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DETERMINANTS OF INFLATION: EVIDENCE FROM BANGLADESH

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Abstract: *The study analyzed the impact of exchange rate, money supply, interest rate and government expenditure on inflation of Bangladesh by using time series data from 1976-2010 by employing Bound Testing approach. The analysis demonstrates that in the long-run, exchange rate has negative effect on inflation, money supply and interest rate have no significant effect on inflation, and government expenditure has positive effect on inflation. While in the short-run, the results indicate directional causality taking inflation as dependent variable with other macro economic variables like exchange rate, money supply, interest rate and government expenditure. It is manifest that inflation is sensitive to changes both interest rate and government expenditure. Therefore, the government should realise effective macro-economic policies. The policy implication is that in Bangladesh to lessen inflation momentum the government will have to pursue a monetary and fiscal policy which matches with the actual scenario of real sectors and monetary sectors.*

Keywords: *ARDL, bound testing, error correcting term, exchange rate, govt. expenditure, inflation, interest rate, money supply.*

Introduction:

The emergence of substantial inflation figure in Asia and Bangladesh in particular has led to widespread studies about its causes. Persistent price increases are among the most serious problems affecting every economic unit. That is why very country is saddle with the responsibility of ensuring stability in general price level as one of core macroeconomic objectives to achieve economic development.

Inflation is generally used to describe a situation of rapid, persisted and unacceptably high rises in the general price level in an economy, resulting to general loss of purchasing power of the currency. Inflation causes serious discomfort for consumers, investors, producers and the government (Asogu, 1990). Long term inflation occurs when the money supply grows at a faster rate than the output of goods and services. This situation occurs when there is more money than is needed to accommodate nominal growth in output, consumers and businesses want to purchase more goods and services than can be produced with current resources (labour, materials, etc.) causing upward pressures on prices. Over a short term, inflation can occur from various shocks in the economy. Food and energy price shocks are common examples of this type of inflation in Bangaladesh. A price of a commodity such as fuel may rise suddenly and sharply, relatively to other commodities prices response, may result to short term increase in overall prices

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Inflation in Bangladesh has been accelerating from beginning and has become a major concern to the government. Several policies were introduced to control inflation in the economy and despite these policies, inflationary trends continue to fluctuate. Government needs to control high levels of unpredictable inflation since it can severally disrupt the economy. The tools governments normally use include monetary policy (i.e. increase or decrease in the money supply and interest rate), fiscal policy (changes in the amount of taxes and government spending) and various controls on prices, tariffs, etc. Many nations choose monetary policy as their primary tool since it has proven to be effective, less disruptive to the market operations and easier and quicker to implement since adjusting the money supply does not require legislative approval as would be for instance changing the tax structure.

The three major explanations of inflation include fiscal, monetary, and balance of payments aspects. Monetary aspect, inflation is considered to be due to an increase in money supply, in fiscal aspect, budget deficit are the fundamental causes of inflation. However, the fiscal aspect is closely linked to monetary explanations of inflation since government deficit are often financed by money creation in developing countries. In the balance of payment aspect, emphasis is placed on exchange rate. That is the collapse of exchange rate brings about inflation either through higher import prices and increase in inflationary expectation, which are often accommodated or through an accelerated wage indexation mechanism (Akinbobola, 2012)

However, efforts by various governments to curb inflationary tendencies, the problems and its effects continued unabated. Studies reveal growth in money supply, government deficit financing, exchange rate decreased agricultural and industrial production among other were responsible for inflationary pressure in Bangaladesh. And the most significant effect of inflation is its impact on government revenues and non-performance of the economy. Inflation also makes budgeting and future planning difficult for economic agents imposes a drag on productivity, particularly when firms are forced to shift resources away from products and services, thereby discouraging investment and retarding growth (Orubu, 2009).

Milton Friedman (1963) wrote Inflation is always and everywhere a monetary phenomenon. The Quantity Theory of Money leads us too agree that the growth in the quantity of money is the primary determinant of the inflation rate. John Maynard Keynes (1936) argued that demand determines output, which, in turn, determines employment and prices. At full employment of men and capital, excessive demand for goods and services drives up the general level of prices causing inflation. The biggest challenge in macro-economic management is reining the inflation. Though currently inflation rate in Bangladesh is declining but during 2009, 2010 and 2011 it was 9.1%, 9.9%, 11.1% respectively. (Source: www.focus-economics.com)

The high inflation rate has become a serious concern in the industrial and emerging market economies globally. Inflation constitutes one of the factors responsible for poverty, low standard of living and growth in Bangladesh. Hence, the paper is to investigate into the root causes of inflation in Bangladesh.

