

Alternative Model - 1

$$Y_t = a + b_1 M_t^e + b_2 UM_t + u_t$$

The OLS estimation of the equation is

$$\hat{Y}_t = 0.8278 + 0.8558M_t^e + 2.7491\ UM_t$$
$$(0.042227)\ (0.018338)\ (0.7681)$$
$$[19.603]\quad [46.668]\quad [3.5791]$$

D.F. = 38 $\qquad R^2 = 0.9829$

F* = 1094.5 $\qquad$ D.W.=0.40

Here we have taken non-stationary data set of log transformation of GNP (Y_t) regressed on anticipated (M_t^e) and unanticipated (UM_t) money supply. The equation gives us that

(i) regression constant ($\hat{\alpha}$) and regression co-efficients ($\hat{\beta}_1$ and $\hat{\beta}_2$) are found significant even at 5% level ;

(ii) the equation is good fit since $R^2 = 0.982$ and F* = 1094.5 and

(iii) the equation suffers from A.C. even at 1% level. Hence rejected.

Alternative Model-2 :

The GLS estimation of the equation shown in alternative model-1 is

$$\hat{Y}_t = 0.58320 + 0.62105\ M_t^e + 1.05321UM_t$$
$$(0.123541)\ (0.193521)\quad (0.985210)$$
$$[4.7207]\quad [3.2092]\qquad [1.06902]$$

D.F. = 37 $\qquad R^2 = 0.60325$

F* =16.72 $\qquad$ D.W.=2.01

Here $\hat{\beta}_2$ fails to be significant representing s that the unanticipated money supply (UM_t) has no effect on GNP (Y_t).

Alternative Model - 3

$$Y_t = \alpha + \beta_1 Y_{t-1} + \beta_2 M_t^e + \beta_3 UM_t + v_t$$

The OLS estimation of the equation is

$$\hat{y}_t = 0.01704 + 0.8069\, Y_{t-1} + 0.1775 M_t^e + 0.3486 UM_t$$
(0.096156) (0.1069) (0.08686) (0.2179)
[1.7723] [7.5507] [2.0441] [1.5997]

D.F. = 37 $R^2 = 0.9986$

F* = 93915 D.W.= 0.7689

Here we have taken non-stationary data set of log-transformation of GNP (Y_t) and one period lag of GNP (Y_{t-1}). The equation tells us that -

(i) The regression constant ($\hat{\alpha}$) and and the regression co-efficients ($\hat{\beta}_1$, $\hat{\beta}_2$ and $\hat{\beta}_3$) are significant at 1% level ;

(ii) The equation is good fit since $R^2 = 0.998$ and F* = 9391.5 ; and

(iii) The equation suffers from A.C. even at 1% level. So omitted.

Alternative Model - 4 :

The GLS estimation of the equation shown in alternative model-3 is

$$\hat{Y}_t = 0.00123 + 0.21054 Y_{t-1} + 0.00917 M_t^e + 0.08513 UM_t$$
(0.000521) (0.08352) (0.00135) (0.07355)
[2.3608] [2.5208] [6.7925] [1.1574]

D.F.= 36 $R^2 = 0.61352$

F* = 12.69 D.W.= 2.08.

Here $\hat{\beta}_3$ is not significant indicating that the unanticipated money supply (UM_t) has no effect on GNP (Y_t).

Alternative Model-5

$$Y_t - \bar{Y} = \alpha + \beta_1 M_t^e + \beta_2 UM_t + w_t$$

$$\text{or, } y_t = \alpha + \beta_1 M_t^e + \beta_2 UM_t + w_t$$

The OLS estimation of the equation is

$$\hat{y}_t = -1.8339 + 0.8324M_t^e + 0.8404UM_t$$
$$(0.017988) \quad (0.0078116) \quad (0.3272)$$
$$[-101.95] \quad [106.55] \quad [2.5685]$$

D.F. = 38 $\qquad R^2 = 0.9966$

F* = 5678.8 $\qquad$ D.W.=0.5062

This is an alternative OLS estimation of non-stationary data set of the equation (6.5).

