Determinants of Inflation in Sri Lanka: An Econometric Analysis

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Abstract

Stabilization of the general price level or prevention of high inflation has become a major macroeconomic objective of the monetary authorities in Sri Lanka as well as in many other countries in view of the adverse repercussions of inflation on economic growth and social welfare. Thus, the Central Bank of Sri Lanka has prioritized price stability as one of its main monetary policy goals in recent times. Central Banks in some countries have adopted inflation targeting in designing their monetary programmes. The success of inflation control by the Central Bank depends, inter alia, on (a) the degree of influence of the money supply on inflation, and (b) the extent of autonomy that the Central Bank enjoys in monetary management. This paper will focus on the first factor. It will attempt to quantify the impact of money supply and other determining factors on inflation. Determination of inflation in an open developing economy will be explained by using a theoretical model. Initially, the model will be estimated applying the conventional regression tools. These tools are weak when the data series are non-stationary. Therefore, we will use Unit Root tests to ascertain the stationarity of the data. If the data are non-stationary, it is necessary to difference the data for estimation. The possible long-run relationships are likely to be ignored when the data are differenced, and therefore, we will use cointegration and vector error correction modeling to overcome that problem and to capture the long-run dynamics. Our findings reveal that inflation is a monetary phenomenon in Sri Lanka. Therefore, prudent monetary management is essential for inflation control. The Central Bank will be able to fulfill this task, if and only if the fiscal authorities are prepared to strictly adhere to fiscal discipline.

1. Introduction

Acceleration of economic growth and maintenance of macroeconomic stability have been the major macroeconomic objectives in the export-oriented growth strategies adopted by the successive governments in Sri Lanka during the post-liberalization period (from 1977 to date). Besides structural adjustments, which are aimed at removing the supply side bottlenecks of the economy, maintenance of macroeconomic stability is a prerequisite to a successful export-oriented growth regime. Policy makers attempting to stimulate economic activities including investment, savings, domestic production and exports should curb inflation, external current account deficit and fiscal deficits. In this regard, macroeconomic policy coordination in the areas of monetary and fiscal policies is vital. Recognizing this need, the Central Bank of Sri Lanka has attached greater priority to the objective of price stability in its monetary policy framework in recent times.

In spite of the above endeavours, much progress has not been achieved with regard to inflation control at least for two reasons. First, consumer prices are partly affected by supply side factors such as import price hikes, production shortfalls, nominal wage increases and exchange rate depreciation. Therefore, monetary and fiscal authorities, who basically deal with the demand side of the economy through their policy instruments, do not have full control over inflation in a developing country like Sri Lanka. Second, the monetary and fiscal authorities are unable to implement prudent demand management policies that are needed to attain price stability due to political obligations. Failure to maintain a low budget deficit by the government, in terms of the Fiscal Responsibility Act, in recent times is a case in point. The overall budget deficit, as a ratio of GDP, declined from a peak level of 10.8 percent in 2001 to 8.0 percent in 2003, but increased to 8.2 percent in 2004. In the meantime, the Central Bank has had to accommodate the increased budget deficits foregoing its obligation to maintain conducive money growth to facilitate price stability. The rate of growth of the broad money supply rose from a high level of 20.1 percent in 2000 to 12.9 percent in the following year, but since then it gradually rose to reach 19.6 percent by 2004. The demand-pull effects emanating from the above-mentioned fiscal and monetary policy slippages led to high inflation. This has been exacerbated by supply-side and cost-push factors like domestic production shortfalls, exchange rate depreciation, import price increases and wage increases. The annual average inflation, measured in terms of the Colombo Consumer Price Index (CCPI), declined from a peak level of 14.2 percent in 2001 to 6.3 percent in 2003, rose again to 11.6 percent in 2005.

Inflation exerts adverse consequences on the economy in many respects. It reduces the real value of money resulting in a deterioration of the purchasing power of money. Fixed income earners, in particular, are adversely affected by inflation. In an inflationary situation, prices of different goods tend to rise at different degrees distorting relative prices as well as consumer behaviour. This leads to a misallocation of resources. Inflation also disturbs business confidence. Another major adverse effect of inflation is that it weakens export competitiveness of the domestic economy. A rise in the general price level of the country relatively to its trade partners makes exports more expensive and imports cheaper, unless the exchange rate depreciates to offset the inflation differential. Depreciation of the exchange rate, in turn, aggravates inflation.