Literature Review:

Inflationary discourse still remains the most contentious Macroeconomic studies which

have theoretical basis in the perspective of both the Monetarist and the Keynesian schools of thought. Most economist before Keynes had underscored the relationship between the amount of money supply and the level of general prices, however, with varying degree of emphasis. The quantity theory of money states that the general price level changes in direct proportion to a change in the level of money supply.

Keynes (1936) posited that inflation is caused by a situation of excess aggregate demand over aggregate supply when there is no excess capacity, a situation in which the economy operates at full employment of resources. Furthermore, there are strong arguments that fiscal deficits are major cause of inflation. Abolo (1997) among other researchers contented that evidence points to fiscal deficits as major cause of inflation.

The argument that price inflation is significantly determined by the process mark-up on the costs of firm's production process has been advanced in the models of Goacher (1986) and Gordon (1984) believed that inflation could result from the cost of imported goods rising independently of the demand for them in the domestic economy.

Most recently, there is an emerging trends of literature on inflation came to be known as the political economy approach to macroeconomic policy Selialia (1995).These recent theories of inflation have shifted attention away from traditional direct economic causes of inflation, such as money creation, towards political and institutional determinants of inflationary pressures because being theoretical and put emphasis almost exclusively on industrial countries.

There are relatively large literature dealing with relations between monetary indicators and other macroeconomic variables. Doroshenko, (2001), consider relation between both money supply and inflation and between money supply and inflation and found a long-run relationship between money growth and inflation. Clemens and Alex (2002) empirically estimate the relationship between exchange rate accommodation and the degree of inflation persistence using a non-linear autoregressive inflation equation for ten European countries for the period 1974-1998..Thier results provide supportive evidence for the existence of a positive link between exchange rate accommodation and inflation persistence for most of the smaller and more dependant exchange rate mechanism countries, even when mean level shift in inflation are appropriately accounted for.

Mahamadu and Philip (2003) explore the relationship between monetary growth, exchange rate, and inflation in Ghana using Error Correction Mechanism The result confirms the existence of a long run equilibrium relationship between inflation, money supply, exchange rate and real income. In line with theory, the finding demonstrates that in the long run, inflation in Ghana is positively related to the money supply and exchange rate and negatively related to real income.

In Nigeria, there have been several studies on causes on inflation. For instances Oyejide(1972),

Odusanya and Atanda (2010) analyzed the dynamics and simultaneous inter-relationship between inflation and its determinants in Nigeria between 1970 and 2007 examined using the Augmented Dickey Fuller (ADF) and unit root test. The result reveals that inflation rate, growth rate of real output, money supply and real share of fiscal deficit

are stationary at levels, while, other incorporated variables-real share of import, exchange rate and interest rate are stationary at first difference. Adeyeye and Kola also examined the causes and effects of inflation in Nigeria between 1969 and 2009 and what could be done to ameliorate the negative effects on the economy. The time series variables properties on some selected variables were examined using ADF unit root test and co-integration analysis. The result reveals that money supply, growth rates, gross domestic product growth rate and expenditure revenue ratio are not spurious but exchange rate of dollar to Naira was non-stationary. The study also revealed that the GDP growth rate is counter inflationary as against inflationary factors. It is sufficed to say that causes of inflation is one of the most highly treated subject in economic researches and literature. Bangladesh Bank, IMF and CPD (2007) explored that both demand and supply side factors constitute the relevant sources of inflation in Bangladesh. Among these are M2 growth, private sector credit growth, market capitalization growth, growth of government borrowing, remittance growth, exchange rate change, market syndicate. Taslim (1980) used regression models for explaining the inflationary process of Bangladesh. He explored that one year lagged money supply had significant positive effect on inflation. However, the introduction of wage variable as an additional independent variable resulted in dramatic fall of statistical significance of coefficients of other variables in the regression model.

