DYNAMICS OF INFLATIONARY PROCESSES IN MALAWI: AN ECONOMETRIC ANALYSIS*

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The paper investigates the sources of inflationary pressures in Malawi and suggests ways of mitigating such pressures.

In the first part of the study, we test for unit root test to determine the order of integration of the variables. A model of inflation is estimated as a co-integrating vector that spans nominal exchange rate and domestic output. In the second stage, a model of inflation is estimated with first differences of the non-stationary variables, a level variable and the co-integrating vector. Results indicate that inflation in Malawi is a result of both real and monetary shocks to the economy. It is further observed that current slumps in production generate inflationary pressures. This is due to the fact that food, a perishable product, exerts an immediate impact on inflation. Measures to control inflation must therefore emphasize enhancing production and supply, especially food. It is also imperative that efforts be made to improve distribution and road networks to reduce costs.

It is worthy to note that although a lot of efforts have been made to curb domestic credit expansion, capital inflows are not usually taken into account and yet they constitute a major source of liquidity injection. Without proper measures including sterilization, the problem will continue to plague the nation. Monetary expansion will need to be controlled through more disciplined financial management to counteract these externally generated liquidity injections. It must also be noted that exchange rate adjustments fuel cost-push inflation.

Thus the inflationary problem in Malawi is a multifaceted issue with many causes. Inflationary control should aim at policies directed at both real and monetary factors.

Keywords : Inflation; Co-integration, Vector Autoregression

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*The findings, interpretation and conclusions expressed in this paper are entirely those of the author. They don't necessarily represent the views of the Reserve Bank of Malawi.

1.0 Introduction

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Inflation is one of the intractable problems the Malawian economy has faced for a long time. The persistence of inflationary pressures therefore, remains one of the pressing macroeconomic problems in Malawi. Such inflationary pressures have provided fertile ground for researchers in recent years. Several hypotheses have been advanced in literature to explain the phenomenon of inflation and to propose corrective measures.

The primary motivation of this study is to identify sources of inflationary pressures in Malawi and to suggest ways of mitigating such pressures.

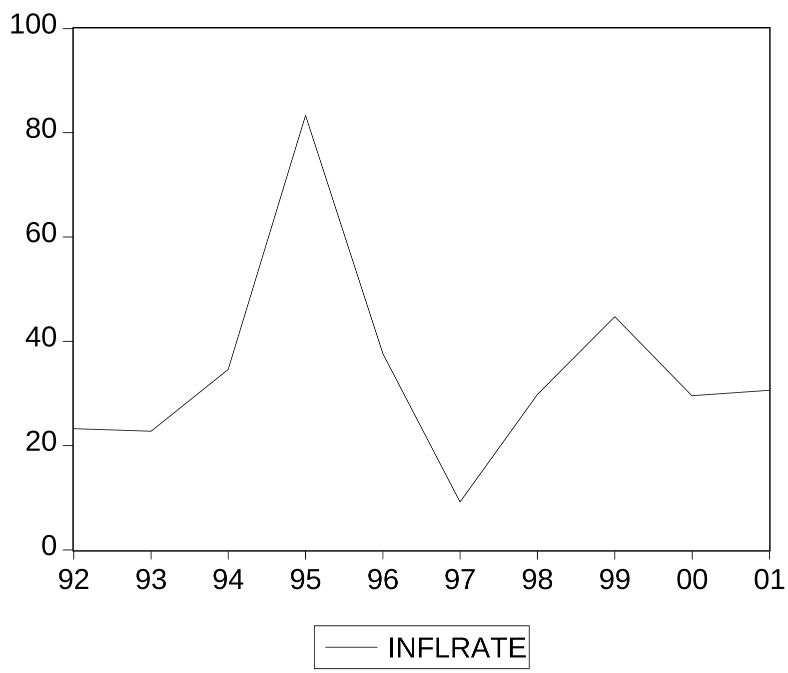
The paper continues in Section 2 with an historical overview of inflation in Malawi. Section 3 outlines the literature survey and the proposed analytical framework for the study. The empirical results are presented in Section 4 and Section 5 concludes with suggestions for controlling inflation.