Given the adverse consequence of inflation on domestic economic activities, inflation control or price stability has been increasingly recognized worldwide as a major objective of macroeconomic policy, particularly that of monetary policy. Accordingly, price stability has become a major concern of the central banks in designing monetary policy in most countries. Meanwhile, the monetary authorities found it difficult to use an exchange rate peg or a monetary aggregate in conducting monetary policy in an open economy. Therefore, in the early 1990s, several industrial countries adopted an 'inflation targeting' approach using monetary policy to keep inflation within an explicit numerical target range. Central banks in developing countries have not adopted this approach yet, but some of them have given high priority to control inflation.

In Sri Lanka, inflation control has been an integral component of macroeconomic policies since the liberalization of the economy in 1977. Taking into account the paramount need to control inflation, the Monetary Law Act was amended in 2002 so as to narrow down the objectives of the Central Bank of Sri Lanka to achieve (a) economic and price stability, and (b) financial system stability with a view to encouraging and promoting the development of the productive resources of Sri Lanka. This has been supplemented by the government's commitment to fiscal discipline, in terms of the recently passed Fiscal Responsibility Act.

The success of inflation control by the Central Bank mainly depends on (a) the degree of influence of the money supply on inflation, and (b) the extent of autonomy that the Central Bank enjoys in managing the money supply, independent of the fiscal authority, i.e. the Ministry of Finance and the General Treasury. The feasibility of inflation targeting as a monetary policy framework also hinges largely upon these two factors. This study will focus on the first factor by quantifying the relationship between inflation and money supply along with other determining variables. For this purpose, we will use a theoretical model of determinants of inflation incorporating both demand-pull and cost-push factors. Initially, we will apply the conventional regression techniques to ascertain the determinants of inflation. However, the recently developed econometric techniques have proved that the conventional regression results are no longer valid, if the time series are nonstationary as they give rise to spurious regression problems. Therefore, we will test the stationarity of the time series using the unit root tests. If the data are non-stationary, we need to difference the data to make them stationary. By differencing, however, we are bound to ignore the possible long-term relationships between certain variables. In order to deal with this problem, we will use the techniques of cointegration and vector error correction modeling in our analysis.

The next section of the paper reviews the inflation trends in Sri Lanka. In Section 3, we will develop a theoretical model to explain the determinants of inflation in the country. Section 4 presents the conventional regression results. Modern time series techniques are presented in Section 5. The final section presents the concluding remarks.

2. Inflation Trends in Sri Lanka

Inflation had not been a major economic problem in Sri Lanka until the crude oil price hike in 1973. The annual average rate of inflation was only 2.1 percent during the two decades between 1953 and 1972. And the annual inflation rate remained at single digit level throughout that period. For the first time, it reached double digit level of 12.3 percent in 1974. Since then the inflation rate declined rapidly and reached a meager 1.2 percent in 1976. On the whole, the average annual inflation rate was only 3.0 percent during 1953-1976. Thus, low inflation was a major characteristic of the economy in the pre-liberalization regime. This could be mainly attributed to the high priority given by the then governments to achieve social welfare through, inter alia, administrative price controls and consumer subsidies at the expense of economic growth.