Estimation of the Models: Augmented Dickey-Fuller (ADF) unit root test was applied in checking the order of integration of the series. The results of the estimates are reported in Table- A.

Table-A: **Results of Augmented Dickey-Fuller tests for unit root of variables concerned**

					Mackinnon Critical Value			
Variable	Exogenous	ADF Test Statistic	Prob. * value	Lag length	1%	5%	10%	Inference
Inflation (I_t) at level	none	-5.54	0.00	0	-3.63	-2.95	-2.61	I(0)
Interest rate (r_t) at 1st difference	none	-3.58	0.01	0	-3.63	-2.95	-2.61	I(1)
Exchange rate(E_t) at 1st difference	none	-5.82	0.00	0	-3.64	-2.95	-2.61	I(1)
Govt.expenditure(G_t) at 1st difference	none	-6.07	0.00	0	-3.65	-2.95	-2.61	I(1)
Money supply(M_t) at 1st difference	none	-4.05	0.0072	0	-3.64	-2.95	-2.61	I(1)

(Source : Estimated Results)

It is important to note that the mixture of both I(0) and I(1) variables would not be possible under the Johansen procedure. This therefore, gives a good justification for using the bounds test approach, or ARDL model, which was proposed by Pesaran et al (2001).

Methodology: The ARDL model can be specified as follows:

$$I_t = \alpha_0 + \alpha_1 E_t + \alpha_2 M_t + \alpha_3 R_t + \alpha_4 G_t + \varepsilon_t \quad (1)$$

Where *I* is Inflation, *E* is exchange rate, *M* is money supply, *R* is interest rate and *G* is govt. expenditure. ε is a white noise process and *t* is the time period. The equation (1) is my model and from this model the ARDL model can be specified.

Estimation Techniques: The methodology used in this study is based on the autoregressive distributed lag (ARDL) model which does not involve pre-testing variables. This methodology is used to examine the cointegration relationship among $I_t, E_t, M_t, R_t \; and \; G_t$ variables.

ARDL framework for the above equation is given as

$$\Delta I_t = \alpha_0 + \sum_{i=1}^{n} \alpha_{1i} \Delta I_{t-1} + \sum_{i=1}^{n} \alpha_{2i} \Delta E_{t-1} + \sum_{i=1}^{n} \alpha_{3i} \Delta M_{t-1} + \sum_{i=1}^{n} \alpha_{4i} \Delta R_{t-1} + \sum_{i=1}^{n} \alpha_{5i} \Delta G_{t-1} + \beta_1 I_{t-1} + \beta_2 E_{t-1} + \beta_3 M_{t-1} + \beta_4 R_{t-1} + \beta_5 G_{t-1} + \varepsilon_t \quad (2)$$

The ARDL model testing procedure starts with conducting the bound test, which states the null hypothesis of zero cointegration, i,e.

$$H_0 = \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = 0$$

against the alternative hypothesis of the existence of cointegration, i.e.

$$H_0 \neq \beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq \beta_5 \neq 0$$

The statistic underlying the procedure is the F-statistic which is used to test the significance of lagged levels of the variables, in order to establish the existence of cointegration. Two sets of critical values are reported in Pesaran and Pesaran (1997), Pesaran et al (2001) or Narayan (2004). The critical values are divided into upper and lower critical bounds. The upper critical values assume that all the series are I(1) while the lower critical values assume that all the series are I(0). In the bound testing approach, the calculated F-statistic is compared with the critical values provided by Pesaran and Pesaran (1997), Pesaran et al (2001) or Narayan (2004). However, due to the limited number of sample observations, the critical values in this paper are extracted from Narayan (2004). If the computed F-statistic falls outside the critical bound, a conclusive inference can be made without considering the order of integration of the underlying regressors. For instance, if the F-statistic is higher than the upper critical bound, then the null hypothesis of no cointegration is rejected. Alternatively, if the F-statistics is lower than the lower critical bound, then the null hypothesis of nocointegration cannot be rejected. If however the calculated F-statistic lies within the lower and upper bounds, then the test is said to be inconclusive. In this context, the unit root tests should be

conducted to ascertain the order of integration of the variables. If all the variables are found to be I(1), then the decision is taken on the basis of the upper critical value. On the other hand, if all the variables are I(0), then the decision is based on the lower critical bound value.