It is observed that

(i) the regression constant ($\hat{\alpha}$) and the regression co-efficients ($\hat{\beta}_1$ and $\hat{\beta}_2$) are significant even at 5% level ;

(ii) the equation is good fit since $R^2 = 0.996$ and F* = 5678 ; and

(iii) the equation suffers from A.C. at 5% level. So the equation is not considered for the analysis in our study.

All these alternative models along with the estimation have been presented in the Table-6.2.

TABLE - 6.2

Results of estimation of alternative models

Sl.No.	Model	Method	Estimation	D.F.	R^2	F*	D.W.
1	2	3	4	5	6	7	8
1	$Y_t = \alpha + \beta_1 M_t^c + \beta_2 UM_t + u_t$	OLS	$\hat{Y}_t = 0.8278 + 0.8558 M_t^c + 2.7491 UM_t$ (0.042227) (0.018338) (0.7681) [19.603] [46.668] [3.5791]	38	0.98293	1094.5	0.400
2.	$Y_t = \alpha + \beta_1 M_t^c + \beta_2 UM_t + u_t$	GLS	$\hat{Y}_t = 0.58320 + 0.62105 M_t^c + 1.05321 UM_t$ (0.123541) (0.193521) (0.985210) [4.7207] [3.2092] [1.06902]	37	0.60325	16.72	2.01
3.	$Y_t = \alpha + \beta_1 Y_{t-1} + \beta_2 M_t^c + \beta_3 UM_t + v_t$	OLS	$\hat{Y}_t = 0.01704 + 0.8069 Y_{t-1} + 0.1775 M_t^c + 0.3486 UM_t$ (0.096156)(0.1069) (0.08686) (0.2179) [1.7723] [7.5507] [2.0441] [1.5997]	37	0.99868	9391.5	0.768
4.	$Y_t = \alpha + \beta_1 Y_{t-1} + \beta_2 M_t^c + \beta_3 UM_t + v_t$	GLS	$\hat{Y}_t = .00123 + .21054 Y_{t-1} + .00917 M_t^c + .08513 UM_t$ (0.000521) (0.08352) (0.00135) (0.07355) [2.3608] [2.5208] [6.7925] [1.1574]	36	0.61352	12.69	2.08
5.	$Y_t - \bar{Y} = \alpha + \beta_1 M_t^c + \beta_2 UM_t + w_t$ i.e. $y_t = \alpha + \beta_1 M_t^c + \beta_2 UM_t + w_t$ $[y_t = Y_t - \bar{Y}]$	OLS	$\hat{y}_t = -1.8339 + 0.8324 M_t^c + 0.8404 UM_t$ (0.017988) (0.0078116) (0.3272) [-101.95] [106.55] [2.5685]	38	0.99666	5678.8	0.506

6.6. SOME RELEVANT ISSUES :

The findings are based on the estimation of the equation (6.6) with a historical data set ranging from 1950 to 1991. Over this period, India got herself transformed from a predominantly agrarian economy to an economy with sound industrial base. Several economic plans have been undertaken and executed with varying degrees of success during this period. Several banks have been nationalized and economic justice has been accorded to priority sectors of the economy. Thus, the period is marked with spectacular economic and social transformations together with varying rates of growth.

This long period, therefore, may be considered as a time span with heterogeneous process of growth. Growth of output and that of money supply have been varying overtime within this period. Consequently, the overall picture which we have obtained from the use of historical data set may have summarized the relations over different individual sub-periods concerned. This calls for the investigation into the response of output level to the changes in anticipated and unanticipated parts of money supply over shorter homogeneous sub-periods. It may then be expected to provide dynamic and better insight into the response of output levels to the changes in different parts of money supply over the period concerned. However, before such study is undertaken, it becomes pertinent to identify some homogeneous sub-periods. This constitutes the matter of over study in the following chapter.