Figure 1

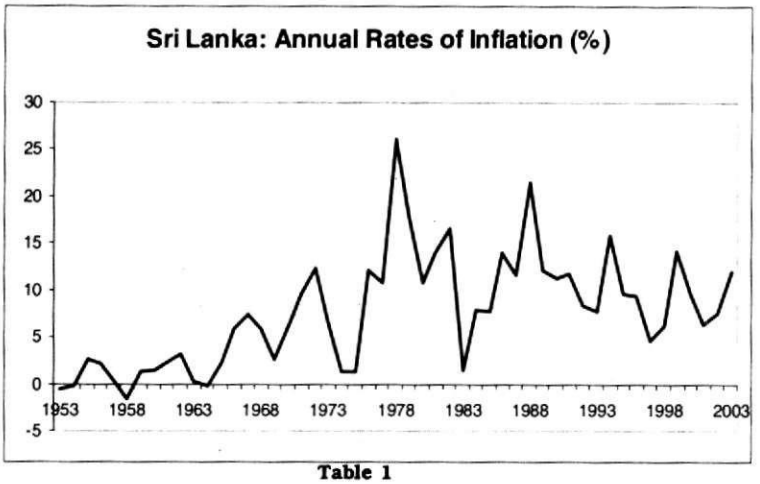

Table 1

Inflation and Factors Affecting Inflation in Sri Lanka

Year	Annual Percentage Changes				% of GDP
	Rate of Inflation	Real GDP	Money Supply	Exchange Rate	Budget Deficit
1977	1.2	4.2	37.9	76.2	-5.8
1978	12.1	8.2	24.9	-0.3	-14.1
1979	10.8	6.3	38.3	-0.4	-13.8
1980	26.1	5.8	31.9	16.5	-23.1
1981	18.0	5.8	23.1	14.2	-15.6
1982	10.8	5.1	24.8	3.7	-17.4
1983	14.0	5.0	22.1	17.3	-13.4
1984	16.6	5.1	16.6	5.1	-9.0
1985	1.5	5.0	11.5	4.3	-11.7
1986	8.0	4.3	5.1	4.0	-12.2
1987	7.7	1.5	14.7	7.9	-11.1
1988	14.0	2.7	16.5	7.4	-15.7
1989	11.6	2.3	12.5	21.1	-11.2
1990	21.5	6.2	18.5	0.6	-9.9
1991	12.2	4.6	22.1	5.8	-11.9
1992	11.4	4.3	17.4	8.0	-8.0
1993	11.7	6.9	23.4	7.7	-8.7
1994	8.4	5.6	19.7	0.8	-10.5
1995	7.7	5.5	19.2	8.1	-10.1
1996	15.9	3.8	10.8	4.9	-9.4
1997	9.6	6.3	13.8	8.1	-7.9
1998	9.4	4.7	9.7	10.6	-9.2
1999	4.7	4.3	13.3	6.4	-7.5
2000	6.2	6.0	13.0	11.0	-9.9
2001	14.2	-1.5	11.4	16.4	-10.8
2002	9.6	4.0	13.2	3.8	-8.9
2003	6.3	6.0	13.8	0.0	-8.0
2004	7.6	5.4	18.5	8.1	-8.2
Annual Average					
1953-1976	3.0	3.5	8.3	2.8	-5.5
1977-2004	11.0	4.8	18.5	9.9	-11.2

Source: Central Bank of Sri Lanka, *Annual Reports* (various issues)

The scenario changed completely after the liberalization of the economy in 1977. Most of the administrative price controls and consumer subsidies were eliminated under the economic reforms. Also, a flexible exchange rate system was introduced in place of the previous fixed exchange rate regime. As the economy was made open to the rest of the world by removing exchange controls and trade barriers, domestic consumer prices became more susceptible to commodity price fluctuations abroad. All these reforms led to an increase in the general price level accelerating inflation. Meanwhile, the rapid increase in public investments after the liberalization resulted in a considerable growth in the money supply, which in turn, exerted demand pressures on inflation. Acceleration of GDP growth immediately after the liberalization further exacerbated the demand pressures. As a result, between 1978 and 1984, the year to year inflation rate remained at double digit level, and the average annual inflation rate was as high as 16 percent.

In the next three years (1985-87) the inflation rate declined due to several factors including slow money growth and exchange rate stability. Between 1988 and 1993, the annual inflation rate remained at double digit level every year reflecting an average annual inflation rate of 14 percent. Monetary expansion backed by high budget deficits was a major cause of inflation during that period. Unfavourable weather conditions and civil disturbances contributed to high inflation in 1988-89. In 1990, the inflation rate reached a peak level of 21.5 percent mainly as a result of the substantial depreciation of the rupee in the previous year. In the subsequent three years, inflation remained at double digit levels, but declined gradually to reach a single digit level in 1994. The reductions of administered prices of certain essential consumer goods, reduction of tariffs and increased supplies of goods helped to contain inflation until 1995.

The favourable trend reversed in 1996 reflecting double digit inflation, and the main causes were shortfalls in domestic food production, cutback of consumer subsidies and higher energy prices. In the subsequent four years, the rate of inflation declined, and remained at single digit level. It was a combined outcome of prudent monetary management, fiscal discipline, rationalized tax and tariff structures and low import prices. The annual inflation rate reached a peak level of 14 percent in 2001 due to supply shortages, administered price revisions, currency depreciation and international commodity price increases. Inflation gradually declined to low levels in 2002 and 2003, benefiting from both demand and supply side factors. Cautious monetary policy of the Central Bank, supported by fiscal consolidation, helped to contain the aggregate demand. On the supply side, increased domestic food production, exchange rate stability and lower import prices reduced the pressure on domestic prices. In 2004, inflation began to rise due to cost-push factors like drought conditions and fuel price increases. The situation was aggravated by demand-pull effects that arose from fiscal slippages and excessive money growth.