2.0 Inflationary trends in Malawi

In Malawi, the rate of inflation has increased steadily since independence in 1964. During the period following independence (1966-1975), the average annual inflation rate was 8.9%. In the next decade, (1976-1985), inflation rate averaged 12.4% annually. This was due to oil price hikes (1974/75 and 1979/80), which led to cost-push inflation via increases in transport costs. The average annualized inflation for the period 1986 to 1990 was 22.2%. The disruption in the traditional routes of Beira and Nacala due to the civil war in Mozambique exacerbated the increases in transport costs. It forced Malawi to use the more costly northern corridor as an alternative route.

In 1992, annual inflation was recorded at 23.3% before declining marginally to 22.8% the following year. In 1994, the inflation rate went up to 34.6% before attaining a record high of 83.3% in 1995.This was a result of the floatation of the Malawi Kwacha in February 1994. In 1996, the rate went down to 37.6% before sliding further to 9.2 % the following year. In 1998, the inflation rate rose markedly to 29.8% before rising further to 44.7% the following year. This was attributed to the August 1998 depreciation of the Kwacha which resulted in high prices of both imported materials and finished products notably petroleum products and maize. At the beginning of 2000 inflation declined to 29.6% and continued its downward trend to 28.7% in 2001. For the year 2003, inflation averaged 14.8%, which was a notable slowdown when compared to an average of 14.8% for 2002. The slowdown was largely attributable to the availability of maize grain because of higher maize production in 2003 vis a vis 2002, as well as continued tight monetary stance that was taken by monetary authorities through intensive open market operations. Food inflation for the year 2003 averaged 5.3%, a significant slowdown from 16.2% for 2002. The improvement was on account of better crop harvest as well as a government subsidy on imported maize and the provision of relief maize by the donor community for free distribution to vulnerable groups and for commercial sale. Non-food inflation averaged 15.0% in 2003 compared to an average of 13.4% recorded in 2002. A continued increase in the national rate of inflation is expected in the ensuing year. This is premised on several factors such as expectations of food costs rising faster in the medium term due to seasonal shortages, increase in fuel prices that occurred in the latter part of the review period, the uncertainties surrounding the status of the donor aid to the country and a likely growth in the coming months due to anticipated expenditures related to forthcoming general elections in May 2004.

Fig.1: Inflation Rate



3.0 Literature Survey

Various models have been applied for the explanation of inflationary trends in both developed and developing countries. Variation of models themselves stem from differences in the proposed sources of inflation. Much of the literature is dominated by demand theories of inflation, partly because they are more amenable to quantitative assessment. The works of Cagan (1956), Harbeger (1963), Azhar (1973), and de Silva (1977) were all basically in the monetary demand framework, with results largely confirming demand - pull inflation.

Cost (supply) factors have generally received less attention in the empirical literature. But in general, in the few cases that were investigated either independently or alongside monetary factors, they appeared to have less influence than the latter. Agry's (1970) attempt to investigate structural inflation for some 22 less developed countries (LDCs) showed insignificant results for the structural indicators, but monetary factors used as "controls" turned out to be significant. Agry noted, one main problem is that structuralist hypotheses are very difficult to quantify, which limits their empirical assessment.

4.0 Analytical Framework

4.1 The Model

A model to specify all causes of inflation and test them econometrically can be set up. Using the known sources of inflation (i.e. monetary factors, real factors and expectations) we specify the simple model in (1):

$$\pi = f_1(MS, RY, EX, P_e) \quad (1)$$

Equation (1) specifies that inflation (π) is dependent on growth in money (MS) and output (RY), the rate of exchange (EX) defined as the domestic price of foreign currency, and price expectations (P_e). A change in money supply feeds into price changes with a lag. Similarly, shortages in output generally precede inflationary peaks. The relevant equation for estimation is:

$$\pi_t = \delta_0 + \sum^{k-1}_{i=1}\delta_{1i}\pi_{t-i} + \sum^{k}_{i=0}\delta_{2i} MS_{t-i} + \sum^{k}_{i=0}\delta_{3i} RY_{t-i} + \sum^{k}_{i=0}\delta_{4i}EX_{t-i} + \mu \quad (2)$$

Where all variables are as defined before and are in logs, μ is the white noise process.

