

# **The Link Between Fiscal Deficit and Inflation: Do public sector wages matter?**

Hemantha K.J. Ekanayake  
Arndt-Corden Department of Economics  
Crawford School of Public Policy  
The Australian National University  
Email: hemantha.ekanayake@anu.edu.au

This paper investigates the validity of the hypothesis that suggests there is a link between fiscal deficits and inflation in developing countries and further explores this link in the absence of public sector wage expenditure. Sri Lanka, a developing country with a persistent fiscal deficit, a large public sector and increasing inflation, has been chosen for the empirical study. An auto-regressive distributed lag (ARDL) model is employed in the analysis, using annual data from 1959 to 2008. The results suggest that, in the long run, a one percentage point increase in the ratio of the fiscal deficit to narrow money is associated with about an 11 percentage point increase in inflation. This link becomes weaker in the absence of the public sector wage expenditure. The overall inference is that inflation is not only a monetary phenomenon in Sri Lanka and public sector wage expenditure is a key factor in explaining the deficit-inflation relationship.

JEL Codes: H62 E62 E63 and D50

Key words: Fiscal deficit, Inflation, Public sector wages, Auto regressive distributed lag models

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## **The link between fiscal deficit and inflation: Do public sector wages matter?**

*In today's world government determines — or can determine — the quantity  
of money* (Friedman & Friedman 1980, p.282)

### **1: Introduction**

Monetary and fiscal authorities are linked through money growth in the form of seigniorage, which provides revenue to the fiscal authority. Developing countries that experience underdeveloped financial markets, less efficient tax systems, large public sectors and limited access to external borrowings, tend to increase reliance on seigniorage income in financing fiscal deficits. Monetary authorities, on the other hand, are left with limited choices, at least in the case where seigniorage revenue is the only way to prevent government from being insolvent. However, the interdependence of these two authorities may not be a symbiotic relationship and, as a result, there is an ongoing debate seeking to explain the costs associated with fiscal and monetary interdependence. The impact of monetary financing of a fiscal deficit on the inflation rate was first formalised by Sargent and Wallace (1981). Since then, attention has increasingly been given to the role of fiscal-factors in explaining inflation.

Is a persistent fiscal deficit inflationary? Empirical studies on this issue have produced mixed results. Some studies that build on Sargent and Wallace (1981) provide evidence in support of the hypothesis that fiscal deficits are inflationary. Most of these studies find a strong correlation only in high inflation countries or during high inflationary periods (de Hann and Zelhorst 1990, Edwards and Tabellini 1991, Fischer, et al. 2002). There are some other studies that have built on the Ricardian equivalence hypothesis (Barro 1989) and have found either no correlation or only a weak correlation between fiscal deficits and inflation (Niskanen 1978, McMillin and Beard 1982, Ahking and Miller 1985, Landon and Reid 1990).

In general, irrespective of the theoretical camp they belong to, most empirical studies find that there is either a strong link between fiscal deficits and inflation during high inflationary episodes or there is a negligible or weak link between the two, even though such link is well defined by the theory. The dilemma between theoretical and empirical evidence gives rise to another strand of literature, which attempts to explain this puzzle. Buffie (1999) addresses this issue and argues that the public sector wage cycle effect underlies the weak correlation between fiscal deficits and inflation rate. Therefore,

to preserve the link between fiscal deficit and inflation, it is necessary to factor out the public sector wage cycle effect (Jha 2001). However, empirical evidence on this hypothesis is scarce.

Catão and Terrones (2005) demonstrate that the limited success of empirical studies in explaining this issue is probably because of the failure to take into account the non-linearity of the correlation between fiscal deficit and inflation. Their analysis, in which the fiscal deficit is scaled by narrow money to introduce a non-linearity to the model, finds that there is a strong link between fiscal deficits and inflation even in moderately high inflation countries.