As can be observed from the above analysis, inflation is determined by both demand-side and supply-side factors in an open economy. Prior to the liberalization, price increases that emerged from these factors were suppressed by the successive governments through various policy measures like administered prices, food rationing, consumer subsidies and government-owned marketing monopolies. Some of these measures are still in operation, and therefore, inflationary pressures continue to be suppressed

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through administrative controls to a certain extent. By and large, however, consumer prices behave more flexibly in the post-liberalization period than before. It is important to identify the inflationary forces in order to design appropriate policies to combat continuous increase in the domestic price level. For this purpose, we will develop a theoretical framework in the next Section. This will be followed by quantification of the impact of money supply and other factors on inflation using alternative econometric techniques.

3. Modelling Inflation

Let us first develop a theoretical model to explain domestic inflation. We assume that the general level of prices (P) is a weighted average of the prices of tradable goods P_t^T and non-tradable goods (P_t^{NT}):

$$LogP_t = \alpha(\log P_t^T) + (1-\alpha)(\log P_t^{NT}) \qquad (1)$$

where $0 < \alpha < 1$.

The prices of tradable goods are assumed to be determined in foreign markets, and dependent on foreign prices (p^f) and on the exchange rate (e):

$$\log P^T = \chi \log e_t + \delta \log P_t^f \qquad (2)$$

A depreciation (appreciation) of the exchange rate or an increase (decrease) in foreign prices causes a rise (fall) in the prices of tradables resulting in a concomitant rise (fall) in domestic prices.

Further, we assume that the prices of nontradables are determined by the demand for and supply of such goods and services depending on the money market equilibrium condition, i.e. real money supply (M / P) equals real money demand (m^d):

$$\log P_t^{NT} = \beta(\log M_t^s - \log m_t^d) \qquad (3)$$

Depending on the scale factor β , the excess of money supply over real money demand has a positive impact on the prices of nontradables. The demand for real money balances depends on real money income (y), inflationary expectations ($E(\pi)$) and interest rates (i). Interest rates represent the opportunity cost of holding money. We may assume that inflationary expectations would capture the opportunity cost. Accordingly, real money demand is: $m_t^d = f(y_t, E(\pi_t))$ (4)

Theoretically, money demand and real income are positively related whereas money demand and expected rate of inflation are inversely related.

Expected rate of inflation can be expressed as follows:

$$E(\pi_t) = d(L(\pi_t)) + (1-d)\Delta \log P_{t-1} \qquad (5)$$

where L represents a distributed lag learning process for the agents in the market.

Rearranging the above expressions, the price level can be expressed as:

$$P_t = f(M_t, y_t, e_t, P^f_t, P_{t-1}) \qquad (6)$$

The expected signs of the coefficients are:

$$\frac{\delta f}{\delta M_t} > 0; \qquad \frac{\delta f}{\delta y_t} < 0; \qquad \frac{\delta f}{\delta e_t} > 0; \qquad \frac{\delta f}{\delta P^f_t} > 0;$$

Using natural logs, we can write the above relationship as:

$$Log P_t = \alpha_0 + \alpha_1 Log M_t + \alpha_2 Log y_t + \alpha_3 Log e_t + \alpha_4 Log P^f_{t-1} + \alpha_5 Log P_{t-1} + u_t \qquad (7)$$

4. Regression Results

In this section, we apply the conventional OLS regression techniques to estimate Equation (7) to ascertain the relationship between the general price level and the independent variables namely, money supply, real GDP, exchange rate and foreign prices. As we found that foreign prices were insignificant, we recomputed the equation without that variable, and the results are given below:

$$LP_t = \underset{(1.97)}{5.445167} + \underset{(3.31)}{0.542083}\, LM_t - \underset{(-2.09)}{0.585894}\, Ly_t + \underset{(2.06)}{0.237268}\, Le_t + \underset{(1.63)}{0.304564}\, LP_{t-1}$$

Adjusted R-Squared = 0.998249
D-W Statistic = 1.783174
F – Statistic = 3563.99

LM is significant at the 1 percent level indicating a strong relationship between the money supply and the general price level. LY and LE are significant at the 5 percent level. All variables carry the correct signs. The high R-squared reflects the relevance of money supply, exchange rate and real GDP in explaining the movements of the general price level.