An increase in money supply and exchange rate is thus expected to generate inflationary pressure; hence their parameter estimates should be of positive signs. On the other hand, the parameter estimates for the output coefficient must be negative, since output shortages are likely to lead to inflationary pressures. It is expected that a high inflationary rate for the previous period may be built into negotiations and thus result in an inflationary spiral. Therefore the sign for the coefficient of the lagged inflation rate should be positive.

The econometric analysis begins by specifying a vector auto-regression (VAR) model of the form:

$$B(L)\, X_t = v_t \qquad (3)$$

Where $X_t = \{\pi, MS, RY, EX\}$ where π is the domestic inflation, MS is money supply, RY is the domestic output, and EX is the nominal exchange rate. B(L) is a 4 x 4 matrix with the lag operator L and $B_0 = I$. The v's are the innovation and the lagged innovation of all other variables. By transforming equation (3), we obtain:

$$X_t = [B(L)]^{-1} v_t \qquad (4)$$

In order to analyze the dynamics of the model, the contemporaneous covariance matrix, $\sum$, needs to be decomposed into variable specific shocks, that is, it has to be orthogonalized. This is achieved by expressing the contemporaneous model as:

$$e_t = Hv_t \qquad (5)$$

such that $H \sum H' = I$, where I is an identity matrix. This ensures that the innovations v_t, will be mutually orthogonal. The added problem is that there is no unique way of orthogonalising $\sum$, or choosing H, the orthogonalised moving average representation of the system. In this study, we will adopt Sims' recursive Choleski decomposition of $\sum$, where the matrix H is taken to be triangular with positive elements on the diagonal. We shall however check the correlation matrix to see if the conclusions might change with a different method of decomposition.

4.2 Empirical Implementation

In the two preceding sections, we will conduct the empirical investigations in three steps. In the first step we will study the data, determine the order of integration and test for co-integration. In this empirical step, we will thus determine the number of co-integrating vectors spanned by the variables in the study.

In the second step, the identified co-integrating vectors will be included in the statistical model as error correction terms. The variables will thus enter the model in log differences form in stationary linear combinations. This is because the error correction terms are computed in a multivariate framework that allows every variable to enter in the short run equation and to affect the short run movements of the variables. We also will carry out the Granger causality test (Granger, 1969, 1980).

Finally, we use the estimated VAR model to decompose the innovations in the variables into portions that can be attributed to innovations in the other macroeconomic variables. In this way we will be able to judge, for example, the relative importance of other variables in causing inflation.

5.0 Empirical results

5.1 Time Series Properties of the Data

We first conduct a descriptive analysis of the data for the first part of the study. Table 1 shows that the variables do not follow a normal distribution. The second step is to test for a unit root in the variables. The results of the unit root tests are shown in table 2.

Table 1: Data Distribution

Variable	Mean	SD	Skewedness	Kurtosis	Normality
π	6.2751	0.7287	-0.2838	1.968	1.8479
RY	7.6766	0.8149	-2.1511	5.883	35.76
MS	8.5304	0.7402	-0.2664	2.113	1.4272
EX	2.8828	0.8244	-0.1808	2.211	1.0036

Table 2: Phillips-Perron Unit Root Test [1]

Variable	PP Value (Intercept)	PP Value Intercept & Trend)	Order Of Integration
π Δπ	-0.619055 (-2.9591) -4.017775*	-1.802164 (-3.5614) -3.9670*	I(1)

[1] The Phillips Perron test, PP, is used since it is a generalization of the Dickey Fuller test procedure but does not require the errors to be serially uncorrelated or homogenous. Instead, the PP test allows the residuals to be weakly dependent and heterogeneously distributed.

	(-2.9627)	(-3.5670)	
RY ΔRY	-3.672306* (-2.9591)	-2.499137 (-3.5614) -6.462717* (-3.5670)	I(1)
MS ΔMS	-1.771799 (-2.9591) -7.464056* (-2.9627)	-3.666351* (-3.5614)	I(1)
EX Δ EX	-0.3624 (-2.9591) -4.9383* (-2.9627)	-2.104367 (-3.5614) -4.854598* (-3.5670)	I(1)

The figures in brackets are Mackinnon critical values for rejection of unit root at the conventional 5 % level of significance. * indicates that the variables are significant at 5 % level of significance. The results show that variables such as domestic inflation, domestic output, and nominal exchange rate are non-stationary (integrated of order one) and thus become stationary after first difference. On the other hand, only money supply is stationary (integrated of order zero).