Multi-country studies of any issue, by their very nature, can only capture the general patterns of the hypothesised relationship. However, when differences among countries are considerable and the quality/coverage of data also varies considerably, it is not possible to uncover a meaningful ‘average’ relationship among countries (Srinivasan 1994). Therefore, this study carries out a country-level analysis using Sri Lankan data to test the empirical validity of the hypotheses that suggest (1) there is a link between the fiscal deficit and inflation, (2) the public sector wage cycle effect underlies the weak link between fiscal deficit and inflation. A positive correlation between the fiscal deficit to GDP ratio and inflation in Sri Lanka can be seen in Figure 1. (in section 3) Moreover, it shows that the positive correlation of movements between the two fundamentals exists throughout low, medium and high inflation episodes over the past fifty years. On the other hand, Sri Lanka has one of the largest public sectors compared to many other countries, which grew at around 3.6 per cent annually (Brownbridge and Canagarajah 2011). Therefore, the Sri Lankan case will also provide a sound empirical setting to test the validity of the hypothesis that argues public sector wage expenditure underlies the weak relationship between the fiscal deficit and inflation.

This study offers some extensions to the previous studies that analyse the nexus between the fiscal deficit and inflation. First, the present study is built upon a modified model of Catão and Terrones (2005) and uses the fiscal deficit to narrow money ratio to estimate the link between fiscal deficits and inflation. Second, it analyses the effect of public sector wage expenditure on the deficit-inflation nexus empirically. As far as I am aware, this is the first empirical attempt to analyse the deficit-inflation link in the absence of the public sector wage effect. Third, and perhaps more importantly, this study fills a gap in the Sri Lankan economic literature by explaining the impact of a fiscal deficit on inflation in a micro-founded model that associates with other possible factors that also affect inflation.

A clear understanding of the time series properties of the data to be used in the analysis is important to ensure the employment of the proper econometric technique. Therefore, this study carries out conventional stationarity tests, as well as stationarity tests in the presence of structural breaks, and finds that not all the time series data for Sri Lanka used in this analysis are of the same degree of

integration. In consequence, this study employs an auto regressive distributed lag (ARDL) model as the main methodological framework. The ARDL model provides consistent estimators in the presence of a mixture of stationary and non-stationary series (Pesaran, et al. 2001). The results indicate that there exists a positive and significant relationship of about 11 per cent between the fiscal deficit and inflation in Sri Lanka. However, in the absence of the public sector wage effect, the deficit-inflation link becomes insignificant, providing counter evidence to the hypothesis (Buffie 1999) that suggests inclusion of the public sector wages in the analysis may weaken deficit-inflation link.

This paper is structured as follows. Section 2 provides a theoretical and empirical survey of the literature. Section 3 explains stylized facts from Sri Lanka over the last five decades followed in Section 4 the model and methodology. Data are explained in Section 5. Empirical results and conclusions are presented in Sections 6 and 7 respectively.

## **2: Review of literature**

Two main views of inflation can be identified in the literature. The conventional view, which is based upon the quantity theory of money, assumes that ‘inflation is always and everywhere a monetary phenomenon’ (Friedman 1968). Monetarists therefore argue that controlling inflation comes mainly under the purview of the monetary authority. This concept is then confronted by the proponents of the fiscal theory of inflation,<sup>1</sup> who suggest that inflation is determined, at least partially, by budgetary policies of the fiscal authority and they argue that long-run price stability is not fully in the purview of the monetary authority.

The fiscal theory of inflation has two main versions. The first version is based on ‘unpleasant monetarist arithmetic’, a seminal paper by Sargent and Wallace (1981), who argued that the rate of inflation is dependent upon the coordination between monetary and fiscal authorities. Using two coordination strategies, they theoretically explain that even when the money base and price level are closely connected, as in the monetarist approach, the monetary authority’s control over inflation is limited under certain conditions. In an event when the monetary authority is dominant, it is free to set monetary targets for the current and future periods. In this way, the monetary authority decides the seigniorage income that can be provided to the government and it is up to the fiscal authority to balance the remainder of its budget using bond sales to the public. Sargent and Wallace (1981) argue that, in this coordination scheme, inflation is completely under the control of the monetary authority. In contrast, when the fiscal authority is dominant it sets the current and future budget balances and determines the amount of seigniorage income required from the monetary authority. Therefore under