Once cointegrating relationship is ascertained, the error correction estimates of the ARDL model are obtained. The diagnostic test statistics of the selected ARDL model can be examined from the short run estimates at this stage of the estimation procedure. Similarly, the test for parameter stability of the model can be performed. The error correction representation of equation (2) can be specified as follows:

$$\Delta I_t = \alpha_0 + \sum_{i=1}^{n} \alpha_{1i}\, \Delta I_{t-1} + \sum_{i=1}^{n} \alpha_{2i}\, \Delta E_{t-1} + \sum_{i=1}^{n} \alpha_{3i}\, \Delta M_{t-1} + \sum_{i=1}^{n} \alpha_{4i}\, \Delta R_{t-1} + \sum_{i=1}^{n} \alpha_{5i}\, \Delta G_{t-1} + \gamma ECT_{t-1} + \varepsilon_t$$

where ECM is the error correction term which measures the speed of adjustment, and ã is the coefficient of the error correction term, which is expected to be negative and statistically significant to further confirm the existence of a cointegrating association.

Sources of data: The time series data were derived from various secondary sources such as: Indian Financial Statistics etc. The macroeconomic data covers between 1976-2010. Base period is 2000. Log of variables has been used in my research work. The data gathered were subjected to various econometric tests with the aid of E-views.

Empirical Analysis

Bound test Cointegration Results: In order to perform the bound testing procedure, equation (2) using the ARDL approach to cointegration, to examine the long run relationships among the variables in equation (1). A lag length of 2 was chosen as the maximum lag length based on the AIC and SIC. This is also consistent with Pesaran and Shin (1999) who recommended choosing a maximum lag length of 2 for small sample annual data. The F-statistic and critical bounds values for testing the null of no cointegrating relationship are reported in table-1.

Table 1: Bounds Test for Cointegration Analysis

Critical value	Lower Bound Value	Upper Bound Value
1%	3.74	5.06
5%	2.86	4.01
10%	2.45	3.52

(Source : Estimated Results)

Note: Computed F-statistic: 6.47 (Significant at 0.05 marginal values).Critical Values are cited from Pesaran et al. (2001), Table CI (iii), Case 111: Unrestricted intercept and no trend.

Table 2: Bounds Test Results

Variables	**F-Statistic**	**Probability**	**Inference**
I_t, E_t, M_t, R_t, G_t	6.47	0.0018	Cointegration

(Source : Estimated Results)

The estimated coefficients of the long-run relationship between I_t, E_t, M_t, R_t, G_t are expected to be significant.

Table- 3: Long-run estimated coefficients based on equation (2)

Dependent variable: d(log Inflation)

Variables	Coefficient	Standard Error	T-Ratio	Probability
Constant	5.91	2.73	2.16	0.03
E_t,	**-8.49**	2.49	-3.40	**0.001**
M_t	0.88	0.67	1.30	0.20
R_t	0.90	0.70	1.28	0.20
G_t	**2.24**	0.85	2.61	**0.01**
R^2 =0.30, Adjusted R^2=0.20, Log likely hood=-13, F-Stat=3.13, AIC-1.07, SIC=1.29				

(Source : Estimated Results)

The calculated F-statistic when inflation is the dependent variable is 6.47, which is higher than the upper bound critical value at the 5% level of significance (4.01). This implies that the null hypothesis of no cointegration is rejected at the 5% level and that there is indeed a cointegration relationship among the inflation and its determinants.

Long Run and Short Run Dynamics: There is a long run association as far as bound test is concerned. Results are given in table -3. The results suggest that exchange rate has negative effect on inflation, money supply and interest rate have no significant effect on inflation, and government expenditure has positive effect on inflation.

