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Sani I. Doguwa
Central Bank of Nigeria

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On the Stability of Money Multiplier Relations in Nigeria: An Alternative Testing Procedure

Dr. Sani I. Doguwa*

The question of stability over time of the adjusted money multiplier relation is of crucial importance for adjusted base money to act as the main link to money supply. This paper tests the hypothesis of stability of money multiplier relations in Nigeria using the forward recursive cusum of squares that uses a confidence interval which is distributed as Pyke's modified Kolmogrov-Smirnov statistic. The results of the stability tests applied to monthly data from January, 1991 to December, 1995 suggest that the functions underlying the adjusted money multipliers were not stable between March, 1992 and December, 1994. The two multiplier relations were, however, found to be stable in fiscal 1995, suggesting that the adjusted base money was the main link to the money stock in that period.

I. INTRODUCTION

Monetary control can be achieved through the indirect control instruments such as the Open Market Operations as currently practised in Nigeria. Under the indirect approach to monetary control, the instruments are normally set and adjusted accordingly to influence the money supply targets through their effects on the monetary base and ultimately on the final objectives of economic policy of moderate inflation, sustainable growth as well as strengthening the external sector performance. Oke (1995) provides the theoretical framework for the operation of the indirect monetary control in Nigeria. However, a sufficient condition for the use of this method is that there should be a stable relationship between the monetary base and the money supply such that changes in the former would be transmitted to the latter in a stable and predictable manner over time. Furthermore, this stable relationship can also be used to estimate the level of money supply arising from a given level of monetary base and the multiplier.

* The author is a Principal Statistician, Research Department, Central Bank of Nigeria, Abuja, He is grateful to the anonymous referee, the editor and the Departmental Editorial Board for their invaluable comments on the earlier draft of this paper. The views expressed in this paper are personal to the author and are not necessarily shared by the Central Bank of Nigeria.

Uchendu (1995) explores the basic assumption of a stable relationship between the monetary base and the money supply over time which has hitherto not been empirically established in Nigeria. There are standard methods for testing the stability (or constancy) of the parameter estimates of the model relations or parameter structural change over time discussed in the literature [Cuthberston et al. (1992), Brown et al. (1975)]. The empirical analysis in Uchendu (1995) fell short of establishing the significance of the stability or constancy of the money multiplier relations. This assertion follows from a perceived flaw in the arguments contained in the equations I.6 and II.1, which for clarity are reproduced in this paper as equations 1a and 1b, respectively:

$$M_s = mBM \tag{1a}$$

$$\text{Log}(M_s) = c + m\,\text{Log}(BM) + e \tag{1b}$$

where m is the money multiplier, BM is the base money and M_s is the money stock. The error term, e, is considered to be normally distributed with zero mean and constant variance.

Taking the natural logarithms of both sides of equation 1a gives:

$$\text{Log}(M_s) = \text{Log}(m) + \text{Log}(BM) \tag{2}$$

Therefore, it follows from equation 2 that if M_s is log-linearly related to the base money, BM, then the following relations

$$\text{Log}(M_s) = c_0 + c_1\,\text{Log}(m) + c_2\text{Log}(BM) + e \tag{3}$$

should hold. Comparing the regression coefficients in equation 3 with that of equation 1b gives:

$$c = c_o + c_1\text{Log}(m) \tag{4}$$

and

$$m = c_2 \tag{5}$$

From equation 4, it is clear that the constant term, c, of equation 1b could also be a function of the money multiplier, m. Moreover, from equations 1a and 1b it is apparent that equation 5 cannot hold, ostensibly because:

$$m = \frac{M_s}{BM} \neq \frac{\text{Log}(M_s)}{\text{Log}\ (BM)} = c_2 \tag{6}$$

This is further depicted in Figures 1 (a and b) for the adjusted narrow and broad money multipliers. For equation 5 to be valid, the two series presented in Figure 1 for each of the money multipliers must necessarily be identical. But this is not the case, implying that the multiplier, m, defined in equation 1b cannot be the same money multiplier defined in equation 1a.

For the stability testing procedure, Uchendu (1995) applied the moving regression (MR) method of Brown et al. (1975), using a combined regression-time series model, with five-year moving interval and six-monthly increment from June, 1976 to December, 1993 to obtain the constant term, c, the multiplier, c_2 and the residual sum of squares. These values were then plotted for the regular and adjusted definitions of money supply. Consequently, inferences were drawn about the stability of the multipliers from the plotted series. As was indicated earlier, the procedure adopted based on the specification 1b cannot be used to test for the stability of the money multiplier relations. Secondly, the graphs presented could only suggest probable departures from stability relationship but could not provide conclusive statistical evidence of the existence of significant instability of the money multiplier. This is especially so since the significant test for the constancy of the regression relations based on the moving regressions approach, called the homogeneity test by Brown et al. (1975: 156), was not applied to the data.

The objective of this paper is to re-examine the hypothesis of stability of the adjusted money multiplier relationship using the forward recursive classical cusum of squares test of Brown and Durbin (1968), as explained in Brown et al. (1975). This test is easier to apply and much more straight forward than the homogeneity test associated with the moving regression approach. For ease of exposition, the rest of the paper is divided into four sections. Section II elaborates on the various money multipliers, while Section III discusses the stability hypothesis testing procedure which is adopted. Section IV reports the results of the stability test applied to Nigeria's adjusted money multipliers between January, 1991 and December, 1995 when the uniform reserve requirement was adopted. Finally, section V summarises and concludes the paper.