Co-integration analysis

The next stage is to determine the co-integrating vectors that span the variables in equation 1, that were found to be integrated of order one. That is we test whether the domestic inflation rate, nominal exchange rate and real income are co-integrated.

In this investigation, we use the multivariate co-integration test, the Johansen Procedure (see Johansen, 1988 and Johansen and Juselius, 1990, 1992). The test results are shown in table 2 below:

Table 2: The Johansen Co-integration Test[2]

Eigen values	Likelihood ratio	5 % Critical value	1% Critical value	Hypothesized No. of CE(s)

[2] The Johansen Technique has the following advantages over the Engle Granger Two Step procedure: First, its results are invariant with respect to the direction of normalization, because it makes all the variables implicitly endogenous. Secondly, it fully captures underlying time series properties of the data. Thirdly, it allows direct hypothesis testing of the co-integrating vector.

0.467066	28.69258	26.91	27.07	None*
0.386397	18.81183	19.96	24.60	At most 1
0.129471	4.159625	9.24	12.97	At most 2

*(**) denotes rejection of the hypothesis at 5%(1%) significance level.

The table shows the eigen values, the likelihood ratio for the significant eigen value and the probability values. The hypothesis that we have no co-integrating vector (none) is rejected. The results thus show that we have one significant co-integrating vector. It should be noted that in a system of N variables, we should expect N-1 co-integrating vectors. The method used here helps us to get the significant vector(s). The vector is identified and normalized with inflation rate consistent with the objectives of the study. The significant vector is formed as follows:

$$ECM = \pi - 0.088895\ RY + 0.823163\ EX + -3.48735$$
$$(0.07759) \qquad (0.07727) \qquad (0.44962)$$

Granger causality

Having identified our co-integrating vector, now our ECM term, the next step is to determine how these variables drive each other. This is done through the Granger causality test. The results are shown in table 3. From these results, we see that exchange rate changes predict the domestic rate of inflation with no feedback effects. Real income does not predict inflation, but does predict the exchange rate and money supply changes. Money supply does not predict the domestic rate of inflation but does predict real income.

Table 3. Granger causality test[3]

RY ⇒⇒ π	$F(3,28) = 5.26650$	[0.75981]
π⇒⇒ RY	$F(3,28) = 0.25602$	[0.85617]
EX⇒⇒ π	$F(3,28) = 5.08441$	[0.00840]
π ⇒⇒ EX	$F(3,28) = 2.10196$	[0.13050]
ECM⇒⇒ π	$F(3,28) = 11.9927$	[0.00000]
π⇒⇒ ECM	$F(3,28) = 3.9498$	[0.02220]
MS⇒⇒ π	$F(3,28) = 2.15222$	[0.12398]
π⇒⇒ MS	$F(3,28) = 4.38765$	[0.01512]

[3] The results should be read as, EX⇒⇒ π, π is predicted by EX.

EX⇒⇒ RY	F (3,28) =0.15167	[0.92740]
RY⇒⇒ EX	F (3,28) = 7.68495	[0.00119]
MS⇒⇒ RY	F (3,28) = 2.48839	[0.08838]
RY⇒⇒ MS	F (3,28) = 0.60807	[0.61715]
MS⇒⇒ EX	F (3,28) = 0.46483	[0.70988]
RY⇒⇒ MS	F (3,28) = 6.04279	[0.00392]

We can thus conclude that the exchange rate changes and real income do predict the domestic rate inflation with no feedback effects. The strength of the causation between the domestic rate of inflation on one hand and exchange rate changes and real income could be assessed by decomposing the forecast error variance. That is, we use the VAR model to decompose the innovations in the variables into portions that can be attributed to other variables. The results are shown in table 4(a) and 4(b).