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<sup>1</sup> There are many expressions that are used to describe fiscal policy and inflation relationship such as fiscal theory of price determination, fiscal theory of money (Canzoneri, et al. (2001), Marimon (2001)). However, this study uses the terminology ‘fiscal theories of inflation’ as an umbrella term for all the theories that explain fiscal policy responses on inflation.

the second coordination scheme, the monetary authority may not only create extra money but also additional inflation, which in turn, weakens its control over price stability. Therefore, this version does not deny that the immediate cause of inflation is money growth, yet it puts forward the importance of the fiscal authority in controlling inflation. In the literature, this version is named as the weak-form of fiscal theory (Carlstrom and Fuerst 2000) and is accepted largely as the correct way of interpreting the fiscal-monetary interrelations in the determination of inflation.

The second version of the fiscal theory of inflation, also called the strong-form of fiscal theory, as in Carlstrom and Fuerst (2000), is introduced by the work of Leeper (1991), Sims (1994), and Woodford (1994, 1995). The main message of these studies is that the price level is determined merely by fiscal variables i.e. government debt, present and future revenue and spending plans, and monetary factors play no role in price determination. Price levels adjust to ensure the government's inter-temporal budget constraint and the adjustment is driven by individuals' wealth effect. Basically, the strong-form fiscal theory argues for non-Ricardian equivalence and, as a result, when there is a fiscal deficit, individuals consider it to be increasing their wealth. This, in turn, raises aggregate demand thereby creating inflation and leaving no role for the monetary authority. In contrast, the Ricardian equivalence hypothesis proposed by Barro (1989) postulates that an increase in budget deficit does not affect aggregate demand, interest rate or price level. However, the identification of Ricardian and non-Ricardian fiscal behaviour empirically is far more complex and, therefore, the strong-form of fiscal theory is still looked at sceptically.<sup>2</sup>

There are numerous empirical studies in the literature that attempt to explain the link between fiscal policy and inflation. Some of these studies try to establish the long term relationship between the two fundamentals while the remainder focus on the short-run effect, analysing the impact of fiscal policy shocks on inflation. However, irrespective of the approach used, most of these studies end up with ambiguous and/or inconclusive findings, in contrast to the theoretical expectations. The literature review below mainly comprises the studies that focus on the long-term effect of fiscal policy on inflation.

Most of the early studies analyse the nexus of fiscal deficits and inflation focus on the experiences of developed countries and find mixed results. Grossman (1982) and Hamburger and Zwick (1981) find that there is a significant link between fiscal deficits and inflation in USA where as McMillin and Beard (1982) find no evidence that the fiscal deficit is related to money growth, and hence, inflation by re-examining the USA situation using extended data. Greece has also been examined by many empirical studies searching for the link between these two fundamentals. Hondroyiannis and Papapetrou (1997) find that rising fiscal deficits have no direct impact on inflation in Greece. In

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<sup>2</sup> Criticism of strong-form fiscal theory of inflation can be found in the literature and, among others, Buiter (2002), Kocherlakota and Phelan (1999), McCallum (2003) name a few.

contrast, Darrat (2000) finds a significant relationship between fiscal deficits and inflation in Greece, using error correction mechanism for the same data set.

Studies based on developing countries also provide mixed evidence. de Hann and Zelhorst (1990), investigate the relationship between government deficits and money growth since World War II in 17 developing countries. Even though their results do not provide much support for the general hypothesis that government deficits influence money growth, they show that there is a positive correlation between the two during high inflation episodes. Similarly, Fischer, et al. (2002) find a strong relationship between fiscal deficits and inflation when inflation rates are high. This interpretation is supported by the findings of Catão and Terrones (2005). Using dynamic panel estimation for 107 countries, they find a strong positive relationship between the fiscal deficit and inflation.

Roubini (1991) finds that the co-movement of budget deficits and inflation in developing countries is underpinned by political instability. This view is supported by the results of Edwards and Tabellini (1991). Jha (2001) explains that when a country has no credible and stable policy regimes, it incurs high costs in borrowing from abroad. As a result, it relies on monetary financing of the deficit thereby weakening the independence of monetary policy from fiscal policy. Cottarelli, et al. (1998) find a strong correlation between the two variables in countries that have an underdeveloped securities market. This implies that limited access to financial markets drives governments to resort to central banks during times of fiscal distress.