II. NIGERIA'S MONEY MULTIPLIERS

Doguwa (1994) derived the following unadjusted money multipliers for both money supply narrowly defined (M1) and broadly defined (M2):

$$m_1 = \frac{1 + k}{k + e + r} \tag{7}$$

and

$$m_2 = \frac{1 + k + q}{k + e + r(1+q)} \tag{8}$$

where

m_1	=	narrow money multiplier
m_2	=	broad money multiplier
k	=	C^p/DD
q	=	QM/DD
e	=	OR/DD
r	=	cash reserve ratio (prescribed by CBN)
C^p	=	currency outside banks
DD	=	private sector demand deposits at commercial banks
QM	=	private sector time and savings deposits at commercial and merchant banks
M1	=	$C^p + DD$
M2	=	M1 + QM
BM	=	$C^p + R$
OR	=	R – RR
R	=	$C^b + D_{1b}$
RR	=	r DD for M1
RR	=	r(DD + QM) for M2
C^b	=	vault cash of commercial and merchant banks
D_{1b}	=	balances of commercial and merchant banks at CBN (CBN records)
BM	=	base money
R	=	total reserves

In the base money multiplier representation in equation 1a, policy actions are reflected not only in base money, through changes in total reserve, but also in the multiplier, through changes in the prescribed cash reserve ratio.

With a simple adjustment of BM, however, the effects of policy actions on the money stock (M1 or M2) can be isolated in one measure. This alternative measure of the base money, called the adjusted base money, reflects the changes in R and r (see Garfinkel and Thornton, 1991). Doguwa (1994) also derived the two adjusted multipliers for M1 and M2 denoted as $m_{1\,adj}$ and $m_{2\,adj}$ as:

$$m_{1\,adj} = \frac{1 + k}{k + e + r_0} \tag{9}$$

and

$$m_{2\,adj} = \frac{k + q + 1}{k + e + r_0(q + 1)} \tag{10}$$

where r_0 is the required reserve ratio during a chosen base period. The corresponding adjusted base monies for M1 and M2 are given as:

$$ABM1 = BM + (r_0 - r)DD$$

and

$$ABM2 = BM + (r_0 - r)\{DD + QM\}$$

respectively. The evidence presented in Doguwa (1994) that the adjusted multipliers, $m_{1\ adj}$ and $m_{2\ adj}$, are independent of CBN policy actions, especially in the post uniform reserve requirement period, confirms the appropriateness of using the adjusted base money, rather than total reserves, as an indicator of the effects of policy actions of the CBN on the money stock.

III. THE STABILITY TESTING PROCEDURE

The regression relations of the monthly adjusted multipliers on the adjusted base money and money stock lagged one period would throw some light on the stability of the multiplier. This relation is given as:

$$m_{adj,\ t} = c_0 + c_1 ABM_t + c_2 M_{s,\ t-1} + e_t \tag{11}$$

where $m_{adj,t}$ and ABM_t are the adjusted multiplier and adjusted base money, respectively, at period t, while $M_{s,\ t-1}$ is the money stock at period t-1. The random disturbance term, e_t, is assumed to be normally distributed with zero mean and constant variance. The regression coefficient, c_1, is expected *a priori* to be less than zero, while the coefficient, c_2, of the money stock is expected to be positive.

An alternative regression relations of the natural logarithm of the monthly adjusted multipliers on the logarithms of the adjusted base money and money stock lagged one and two periods would also throw some light on the stability of the adjusted multiplier. This relation is given as:

$$Log(m_{adj,t}) = c_0 + c_1 Log(ABM_t) + c_2 Log(M_{s,\ t-1}) + c_3 Log(M_{s,\ t-2}) + e_t \tag{12}$$

where $m_{adj,t}$ and ABM_t are the adjusted multiplier and adjusted base money, respectively, at period t, while $M_{s,\ t-1}$ and $M_{s,\ t-2}$ are the money stock at periods t-1 and t-2, respectively. The random disturbance term, e_t, is assumed to be normally distributed with zero mean and constant variance. The question of stability over time of the models defined in equations 11 and/or 12 and by inference the adjusted money multiplier relation, is of crucial importance for the adjusted base money to act as the main link to the money supply.

Regression analysis of time series data is usually based on the assumption that the regression relationship is invariant over time. In some applications, particularly in the economic field, the validity of this assumption is open to question and it is often desirable to examine it critically, particularly if the model is to be used for forecasting. Brown and Durbin (1968) developed a method for testing the stability of the regression coefficient which does not presuppose prior knowledge of when the functional relations changed. This test, known as the classical cusum of squares test, has an additional advantage to Chow's (1960) and Gujerati's (1970) alternatives in that it would be viewed graphically over the sample periods. In brief, the cusum of squares test calculates the statistic s_t:

$$s_t = \frac{SSR_t}{SSR_T}, \quad t = k+1, k+2, \ldots, T \qquad (13)$$

where SSR_t is the residual sum of squares using the first t observations, and k is the number of independent variables plus one. Thus, for the monthly observations from February, 1991 to December, 1995, we have $T = 59$ observations, and for the general model defined in equation 11, the parameter k takes the value of 3. In contrast, k takes the value 4 and $T = 58$ observations, ranging from March, 1993 to December, 1995 for the model defined in 12.

From the SSR_t and SSR_T of these regressions, the observed s_t could be calculated and compared to the usual 90 per cent confidence bounds. Under the null hypothesis of constancy of the regression relations, the values of observed s_t should lie within the confidence bounds of s_t, which are given by

$$E(s_t) - \lambda_0 \leq s_t \leq E(s_t) + \lambda_0$$

where

$$E(s_t) = \frac{t-k}{T-k}$$

If s_t passes beyond the confidence bounds, this indicates that at time t, the regression relation shifted or was unstable. Thus, to satisfy the null hypothesis of constancy in the regression relation, at the given confidence level and at time t, the locus of s_t must lie within the confidence bounds for those values of t. For a 90 per cent confidence bounds (α = 10 per cent) and with approximately 58 and 59 observations, $\lambda_0 = 0.1664$ and 0.1628, respectively, from the significance table (Table 1, p.4 of Durbin, 1969). If the plots described above indicate departures from constancy, it may be useful to examine the plots of the regression coefficients against time to try to identify the source of the instability. Further, to help locate the point of change, it is often informative to look at the set of plots which are obtained by running the analysis backwards through time as well as forwards.