Table4 (a): Decomposition of the forecast error variance (%): Inflation ($\Delta\pi$)

STEPS	ΔRY	Δ EX	MS	Δπ
2	2.178342	5.841024	0.086614	91.59402
4	5.904915	18.26254	0.067841	75.76471
6	6.654328	19.29020	0.085654	73.96382
8	7.156001	19.33682	0.106999	73.40018
10	7.318607	19.62289	0.130373	72.91813

Table4 (b): Decomposition of the forecast error variance (%): Nominal Exchange Rate (ΔEX)

STEPS	ΔRY	Δ EX	MS	Δ π
2	2.236919	85.10317	0.249610	12.41030
4	4.601012	83.08623	0.333920	11.97884
6	4.668066	82.05003	0.375700	12.90621
8	4.727598	81.70327	0.418009	13.15112
10	4.723235	81.58510	0.454248	13.23742

From these results, we see that exchange rate is relatively stronger in driving the domestic inflation than the reverse effects. The results also suggest that neither of the variables is dominant in accounting for the other's innovations. The rate of inflation only accounts for about 12% of the innovations in exchange rate changes, while money supply only accounts for about 1% and domestic growth accounts for 4% and the rest comes from their own innovation, that is, the exchange rate movements, about 83%, at the end of the forecast horizon. On the other hand, the rate of inflation accounts for about 78% of its own innovation, aided by 16% from exchange rate changes, 5% from real income and less than 1% from money supply. Real income was assumed pre-determined; thus we do not show its innovations because it is an interpolated variable. We report the results for innovations of money supply in Appendix 3.

The final step is to estimate the short run model of domestic inflation. We enter the variables in first differences lagged two periods, the co-integrating vector (ECM) lagged one step and reduce the model until we arrive at the preferred model. The coefficient of the ECM can be interpreted as the strength of adjustment or the amount of dis-equilibrium transmitted each period to the rate of inflation.

Table 5: The Short Run Model of Inflation ($\Delta LN\pi$)

Variable	*Coefficient*	*S.E.*	*T-Statistic*	*Prob.*
C	0.067	0.005	-10.630	0.0000*
ΔLNEX	0.114	0.037	3.051	0.0057*
ΔLNRY	-0.022	0.011	-1.921	0.0671*
ΔLNMS	0.032	0.076	0.412	0.6835
ECM(-1)	-0.235	0.022	-10.63	0.0000*
AR[4] (2)	-0.906	0.092	-9.364	0.0000*

R^2 = 0.884901
Adj. R^2 = 0.859879

Jarque Bera	F-Stat	=1.280894	Prob	=0.527057
White Heteroscedasticity	Obs*Rsq	=4.797577	Prob	=0.778976
ARCH	F-Stat.	=0.517400	Prob	=0.478369
Brusche Godfrey	Obs*R sq	=0.563782	Prob	=0.75438
Ramsey Reset Test	F-Stat	=0.247590	Prob	=0.623714

* Implies that the variables are significant at both 1% and 5% level of significance.

The results from the estimation show that exchange rate devaluations are the strongest force behind Malawi's inflationary push. A 1 percent devaluation of the Malawi Kwacha leads to a 0.11 percent increase in the rate of inflation.

[4] AR(2) is an autoregressive term correcting for serial correlation of higher order.

Monetary pressures are the next strongest force behind Malawi's inflation. It is further observed that current slumps in production exert effects on inflation. This is due to the fact that food, a perishable product, exerts an immediate impact on inflation. The ECM at 24% shows that the domestic prices adjust to their own equilibrium level relatively slowly.

The diagnostic tests are all insignificant at 5% level of significance. This implies that the model is well specified, that there are no problems of autocorrelation of the second order, that the errors are homoscedastic and that the errors are normally distributed. There is also no problem of serious multicollinearity among the variables (see appendix 1, table 1) and the Cusum test and Cusum of squares test on the short-run model show that the model is stable over the study period since the residuals lie within the 5% level of significance bounds according to the graph (see appendix 2). The forecasting power of the error correction model is also good as can be see from the One-step and N-step Forecast tests in Appendix 2(d), and (e). Appendix 2(c) shows graph of actual and fitted values of inflation rate of the error correction model. Dummies have been left out of the model, as recursive coefficient estimation does not portray any episode of shocks or structural breaks. The parameters are stable as depicted in appendix 2(f).