Table-4: Error Correction Representation for the Selected ARDL Model

Dependent Variable: D(INFLATION)				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	-0.016047	0.253381	-0.063333	0.9501
D(INFLATION(-1))	0.805913	0.387620	2.079129	0.0507
D(INFLATION(-2))	0.360397	0.274169	1.314506	0.2036
D(EXCHANGERATE(-1))	7.030518	4.166130	1.687542	0.1070
D(EXCHANGERATE(-2))	1.571135	3.728362	0.421401	0.6780
D(MONEYSUPPLY(-1))	0.038490	2.538937	0.015160	0.9881
D(MONEYSUPPLY(-2))	1.714355	2.706644	0.633388	0.5337
D(INTERESTRATE(-1))	-3.793734	1.997255	-1.899474	0.0720
D(INTERESTRATE(-2))	3.327917	1.712781	1.942990	0.0662
D(GOVTEXPENDITURE(-1))	-6.579168	2.170203	-3.031591	0.0066
D(GOVTEXPENDITURE(-2))	1.420193	1.370513	1.036249	0.3125
ECT(-1)	-1.962548	0.494318	-3.970214	0.0008
R-squared	0.774936	Mean dependent var		0.007590
Adjusted R-squared	0.651151	S.D. dependent var		0.633897
S.E. of regression	0.374401	Akaike info criterion		1.153018
Sum squared resid	2.803524	Schwarz criterion		1.702669
Log likelihood	-6.448292	Hannan-Quinn criter.		1.335212
F-statistic	6.260340	Durbin-Watson stat		1.811603

Prob(F-statistic)	0.000211			

(Source : Estimated Results)

In the above model D(INFLATION(-1)), D(INFLATION(-2)), D(EXCHANGERATE (-1)), D(EXCHANGERATE(-2)),D(MONEYSUPPLY (-1)), D(MONEYSUPPLY(-2)), D(INTERESTRATE(-1)), D(INTERESTRATE(-2)), D(GOVTEXPENDITURE(-1)), D(GOVTEXPENDITURE(-2)) all are short run coefficient. ECT(-1) is the speed of adjustment parameter. It should be negative and significant. It means that the whole system would get back long run equilibrium.
The above model should be check whether the model has serial correlation or not and whether the model is stable or not.

Table-5 Serial correlation LM test:

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	**0.992140**	Prob. F(2,18)	0.3902
Obs*R-squared	3.177345	Prob. Chi-Square(2)	**0.2042**

(Source : Estimated Results)

It is clear from the above table on the basis of F-statistic that the null hypothesis is accepted i.e, there is no serial correlation.

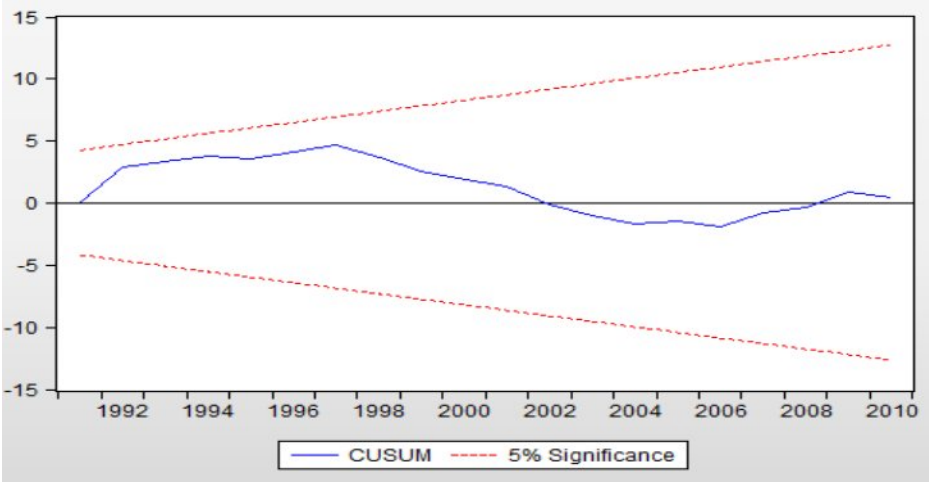

Figure 2: CUSUM Test for stability of parameters:

The diagnostic test statistics indicates that there is no evidence of serial autocorrelation in the disturbances. The coefficient of determination (R^2) indicates that the model is reasonably accurate in prediction, and 77 percent of variation in the dependent variable is accounted for by the independent variables. The stability of the regression coefficients are evaluated using cumulative sum (CUSUM) test. The regression equation appears to

be stable as the CUSUM test statistics lies within the 5% critical bound as shown in the figure-2.