5. Unit Root Test and Cointegration

A major weakness of the conventional regression techniques presented in the previous section is that when they are applied for nonstationary time series, spurious regression problems may occur. In this section, we will test for the staionarity of the time series, and apply the Cointegration and Vector Error Correction Model to ascertain the determinants of inflation.

First, we will establish whether the variables in Equation 7 are stationary or free from unit roots. A time series, **Z** is said to be non-integrated of order **d** (contains unit roots), if it becomes stationary after being differenced **d** times, denoted by **Z ~ I(d)**. Nonstaionarity of the variable may result in spurious regression results. Therefore, it is necessary to test whether the variables are stationary. For this purpose, we use a Unit Root Test known as the Augmented Dickey-Fuller (ADF) Test. The following equation is estimated for each variable for the ADF test:

$$\Delta Y_t = \alpha + \beta Y_{t-1} + \rho t + \sum_{i=0}^{m} \delta \Delta Y_{t-1} + \varepsilon_t \qquad (8)$$

where Δ is the first-differnce operation, t is the time trend, ε is the stationary random error, and m is the maximum lag length.

Secondly, we need to ascertain whether the inflation and other variables, namely, real GDP, money supply and exchange rate are cointegrated[1]. Although individual time series that contain stochastic trends are nonstationary in their levels, it is possible that stochastic trends are common across the series leading to stationary combinations of the levels. This means that although two variables will follow random walks, a linear combination of these variables will be stationary. As a result, their residuals will be stationary indicating a long-run relationship between the two variables. This is known as Cointegration. Information about this long-run relationship between two variables may be lost as a result of differencing the variables to make them stationary. Therefore, it is important to test for Cointegration to establish whether it is necessary to use an error correction term in the system to capture the long-run relationship. This procedure involves the estimation of a vector error-correction model (VECM) in order to obtain the likelihood ratios (LR). The VECM used in this study for cointegrated variables is as follows:

[1] Cointegration was introduced by Clive Granger (1981). He has done extensive work within nonstationary variables, which caused problems to commonly used econometric methods. Among these problems was spurious correlation. The principle of cointegration is simply that even though variables behave wildly individually (are non-stationary) there may be relations between them that they behave nicely (they are stationary). It took a while before the importance of cointegration was widely recognized. The major breakthrough was the publications of two papers by Engle and Granger (1987) and Johansen (1988) where the latter manages to nest the concept into the vector autoregressive (VAR) model. Many aspects of the theory have been developed since then, as they arose from economic hypotheses of interest; several of these can be found in Johansen (1996).

$$\Delta P_t = \alpha + \sum_{i=0}^{k} \beta \Delta P_{t-i} + \sum_{i=0}^{k} X_{t-i} + \delta Z_{t-i} + v_t \qquad (9)$$

when there is no cointegration, the above equation may be used without the error correction term, Z_{t-i}, which represents the long-run relationship.

Let us first test the null hypothesis that each series is stationary, using the Augmented Dickey-Fuller (ADF) unit root test. The results are shown in Table 2. The computed ADF statistic with respect to the levels of all variables is lower than the critical values indicating that the series are nonstationary. When the series are first differenced, all variables became stationary.

Table 2
Unit Root Tests

Augmented Dickey-Fuller Test

Variable	ADF Statistic	Critical Values 1%	5%	10%
Log P				
Level	-2.377599	-3.7204	-2.9850	-2.6318
1st Difference	-3.434507	-3.7343	-2.9907	-2.6348
Log M				
Level	-0.442454	-3.7204	-2.9850	-2.6318
1st Difference	-3.187346	-3.7343	-2.9907	-2.6348
Log Y				
Level	-0.480556	-3.7204	-2.9850	-2.6318
1st Difference	-3.196439	-3.7343	-2.9907	-2.6348
Log E				
Level	-1.402861	-3.7204	-2.9850	-2.6318
1st Difference	-4.431104	-3.7343	-2.9907	-2.6348

Having tested the series for unit roots, let us now establish whether they are cointegrated. This will help us to see whether they have a long-term relationship. The results, which are shown in Table 3, indicate that we can reject the null hypothesis that the series are not integrated at the 1 percent level. This means that the money supply, real GDP and exchange rate are related to the general price level of the country in the long run. Therefore, we should not ignore this long-run convergence in our computations, as mentioned earlier.