IV. RESULTS OF THE STABILITY TESTS

We propose to test the stability of the coefficients of regression estimates of equation 11 from 1991:2 [1991: 3 for equation 12] to 1995: 12 for the adjusted narrow money and broad money multipliers, $m_{1\ adj}$ and $m_{2\ adj}$, which are used as the dependent variables. Thus, the procedure is to run the regression recursively from $t = 4$ to $t = 59$ in the case of equation 11 and from $t = 5$ to $t = 58$ for equation 12 to generate SSR_t. Since $k = 3$ for equation 11, and we have monthly observations from January, 1991 to December, 1995, we ran 56 regressions for each money stock and the appropriate combinations of monetary base and multipliers, starting with a set of observations from 1991:2 to 1991:5 and ending with observations from 1991:2 to 1995:12.

Estimates of equation 11 for the whole period from 1991:2 to 1995:12 are presented in Table 1 for the two adjusted multipliers, $m_{1\ adj}$ and $m_{2\ adj}$. It is worth noting that for the two regressions, the Durbin-Watson statistic does not indicate the presence of serial correlation in the residuals, indicating that the two models could be used for forecasting. The R^2 adjusted values indicate that about 70.3 per cent of the variations in $m_{1\ adj}$ are explained by the explanatory variables, while about 76.0 per cent of the variations in $m_{2\ adj}$ are explained by the independent variables. The t-values indicate that all the explanatory variables are significant determinants of the adjusted multipliers. However, it is the intention of this paper to test the stability of these two relations.

The cusum of squares test, s_t – forward recursive, was applied to the adjusted narrow money multiplier and adjusted broad money multiplier to examine the stability of each multiplier relations. The results of this procedure are shown in Figures 2(a) and 3(a) which are easier to follow than Table 2 in which the results are repeated to give all details. Looking at the results for the forward recursive cusum of squares test from 1991:2 to 1995:12, Figure 2(a) and Table 2 show that s_t for the adjusted narrow money multiplier crosses the lower confidence bound in two periods: April, 1992 and January, 1995, giving a shift in the relation between March, 1992 and April, 1992 and between December, 1994 and January, 1995, respectively. Similarly, Figure 3(a) and Table 2 show that s_t for the adjusted broad money multiplier crosses the lower confidence bound in two periods: March, 1992 and December, 1994, suggesting a shift in the relation between February, 1992 and March, 1992 and between November, 1994 and December, 1994.

At this point, regression of equation 11 for the abbreviated periods suggested by the cusum of square test applied forward was singled out for further analysis. The results are shown in Tables 3 and 4. Table 3 shows the outcomes for adjusted narrow money multiplier. The first three regressions in Table 3 sub-divide the period at 1992:3/1992:4 and 1994:12/1995:1 as indicated in the forward recursive cusum of squares test. These three regressions are satisfactory in terms of R^2 adjusted and Durbin-Watson statistics. However, the shift in the multiplier relations in the period April, 1992 to December, 1994 resulted in the higher error volatility of 41.9 per cent as indicated in the residual sum of squares and a slight decline in the explanatory power of the model.

Table 4 presents the regression for adjusted broad money multiplier, m_{2adj}, by dividing 1991:2 to 1995:12 into sub-periods as indicated by the cusum of squares test. These three regressions are satisfactory in terms of R^2 adjusted and Durbin-Watson statistics. The instability in the multiplier relations between March, 1992 and November, 1994 translated into a higher residual sum of squares, as compared to the period of relative stability. Taken as a whole, the evidence presented establishes that the functions underlying the adjusted multiplier relations were not stable between April, 1992 and December, 1994 (March, 1993 and November, 1994 for $m_{2\,adj}$). The two multiplier relations were, however, stable in fiscal 1995 as indicated in the forward recursive cusum of squares test. Thus, the assumption that the regression relationships for forecasting the adjusted multipliers were invariant in 1995 is, therefore, validated.

Since k equals 4 for equation 12, and we have monthly observations from January, 1991 to December, 1995, we ran 54 regressions for each money stock and the appropriate combinations of monetary base and multipliers, starting with a set of observations from 1991:3 to 1991:7 and ending with observations from 1991:3 to 1995:12. Estimates of equation 8 for the whole period from 1991:3 to 1995:12 are presented in Table 5 for the two adjusted multipliers, $m_{1\,adj}$ and $m_{2\,adj}$. It is noted that for the two regressions, the Durbin-Watson statistic does not indicate the presence of serial correlation in the residuals. The R^2 adjusted values indicate that over 90 per cent of the variations in $m_{2\,adj}$ are explained by the explanatory variables, while about 84 per cent of the variations in $m_{1\,adj}$ are explained by the independent variables. The t-values indicate that all the explanatory variables are significant determinants of the adjusted multipliers. The residual sum of squares of the two regression models suggest that forecast of $m_{2\,adj}$ could be made with smaller error than the $m_{1\,adj}$ multiplier, and could, therefore, be preferable. It is also our intention to test the stability of these two relations.

The cusum of squares test, s_t – forward recursive, was applied to the adjusted narrow money multiplier and adjusted broad money multiplier to examine the stability of each multiplier relations. The results of this procedure are shown in Figures 2(b) and 3(b) which are easier to follow than Table 6 in which the results are repeated to give all details. Looking at the results for the forward recursive cusum of squares test from 1991:3 to 1995:12, Figure 2(b) and Table 6 show that s_t, for the adjusted narrow money multiplier, traverses the lower confidence bound in two periods: May, 1992 and December, 1994, indicating a shift in the relation between April, 1992 and May, 1992 and between November, 1994 and December, 1994, respectively. Similarly, Figure 3(b) and Table 6 show that s_t, for the adjusted broad money multiplier, crosses the lower confidence bound in two periods: May, 1992 and November, 1994, suggesting a shift in the relation between April, 1992 and May, 1992 and between October, 1994 and November, 1994, respectively.

At this point, the regression of equation 12 for the abbreviated periods, suggested by the cusum of square test applied forward, was singled out for further analysis. The results are shown in Tables 7 and 8. Table 7 shows the outcomes for adjusted narrow money multiplier. The first three regressions in Table 7 subdivide the period at 1992:4/1992:5 and 1994:11/1994:12 as indicated in the forward recursive cusum of squares test. These three regressions are satisfactory in terms of R^2 adjusted. The Durbin-Watson statistic for the third period indicates the presence of serial correlation in the residuals, which could not be unconnected with the non-significance of the money stock in the lagged periods 1 and 2.