Short-run Causality Test (Wald Test F-statistic):

Table-6: Short run causality between inflation and exchange rate

Wald Test:			
Test Statistic	Value	df	Probability
F-statistic	1.598022	(2, 20)	0.2271
Chi-square	3.196043	2	0.2023

(Source : bid)

Exchange rate at lag 1 and exchange rate at lag 2 cannot jointly cause inflation because null hypothesis i.e., c(4)=c(5)=0 is accepted. Therefore, there is no short run causality running form exchange rate to inflation.

Table-7: Short run causality between inflation and money supply

Wald Test:			
Test Statistic	Value	df	Probability
F-statistic	0.216421	(2, 20)	0.8073
Chi-square	0.432843	2	0.8054

(Source : ibi)

Money supply at lag 1 and money supply at lag 2 cannot jointly cause inflation because null hypothesis i.e., c(6)=c(7)=0 is accepted. Therefore, there is no short run causality running form money supply to inflation.

Table-8: Short run causality between inflation and interest rate

Wald Test:			
Equation: Untitled			
Test Statistic	Value	df	Probability
F-statistic	2.472744	(2, 20)	0.1097
Chi-square	4.945488	2	0.0844

(Source : ibid)

Interest rate at lag 1 and interest rate at lag 2 can jointly cause inflation because null hypothesis i.e., c(8)=c(9)=0 is rejected. Therefore, there is a short run causality running form interest rate to inflation.

Table-9: Short run causality between inflation and govt. expenditure

Wald Test:			
Equation: Untitled			
Test Statistic	Value	df	Probability

F-statistic	5.941915	(2, 20)	0.0094
Chi-square	11.88383	2	0.0026

(Source : ibid)

Govt. expenditure at lag 1 and govt. expenditure at lag 2 can jointly cause inflation because null hypothesis i.e., c(10)=c(11)=0 is rejected. Therefore, there is a short run causality running form govt. expenditure to inflation.

Conclusion and Implication:

This paper has estimated the impact of exchange rate, money supply, interest rate and government expenditure on inflation of Bangladesh by using time series data from 1976-2010 by employing Bound Testing approach. The analysis demonstrates that in the long-run, exchange rate has negative effect on inflation, money supply and interest rate have no significant effect on inflation, and government expenditure has positive effect on inflation.

While in the short-run, the results indicate directional causality taking inflation as dependent variable and exchange rate, money supply, interest rate and government expenditure. It is manifest that inflation is sensitive to changes both interest rate and government expenditure. Therefore, the government should realise effective macro-economic policies. The policy implication is that in Bangladesh to lessen inflation momentum the government will have to pursue a monetary and fiscal policy which matches with the actual scenario of real sectors and monetary sectors. Govt. spending should be prudently utilized.

There is a recommendation that further study should be carried out using different sets of variables with appropriate mathematical models to detect determinants of the inflation in Bangladesh.

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Appendix:

Table-B: Estimated Model based on equation (2)

Dependent variable: 1st difference inflation (DInflation)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.077	5.821	-0.185	0.85
D(INFLATION(-1))	0.309	0.427	0.725	0.47
D(INFLATION(-2))	0.279	0.270	1.032	0.31
D(EXCHANGERATE(-1))	-8.980	6.636	-1.353	0.19
D(EXCHANGERATE(-2))	-7.575	4.930	-1.536	0.14
D(MONEYSUPPLY(-1))	3.445	3.554	0.969	0.34
D(MONEYSUPPLY(-2))	4.165	3.236	1.286	0.21
D(INTERESTRATE(-1))	-1.953	2.087	-0.935	0.36
D(INTERESTRATE(-2))	4.800	1.772	2.708	0.01
D(GOVTEXPENDITURE(-1))	-3.534	2.375	-1.488	0.15
D(GOVTEXPENDITURE(-2))	2.226	1.285	1.731	0.10
INFLATION(-1)	-1.100	0.577	-1.904	0.07
EXCHANGERATE(-1)	8.983	9.880	0.909	0.37
MONEYSUPPLY(-1)	-1.813	1.782	-1.017	0.32
INTERESTRATE(-1)	-0.493	0.966	-0.509	0.61
GOVTEXPENDITURE(-1)	-1.823	2.349	-0.776	0.44
R^2=0.86, Adjusted R^2=0.74, log likelyhood=1.94, F-Stat=6.94, AIC=0.87, SIC=1.61, D.W.=2.47				