Table 3
Johansen Cointegration Test

Eigen Value	Likelihood Ratio	5 Percent Critical Val	1 Percent Critical Val	Hypothesized No. of CE(s)
0.712777	58.54443	47.21	54.46	None **
0.472679	27.35703	29.68	35.65	At most 1
0.356620	11.35836	15.41	20.04	At most 2
0.013226	0.332867	3.76	6.65	At most 3

*(**) denotes rejection of the hypothesis at 5%(1%) significance level
L.R. test indicates 1 cointegrating equation(s) at 5% significance leve

In order to capture the long-run relationship, we estimated Equation 9, which includes an error correction term z_{t-1}. The results are summarized below:

$$\Delta LP_t = \underset{(-0.71)}{-0.02198} + \underset{(3.89)}{0.66685}\,\Delta LM_t + \underset{(1.51)}{0.23972}\,\Delta LE_t + \underset{(1.78)}{0.27518}\,\Delta LE_{t-1} - \underset{(-0.09)}{0.01888}\,\Delta LP_{t-1} - \underset{(-0.41)}{0.19199}LY_t - \underset{(-2.61)}{0.65529}\,Z_{t-1}$$

$R^2 = 0.65$
D-W Statistic = 1.55
F = 5.65

The above equation indicates that the error correction term is significant at the 5 percent level reflecting that the variables are cointegrated. "LM_t is significant at the 1 percent level. It is also noteworthy that the short-run elasticity of money (= 0.668) is much greater than that of exchange rate or real GDP, accentuating the importance of monetary factors in the inflationary process in Sri Lanka. All variables have the correct signs. However, real GDP is insignificant.

As "Y_t is insignificant in the above equation, we recomputed the relationship by dropping that variable, and the results are given below:

$$\Delta LP_t = \underset{(-1.10)}{-0.02849} + \underset{(4.13)}{0.664003}\,\Delta LM_t + \underset{(1.99)}{0.27083}\,\Delta LE_t + \underset{(1.92)}{0.28555}\,\Delta LE_{t-1} - \underset{(-0.16)}{0.02907}\,\Delta LP_{t-1} - \underset{(-2.67)}{0.65547}\,Z_{t-1}$$

$R^2 = 0.65$
D-W Statistic = 1.57
F = 7.07

Again, the error correction term is significant at the 5 percent level, reiterating cointegration. It also reflects rapid adjustment of inflation toward its equilibrium value. That means that there is a 85 percent feedback from the previous period into the short-run dynamic process. Money supply is significant at the 1 percent level, and its elasticity is fairly high, as in the case of the previous equation. Exchange rate is significant at the 10 percent level.

6. Conclusion

In this paper, we applied different econometric methods to ascertain the main determinants of inflation in Sri Lanka. The results based on the conventional regression tools reveal that the money supply has a considerable influence on the general price level of the country, compared with the real variables.

Given the shortcomings of the regression analysis, we used the unit root tests to check the non-stationary properties of data. In the short run, money supply is the main determinant of inflation. Exchange rate also plays a key role in the short run. In the long run too, in addition to money supply, the exchange rate is instrumental in the inflationary process. However, the high magnitude of elasticity of inflation with respect to money supply growth points to the fact that inflation in Sri Lanka is mainly caused by monetary factors rather than by real factors in the long run.

A key policy implication that can be drawn from this study is that inflation in Sri Lanka is a monetary phenomenon. Therefore, both the Central Bank and the government will have to pursue monetary and fiscal policies to achieve inflation reduction. The Central Bank uses the Open Market Operations (OMO) framework as its main policy instrument nowadays for monetary management. In most instances, however, the Central Bank is unable to make use of this instrument effectively as it has to accommodate government borrowings to finance of fiscal imbalances. These developments reflect the conflict between monetary and fiscal policies. This conflict usually aggravates when fiscal deficits are larger. In the circumstances, it is questionable, whether the Central Bank could adopt an inflation targeting policy as envisaged, unless the fiscal authorities strictly adhere to the terms and conditions laid down in the Fiscal Responsibility Act.

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