Persistent fiscal deficits, increasing money growth, and high inflation are common in most developing countries. Therefore, most studies in the existing literature focus attention on a panel data framework. However, there are huge differences in the monetary and fiscal policies implemented by different countries, and, sometimes, in the same country at different points in times (Edward and Tabellini 1991). Furthermore, the macroeconomic consequences of a higher fiscal deficit can vary from one country to another, based on the method of financing (Jha 2001). The link between fiscal deficits and inflation is also less obvious in countries that have institutional arrangements to curb fiscal dominance, wider access to external financing, and a broader seigniorage tax base. When the differences in these factors among countries are considerable, it is harder to uncover the relationship between fiscal deficits and inflation from cross country panel studies (Catão and Terrones 2005). Therefore, it is important to analyse this issue within individual countries over time to build a sound empirical basis to make country-specific policy recommendations.

There are only a handful of studies that examine the relationship between the fiscal deficit and inflation in a single country context. By employing a rational expectations macro model of inflation, Choudhary and Parai (1991) find that the large fiscal deficit and high money growth contribute to

inflation in the Peruvian economy. Sowa (1994) finds that inflation in Ghana is influenced more by output volatility or supply side factors than by monetary and fiscal factors. Using a simultaneous equations framework for Pakistan data, Chaudhary and Ahmad (1995) explain that financing a fiscal deficit from domestic sources leads to an increase in the money supply, which generates inflation in the long run. This view is supported by Agha and Khan (2006). Alavirad and Athawale (2005) examine the impact of the fiscal deficit on inflation in Iran, utilising an Auto Regressive Distributed lag model. Their findings suggest that the fiscal sector is dominant in explaining price movements in Iran.

In general, most empirical studies suggest that (i) budget deficits are not inflationary, (ii) there is only a weak correlation between the two, and (iii) there is a strong link between fiscal deficits and inflation only during high inflationary episodes; even though the link is well defined by the theory. Relating to this puzzle, Buffie (1999) argues that the public sector wage cycles may underlie the weak correlation between fiscal deficit and the inflation rate. Using a perfect foresight model he theoretically postulates that, in developing countries, public sector real wage cuts are always followed by a real wage rise of equal or different depth and durations. These wage patterns are associated with the inflationary expectations of the general public; therefore, inflation might pick up even in a low fiscal deficit (due to public sector wage cuts) period, linking the fiscal deficit and inflation weakly or inversely. Consequently, the link between fiscal deficit and inflation may remain intact when the public sector wage cycle effect is factored out (Jha 2001). However, empirical evidence on this hypothesis is scarce.

Catão and Terrones (2005) explain the dilemma between theoretical and empirical findings from a different perspective. They argue that the limited success of empirical studies on this issue is probably because the non linearity of the correlation between the fiscal deficit and inflation has been ignored. In their analysis, the fiscal deficit is scaled by narrow money, introducing a non-linearity to the model. They find that there is a strong link between fiscal deficits and inflation even in moderately high inflation countries.

This survey of literature points out not only the inconclusive nature of the existing studies on this issue, but also the important caveats that must be taken into account by any contemporary study of the nexus of deficit-inflation. This paper revisits the relationship between these two fundamentals by taking some of these caveats (Buffie 1999, Catão and Terrones 2005) into account.

### **3: Stylized facts**

#### **3.1: Overview of fiscal policy and its developments**

As in many other developing countries, fiscal policy in Sri Lanka has been mostly pro-cyclical over the past 60 years. Government expenditure as well as government revenue, increase during economic booms. However, the fiscal deficit is found to be acyclic during the same period. Counter effects of pro-cyclical expenditure and revenue policies on business cycles might result in an acyclic overall fiscal policy stance.<sup>3</sup>

Since 1956, the Sri Lankan government has consistently run fiscal deficits. It recorded its highest fiscal deficit (23 per cent of GDP) in 1980. During the period 1950 to 1960, economic activities were driven mainly by the private sector while the government was committed to provide social services and general administration. As a result, the fiscal deficit on average was at a low level of 3.2 per cent of GDP. In the 1960s and 1970s, fiscal policy mainly focused on the redistribution of income and welfare improvement, under restricted trade policies and public sector expansion. The fiscal deficit, which was 4 per cent of GDP in 1957, had almost doubled to 8.4 per cent by 1977.