Table 8 presents the regression for the adjusted broad money multiplier, m_{2adj}, by dividing 1991:3 to 1995:12 into sub-periods as indicated by the cusum of squares test. In contrast, these three regressions are satisfactory in terms of R^2 adjusted and Durbin-Watson statistics. As a whole, the evidence presented in Tables 7 and 8 establishes that the functions underlying the adjusted multiplier relations were not stable between May, 1992 and November, 1994 (October, 1994 for m_{2adj}). The m_{2adj} multiplier relations were, however, stable in fiscal 1995 as indicated in the forward recursive cusum of squares test. It is important to note that while the multiplier relations given in equation 12 have higher variability in terms of explanatory power, the relation given in equation 11 is more parsimonious and should, therefore, be preferred for forecasting purposes.

V. SUMMARY AND CONCLUSIONS

Some recent studies have attempted to establish the stability relations between money supply and base money or money multiplier relations. One of these studies adopted the moving regression technique to test the stability hypothesis of the money multiplier relationships in Nigeria but failed to apply the homogeneity test of Brown et al. (1975:156). Another drawback inherent in the adopted moving regression technique was that the models did not represent the money multiplier relations whose stability analysis was the subject of such study. In an attempt to test the stability of the money multiplier relations, an alternative testing procedure known as the forward recursive cusum of squares test was used during the period when the uniform reserve requirements regime was adopted by the Central Bank of Nigeria.

The results of the regression analysis of the two models, representing the multiplier relations, suggested that model (11) has some advantages over model (12) in that:

(i) its explanatory power was consistently high in the periods of stability and

(ii) all the diagnostic tests based on the DW statistic, t-statistic and the F-statistic were consistent.

In addition, model (11) is more parsimonious than model (12) and could, therefore, be used for forecasting the adjusted money multipliers.

The results of the forward recursive cusum of squares test for the case of model (11) from January, 1991 to December, 1995 showed that the test statistic, s_t, for the adjusted narrow money multiplier crossed the lower confidence bound in two periods: April, 1992 and January, 1995, indicating a shift in the relation between March, 1992 and April, 1992 and between December, 1994 and January, 1995, respectively. Similarly, the statistic, s_t, for the adjusted broad money multiplier traversed the lower confidence bound in two periods: March, 1992 and December, 1994, suggesting a shift in the relation between February, 1992 and March, 1992 and between November, 1994 and December, 1994.

Further analysis of the abbreviated periods suggested by the cusum of squares test revealed that the shift in the narrow money multiplier relations between April, 1992 and December, 1994 resulted not only in a lower explanatory power which declined from 74.7 per cent to 63.3 per cent but also a higher error volatility of 41.9 per cent. Similarly, the instability in the broad money multiplier relations between March, 1992 and November, 1994 translated into a higher residual sum of squares as compared to the periods of relative stability. These periods of instability of the multiplier relations largely arose as a result of the absence of effective co-ordination of fiscal and monetary policies.

However, the two multiplier relations were stable in fiscal 1995, suggesting that there was a stable relationship between monetary base and money supply in 1995. This stability relationship might have been achieved as a result of the co-operation between fiscal and monetary authorities in that year. This stable relationship tended to reinforce the use of the indirect approach to monetary control that has been complemented by the fiscal discipline of government.

Table 1
Regression Estimates Between February, 1991 and December, 1995

Dependent Variable	Independent Variable					
	C_0	C_1	C_2	R^2-Adj.	DW	RSS
$m_{1\ adj}$	1.574 (55.6)	-0.144E-4 (-11.8)	0.932E-5 (11.2)	0.703	2.24	0.547
$m_{2\ adj}$	2.927 (60.1)	-0.270E-4 (-12.4)	0.927E-5 (10.1)	0.763	1.96	1.409

The values of the t-statistics are given in parenthesis.

Table 2
Cusum of Squares of Recursive Residuals:
Forward Recursive Based on Model (11)

Month	t	$LB(S_t)$	$UB(S_t)$	m_1adj	m_2adj
1991:5	4	-	0.1807	0.0024	0.0022
1991:6	5	-	0.1985	0.0u77	0.0053
1991:7	6	-	0.2164	0.0099	0.0070
1991:8	7	-	0.2342	0.0102	0.0070
1991:9	8	-	0.2521	0.0102	0.0070
1991:10	9	-	0.2699	0.0128	0.0089
1992:11	10	-	0.2878	0.0128	0.0089
1992:12	11	-	0.3057	0.0267	0.0223
1992:1	12	-	0.3235	0.0371	0.0241
1992:2	13	0.0158	0.3414	0.0382	0.0257
1992:3	14	0.0336	0.3592	0.0384	0.0282
1992:4	15	0.0515	0.3771	0.0393	0.0283
1992:5	16	0.0693	0.3949	0.0393	0.0290
1992:6	17	0.0872	0.4128	0.0404	0.0300
1992:7	18	0.1051	0.4307	0.0506	0.0429
1992:8	19	0.1229	0.4485	0.0510	0.0443
1992:9	20	0.1408	0.4664	0.0614	0.0443
1992:10	21	0.1586	0.4842	0.0616	0.0444
1992:11	22	0.1765	0.1521	0.0632	0.0451
1992:12	23	0.1943	0.5199	0.1314	0.1298

Table 2 (cont'd)
Cusum of Squares of Recursive Residuals:
Forward Recursive Based on Model (11)