6.0 Conclusion and Policy Implications

Inflation in Malawi is a result of both real and monetary shocks to the economy. Our econometric results point out that supply factors constitute a more significant inflationary pressures compared to monetary factors. Measures to control inflation must therefore emphasize enhancing production and supply, especially food. Shortages in food production are usually accentuated by rigidities in the transport and distribution networks in the country. It is therefore imperative that efforts be made to improve distribution and road networks to reduce costs.

It is worthy to note that although a lot of efforts have been made to curb domestic credit expansion, capital inflows are not usually taken into account and yet they constitute a major source liquidity injection. Without proper measures including sterilization, the problem will continue to plague the nation. Monetary expansion will need to be controlled through more disciplined financial management to counteract these externally generated liquidity injections. It must also be noted that exchange rate adjustments fuel cost-push inflation through devaluations. Thus the inflationary problem in Malawi is a multifaceted issue with many causes. Inflationary control should at policies directed at both real and monetary factors.

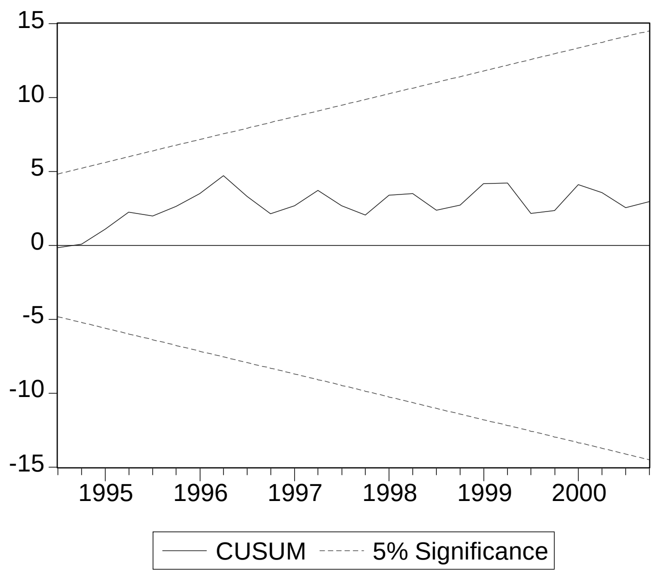
Appendix 1

Table 1: The Correlation Matrix

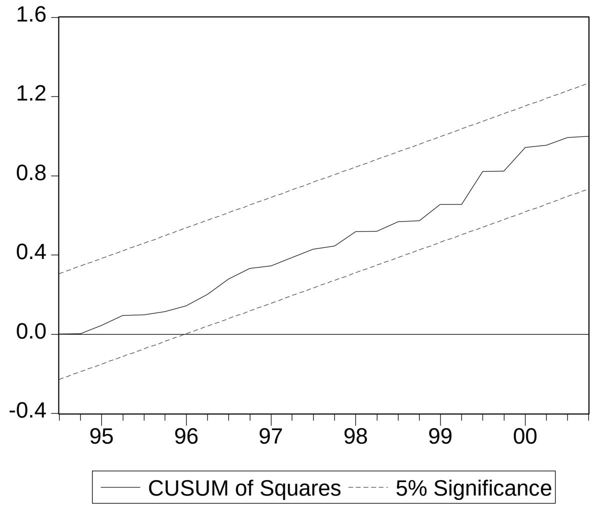
Variable	ΔLNEX	ΔLNπ	ΔLNRY	LNMS
ΔLNEX	1.000000	0.295270	0.066061	0.020719
ΔLNπ	0.295270	1.000000	-0.002947	-0.119596
ΔLNRY	0.066061	-0.002947	1.0000	-0.334942
LNMS	0.020719	-0.119596	-0.334942	1.0000000