Following the liberalisation reforms initiated in 1977, there were attempts to reduce the fiscal deficit. However, the country experienced a double digit fiscal deficit to GDP ratio during most of the 1980s and 1990s. Huge military spending, a large public sector wage bill, heavy domestic subsidisation, and massive capital investment programmes were among the high expenditure items (Athukorala and Jayasuriya 1994). However during the period 2000-2008 the annual average fiscal deficit came down to 8.1 per cent of GDP.

The fiscal deficit might have both a direct and an indirect bearing on inflation. Directly, it affects inflation via government expenditure, while the indirect effect comes from deficit financing through monetary expansion. Government expenditure, which constitutes nearly 30 per cent of aggregate expenditure (as at the end of 2008) might cause demand-pull inflation to some extent. On the other hand, borrowings by the government from the banking system to finance the deficit create monetary expansion in an economy. This leads to an increase in the price level to the extent that it exceeds the amount of goods and services produced in the economy. Therefore, it is generally accepted that deficit financing by expansionary measures is inappropriate for Sri Lanka, where production of goods and services is largely constrained by supply factors rather than by the aggregate demand (Jayasundera 1986).

After realising the macroeconomic consequences of expansionary fiscal policies, the government made an effort to not only reduce the fiscal deficit, but also to limit deficit financing from the banking

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<sup>3</sup> See Ekanayake (2012) Chapter 2 for details.

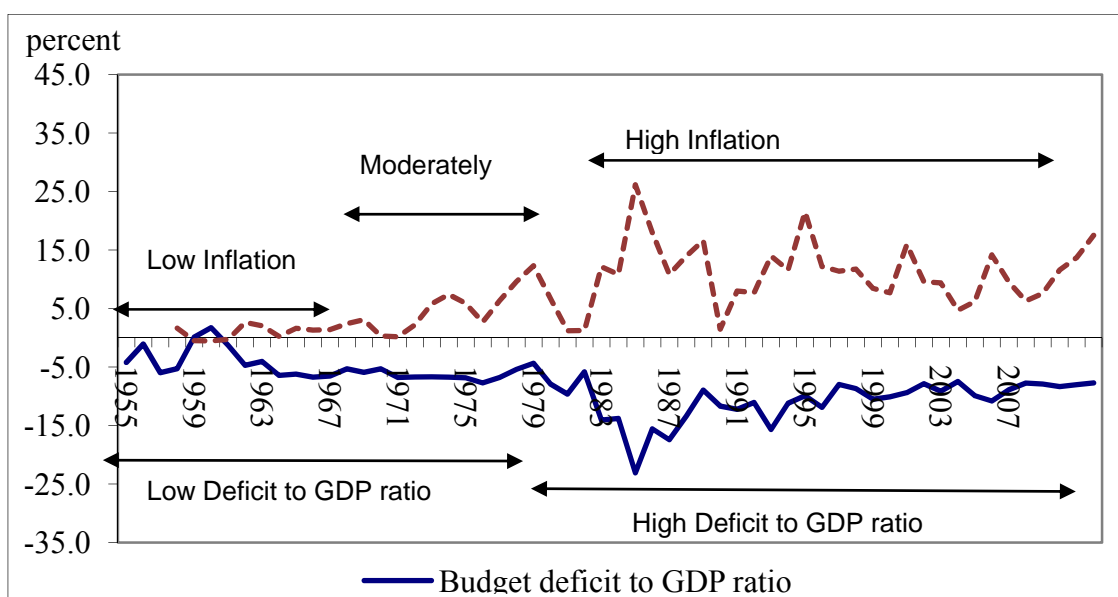


system. As a result, since 1980 foreign sources have given increased attention to financing the deficit. Jayasundera (2011) explains that foreign financing typically accounts for over 40 per cent of the fiscal deficit and the government has also relied on non-inflationary domestic sources to finance fiscal deficits throughout post reform era. From 2002 to the present day, the government has been able to limit the budget deficit to GDP ratio to a single digit level.