Month	t	$LB(S_t)$	$UB(S_t)$	m_1adj	m_2adj
1993:1	24	0.2122	0.5378	0.1343	0.1325
1993:2	25	2301	0.5557	0.1345	0.1326
1993:3	26	0.2479	0.5735	0.1435	0.1392
1993:4	27	0.2658	0.5914	0.1438	0.1410
1993:5	28	0.2836	0.6092	0.1481	0.1475
1993:6	29	0.3015	0.6271	0.1497	0.1507
1993:7	30	0.3193	0.6449	0.1499	0.1513
1993:8	31	0.3372	0.6628	0.1612	0.1639
1993:9	32	0.3551	0.6807	0.1614	0.1672
1993:10	33	0.3729	0.6985	0.1755	0.1683
1993:11	34	0.3908	0.7164	0.1788	0.1836
1993:12	35	0.4086	0.7342	0.2064	0.1836
1994:1	36	0.4265	0.7521	0.2113	0.1896
1994:2	37	0.4443	0.7699	0.2447	0.3109
1994:3	38	0.4622	0.7878	0.3120	0.4302
1994:4	39	0.4801	0.8057	0.3929	0.4772
1994:5	40	0.4979	0.8235	0.3531	0.4787
1994:6	41	0.5158	0.8414	0.3537	0.4791
1994:7	42	0.5336	0.8592	0.3542	0.4850
1994:8	43	0.5515	0.8771	0.3824	0.5113
1994:9	44	0.5693	0.8949	0.3827	0.5120
1994:10	45	0.5872	0.9128	0.3888	0.5120
1994:11	46	0.6051	0.9307	0.5928	0.6431
1994:12	47	0.6229	0.9485	0.8728	0.8109
1995:1	48	0.6408	0.9664	0.8757	0.8121
1995:2	49	0.6586	0.9842	0.8887	0.8741
1995:3	50	0.6765	-	0.9121	0.9257
1995:4	51	0.6943	-	0.9185	0.9446
1995:5	52	0.7122	-	0.9291	0.9576
1995:6	53	0.7301	-	0.9552	0.9732
1995:7	54	0.7479	-	0.9554	0.9741
1995:8	55	0.7658	-	0.9766	0.9850
1995:9	56	0.7836	-	0.9780	0.9958
1995:10	57	0.8015	-	0.9782	0.9960
1995:11	58	0.8193	-	0.9987	0.9982
1995:12	59	0.8372	-	1.0000	1.0000

Table 3
Regression Estimates and Residual Sum of Squares (RSS) with m_{1adj} as the Dependent Variable

Period	Independent Variable C_0	C_1	C_2	R^2-Adj.	DW	RSS
1991:2-1992:3	1.676 (18.9)	-0.396E-4 (-5.8)	0.231E-4 (4.2)	0.747	2.56	0.021
1992:4-1994:12	1.621 (23.2)	-0.143E-4 (-6.6)	0.868E-5 (4.6)	0.633	2.03	0.419
1995:1-1995:12	1.633 (3.6)	-0.119E-4 (-6.4)	0.753E-5 (2.8)	0.799	2.16	0.051

The values of the t-statistics are given in parenthesis.

Table 4
Regression Estimates and Residual Sum of Squares (RSS) with m_{2adj} as the Dependent Variable

Period	Independent Variable C_0	C_1	C_2	R^2-Adj.	DW	RSS
1991:2-1992:2	2.944 (15.6)	-0.956E-4 (-8.9)	0.337E-4 (5.7)	0.908	2.83	0.036
1992:3-1994:11	2.985 (31.7)	-0.319E-4 (-10.3)	0.107E-4 (7.0)	0.828	1.501	0.679
1994:12-1995:12	3.391 (7.2)	-0.200E-4 (-7.4)	0.504E-5 (3.5)	0.842	1.601	0.119

The values of the t-statistics are given in parenthesis.

Table 5
Regression Estimates Between March, 1991 and December, 1995

Dependent Variable	Independent Variables C_0	C_1	C_2	C_3	R^2-Adj.	DW	RSS
$Log\{m_{1adj}\}$	0.212	-0.900	0.496	0.393	0.837	2.003	0.139
	(1.6)	(-17.0)	(4.3)	(3.2)			
$Log\{m_{2adj}\}$	0.406	-0.905	0.499	0.383	0.914	2.053	0.071
	(3.0)	(-22.1)	(4.4)	(3.2)			

The values of t-statistic are in parenthesis.

Table 6
Cusum of Squares of Recursive Residuals, Forward Recursive Based on Model (12)

Month	t	$LB(S_t)$	$UB(S_t)$	m_{1adj}	m_{2adj}
1991:7	5	-	0.1849	0.0024	0.0009
1991:8	6	-	0.2034	0.0027	0.0016
1991:9	7	-	0.2220	0.0038	0.0052
1991:10	8	-	0.2405	0.0100	0.0109
1991:11	9	-	0.2590	0.0103	0.0113
1991:12	10	-	0.2775	0.0193	0.0173
1992:1	11	-	0.2960	0.0238	0.0175
1992:2	12	-	0.3145	0.0279	0.0184
1992:3	13	0.0003	0.3331	0.0285	0.0195
1992:4	14	0.0188	0.3516	0.0285	0.0218
1992:5	15	0.0373	0.3701	0.0286	0.0218
1992:6	16	0.0558	0.3886	0.0299	0.0237
1992:7	17	0.0743	0.4071	0.0465	0.0382
1992:8	18	0.0929	0.4257	0.0505	0.0577
1992:9	19	0.1114	0.4442	0.0647	0.0578
1992:10	20	0.1299	0.4627	0.0650	0.0591
1992:11	21	0.1484	0.4812	0.0674	0.0604
1992:12	22	0.1669	0.4997	0.0700	0.0629
1993:1	23	0.1855	0.5183	0.0729	0.0640
1993:2	24	0.2040	0.5368	0.0771	0.0640
1993:3	25	0.2225	0.5553	0.0797	0.0643

Table 6 (cont'd)
Cusum of Squares of Recursive Residuals,
Forward Recursive Based on Model (12)