Appendix 2

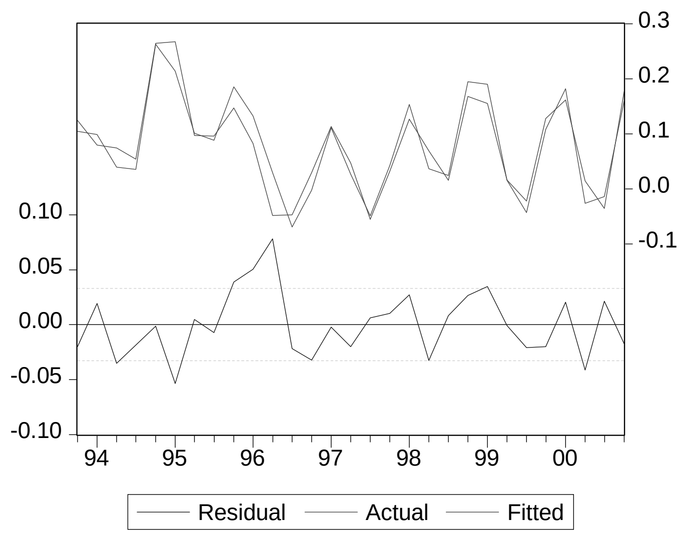
(a) Cusum test



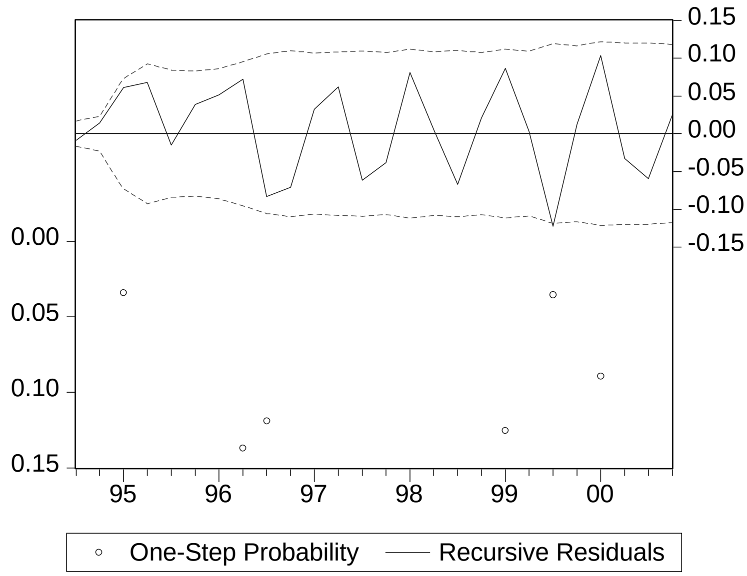
(b) **Cusum of Square Test**



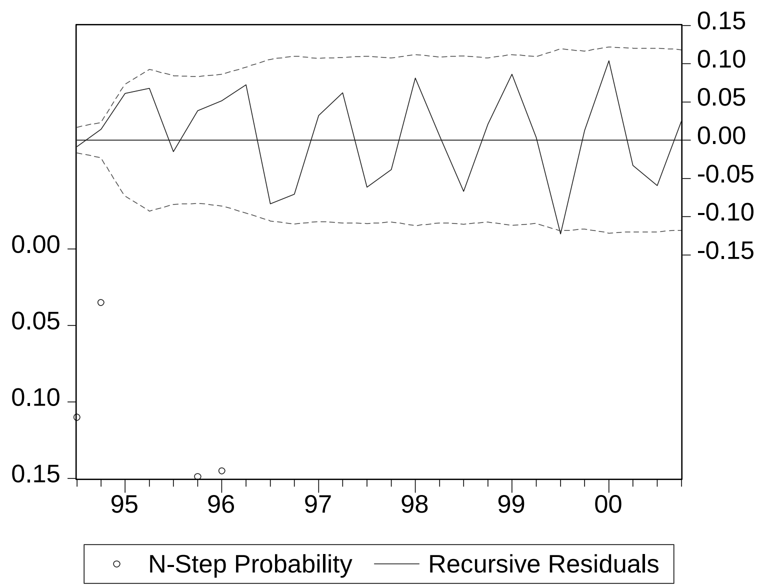
(c) Actual versus Fitted values



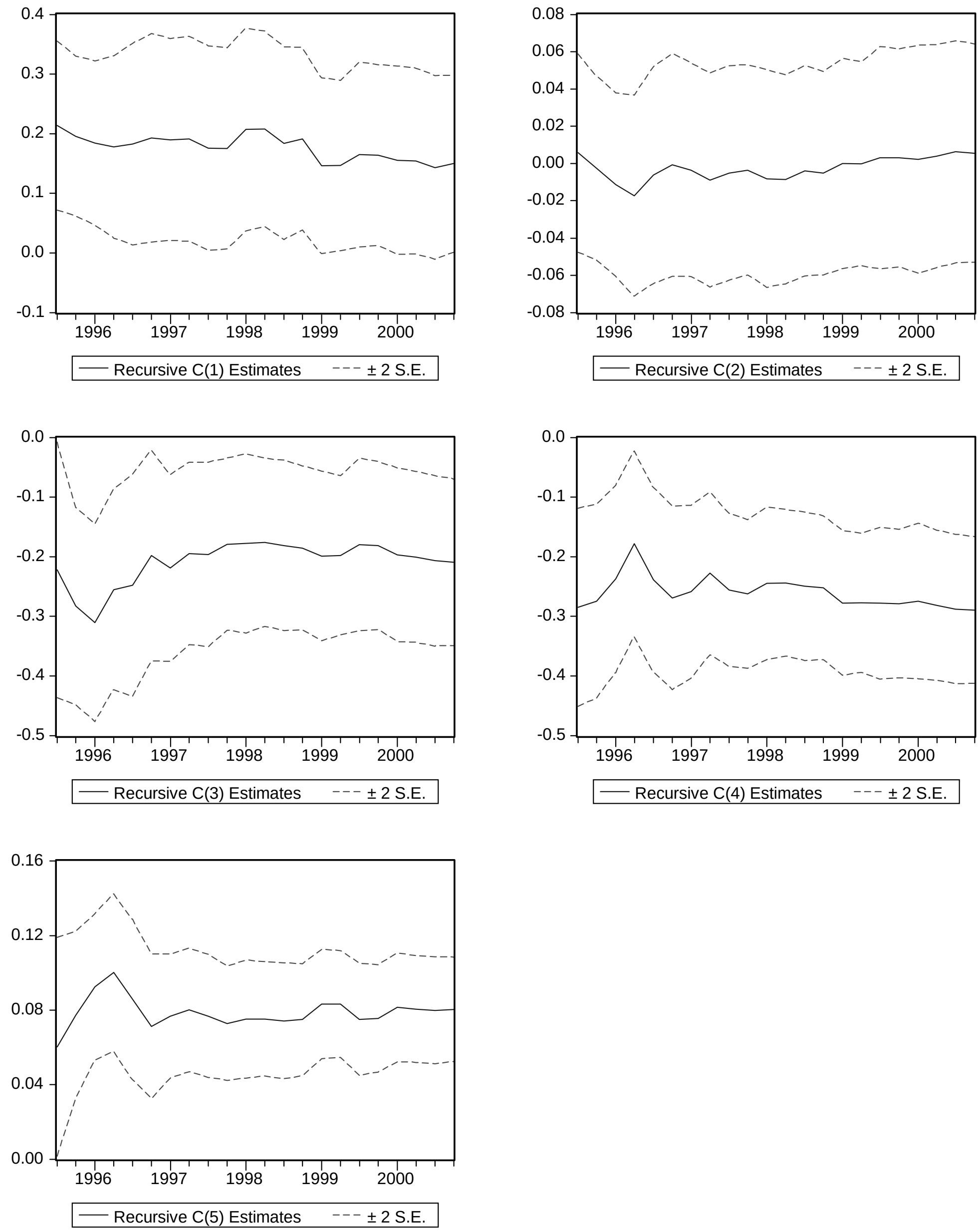
(d) **One-Step Forecast Test**



(e) N-Step Forecast Test



(f) Recursive Coefficient test



Appendix 3: Decomposition of the forecast error variance (%): Money Supply (ΔMS)

STEPS	Δπ	Δ RY	MS	ΔEX
2	21.43498	3.740047	74.36845	0.456524
4	14.62202	2.853612	77.84483	4.679538
6	8.877139	2.492831	74.52214	14.10789
8	6.814297	3.058965	75.09404	15.03270
10	5.491292	2.868934	74.78812	16.85165

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