Month	t	$LB(S_t)$	$UB(S_t)$	m_{1adj}	m_{2adj}
1993:4	26	0.2410	0.5738	0.0797	0.0693
1993:5	27	0.2595	0.5923	0.0828	0.0865
1993:6	28	0.2780	0.6108	0.0838	0.0869
1993:7	29	0.2966	0.6294	0.0844	0.0890
1993:8	30	0.3151	0.6479	0.0846	0.0900
1993:9	31	0.3336	0.6664	0.0920	0.0967
1993:10	32	0.3521	0.6849	0.0959	0.1047
1993:11	33	0.3706	0.7034	0.0960	0.1048
1993:12	34	0.3892	0.7220	0.1014	0.1401
1994:1	35	0.4077	0.7405	0.1061	0.1555
1994:2	36	0.4262	0.7590	0.1714	0.2699
1994:3	37	0.4447	0.7775	0.2392	0.2699
1994:4	38	0.4632	0.7960	0.2405	0.2846
1994:5	39	0.4817	0.8145	0.2408	0.2851
1994:6	40	0.5003	0.8331	0.2410	0.2887
1994:7	41	0.5188	0.8516	0.2410	0.2911
1994:8	42	0.5373	0.8701	0.2547	0.2949
1994:9	43	0.5558	0.8886	0.2559	0.2961
1994:10	44	0.5743	0.9071	0.2746	0.2988
1994:11	45	0.5929	0.9257	0.5874	0.6418
1994:12	46	0.6114	0.9442	0.7244	0.7484
1995:1	47	0.6299	0.9627	0.8765	0.8403
1995:2	48	0.6484	0.9812	0.8771	0.8417
1995:3	49	0.6669	0.9997	0.9334	0.9791
1995:4	50	0.6855	-	0.9364	0.9792
1995:5	51	0.7040	-	0.9583	0.9832
1995:6	52	0.7225	-	0.9670	0.9878
1995:7	53	0.7410	-	0.9675	0.9899
1995:8	54	0.7595	-	0.9752	0.9983
1995:9	55	0.7780	-	0.9752	0.9990
1995:10	56	0.7966	-	0.9756	0.9992
1995:11	57	0.8151	-	0.9906	0.9999
1995:12	58	0.8336	-	1.0000	1.0000

Table 7
Regression Estimates and RSS with Adjusted Narrow Money Multiplier m_{1adj} as the Dependent Variable

Period	Independent Variables C_0	C_1	C_2	C_3	R^2-Adj	DW	RSS
1991:3-1992:4	0.583 (1.4)	-0.688 (-8.8)	0.309 (1.7)	0.340 (2.0)	0.868	2.422	0.004
1992:5-1994:11	0.730 (2.1)	-0.935 (-11.9)	0.690 (2.2)	0.186 (0.5)	0.875	1.584	0.067
1994:12-1995:12	5.359 (2.5)	-0.818 (-5.5)	0.239 (1.5)	0.140 (0.8)	0.720	0.777	0.026

The values of t-statistic are in parenthesis.

Table 8
Regression Estimates and RSS with Adjusted Broad Money Multiplier m_{2adj} as the Dependent Variable

Period	Independent Variables C_0	C_1	C_2	C_3	R^2-Adj	DW	RSS
1991:3-1992:4	0.482 (1.4)	-0.847 (-17.3)	0.359 (1.9)	0.463 (2.5)	0.964	2.332	0.002
1992:5-1994:10	0.274 (1.2)	-0.987 (-25.2)	0.880 (4.5)	0.089 (0.5)	0.968	2.011	0.017
1994:11-1995:12	0.372 (0.1)	-0.740 (-4.5)	0.387 (1.5)	0.345 (1.3)	0.645	1.594	0.039

The values of t-statistic are in parenthesis.

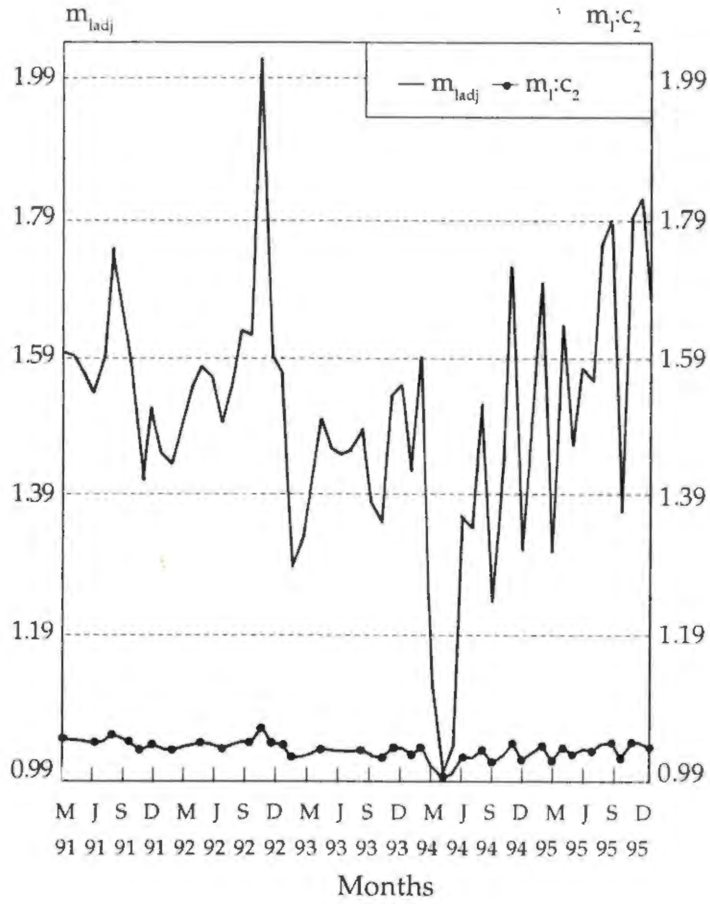

Fig. 1 (a): Narrow Money Multipliers

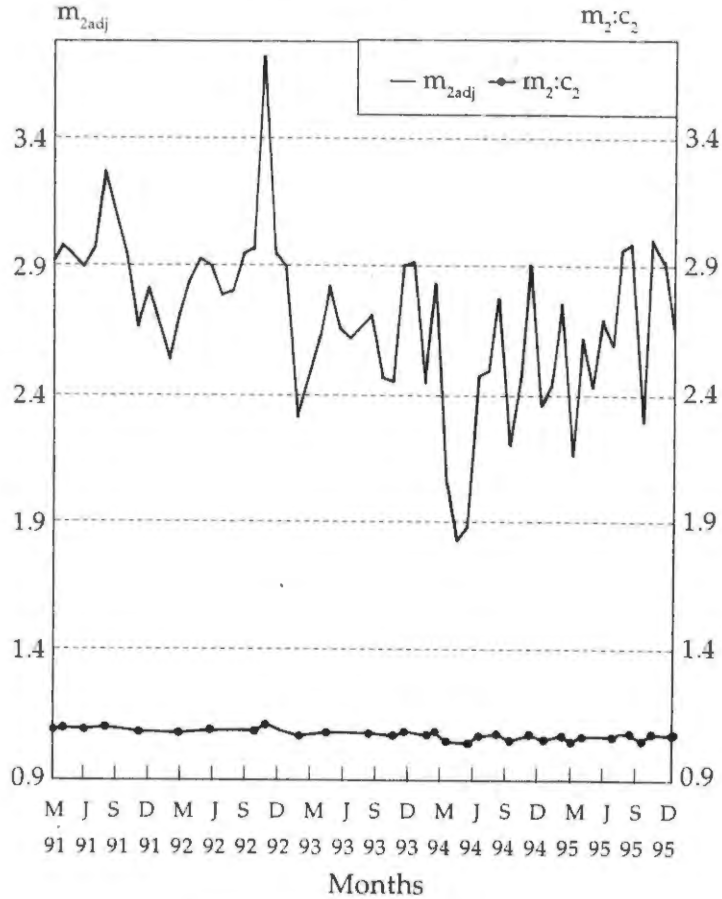

Fig. 1 (b): Broad Money Multipliers

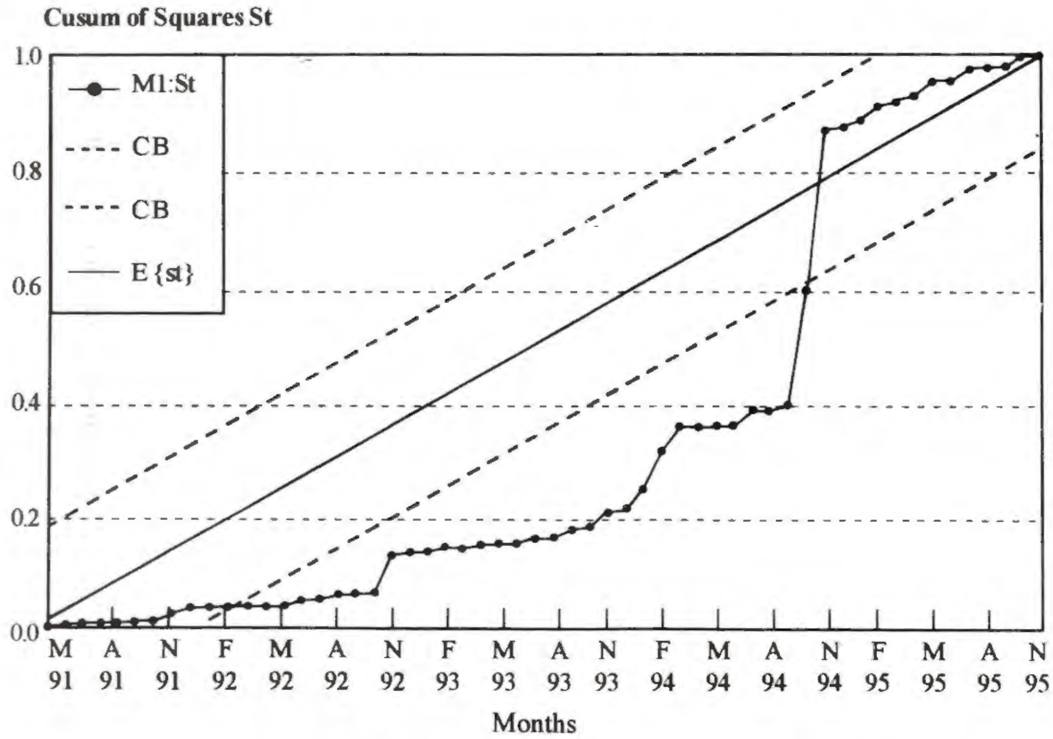

Fig. 2(a): Cusum of Squares of Recursive Residuals, forward: M1

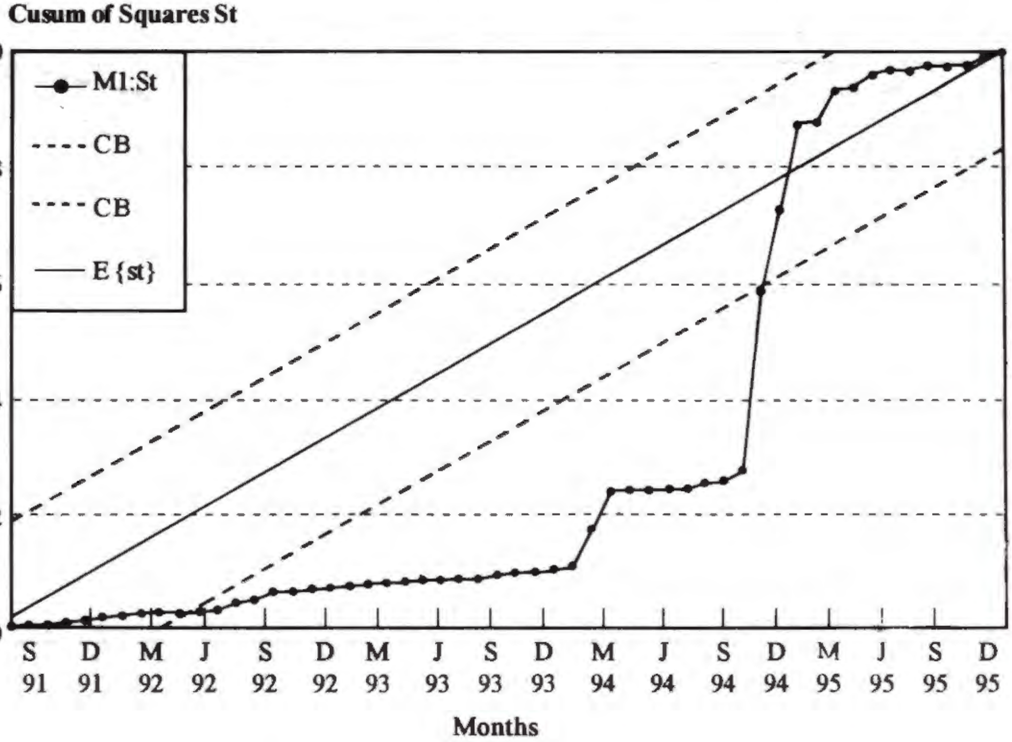

Fig. 2(b): Cusum of Squares of Recursive Residuals, forward: M1

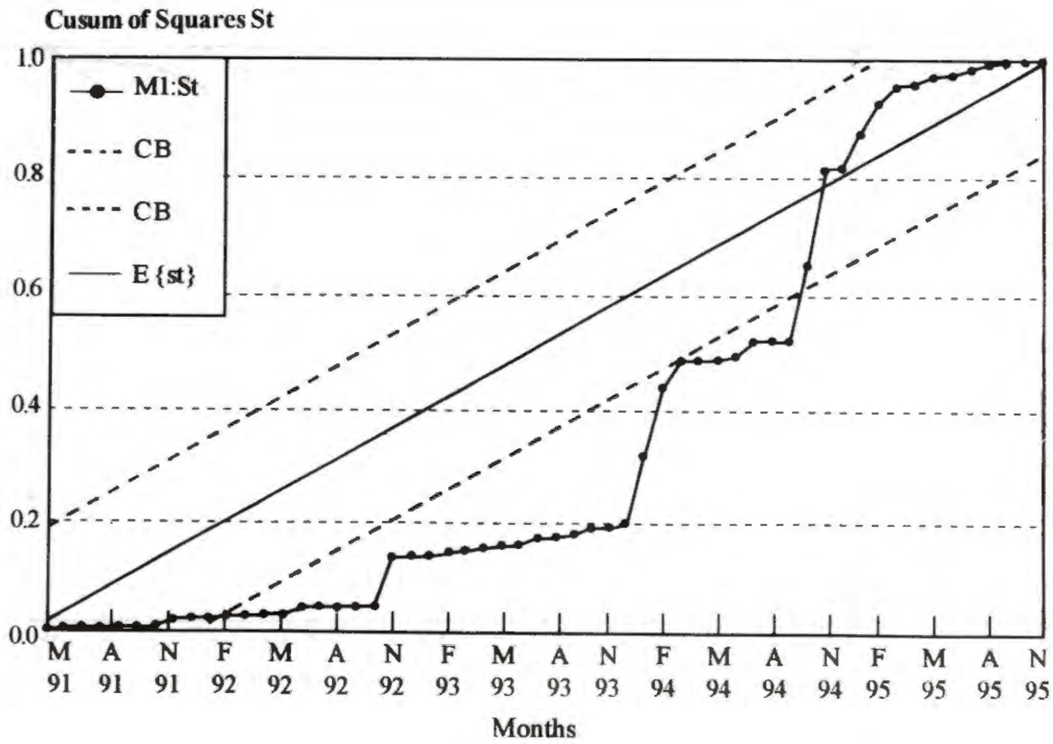

Fig. 3(a): Cusum of Squares of Recursive Residuals, forward: M2

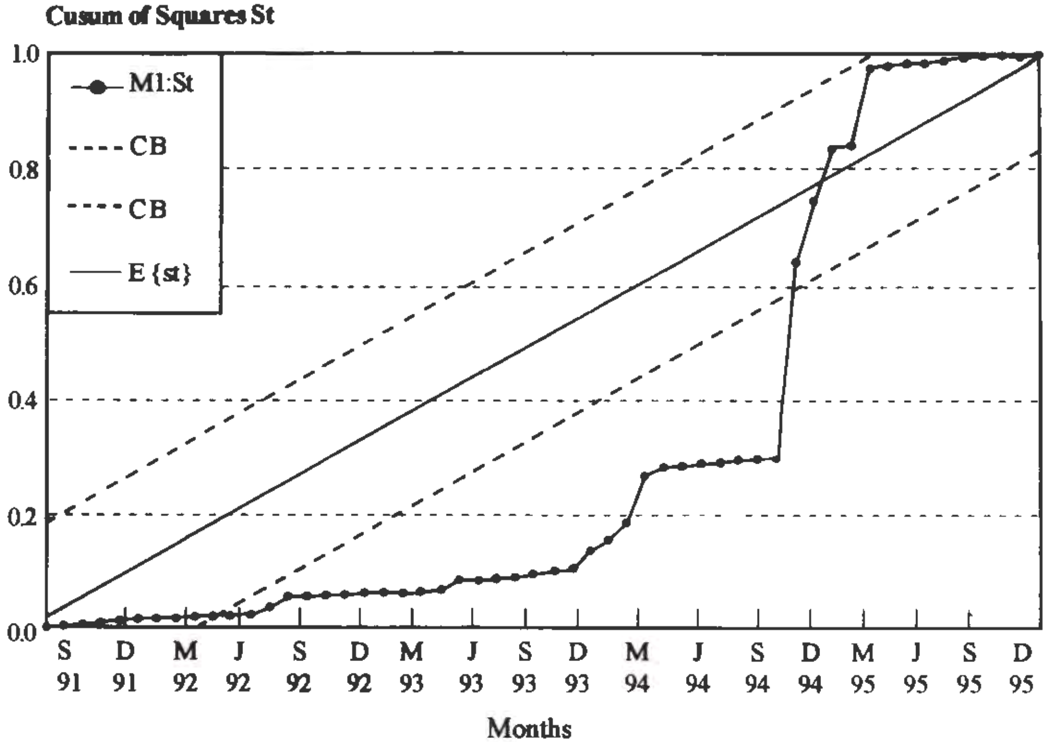

Fig. 3(b): Cusum of Squares of Recursive Residuals, forward: M2

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