### 3.2: Inflationary developments

Inflation in Sri Lanka over the past six decades has gone through three distinct phases (Fig.2.1). The country experienced low annual average inflation of 1.2 per cent from 1950 to 1966. The inflation rate rose to 6.4 per cent during the moderate inflation era of 1966 to 1977. In 1977, the country liberalised its economy and began to experience double digit inflation rates for most of the years from 1977 to 2008. Contributing factors can be broadly categorised into domestic factors (unfavourable weather conditions, civil disturbances, etc.) and external factors (oil price shock, food price hikes etc.).

**Figure 1: Co-movement between fiscal deficit and inflation in Sri Lanka**



Source: Central Bank of Sri Lanka (2010)

However, Duma (2008) argues that external factors can only explain about 25 per cent of inflation in Sri Lanka. She further explains that external factors are common for all South Asian countries, yet Sri Lankan inflation behaves differently from other countries. This demonstrates the importance of domestic causes of inflation in the country. Goyal (2011) also identifies the different behaviour of inflation in Sri Lanka from other South Asian countries. However, she considers that the prevalence of double-digit inflation in Sri Lanka over the last few decades could be due to the prevailed unrest over the period.

The historical development of the fiscal deficit to GDP ratio exhibits a similar pattern (Fig.2.1). In 1980, the country recorded its highest level of annual inflation of 26.1 per cent and also the highest fiscal deficit to GDP ratio. Therefore, the similar movements of budget deficit to GDP ratio and annual inflation rate form an important research agenda to analyse the relationship between the two fundamental indicators.

**4: Model and Methodology**

The model is drawn from Catão and Terrones (2005), with modifications to suit the Sri Lankan economy and to derive a testable specification. This research essay posits the existence of a basic money-in-the-utility function, i.e. a MIU model. The inclusion of real balances in the utility function reflects the convenience of using money in carrying out transactions. Further, it captures money’s role as a store of value and a medium of exchange, yielding an empirically realistic money demand function (Obstfeld and Rogoff 1996). Moreover, in the Sri Lankan context, it is reasonable to assume that the amount of real balances provide direct utility to consumers. Therefore this study starts with the MIU model instead of using a shopping time model, as in Catão and Terrones (2005).

The hypothetical economy in this model has a ‘one good’ endowment, a flexible exchange rate, infinitely-living households, and a government. It faces an exogenous world interest rate. The representative household is endowed with fixed resources,  $Y$ , for each period and allocates his resources among consumption ( $c_t$ ), taxes ( $\tau_t$ ), risk free bonds ( $b_t$ ) and real money holdings ( $m_t/p_t$ ) to maximise the following lifetime utility function:

$$U = \sum_{t=0}^{\infty} \beta^t u(c_t, \frac{m_t}{p_t}) \dots\dots\dots (E 1)$$

subject to a resource constraint of

$$c_t + \frac{b_t}{R_t} + \frac{m_t}{p_t} = y_t - \tau_t + b_{t-1} + \frac{m_{t-1}}{p_t} \dots\dots\dots (E 2)$$

where  $\beta$  is the discount factor ( $0 < \beta < 1$ ) and utility is assumed to be increasing in both arguments, strictly concave and continuously differentiable. Initial stocks of  $b_0$  and  $m_0$  are given.  $R_t$  is the international real interest rate on one period bonds and  $p_t$  represent the aggregate price level.

The first order conditions (FOCs) of this maximisation problem with respect to  $c_t$ ,  $m_t$  and  $b_t$  are as follows:

$$\beta^t u_c(c_t, \frac{m_t}{p_t}) - \lambda_t = 0 \dots\dots\dots (E 3)$$

$$\beta^t u_m(c_t \frac{m_t}{p_t}) - \frac{\lambda_t}{p_t} + \frac{\lambda_{t+1}}{p_{t+1}} = 0 \dots\dots\dots (E 4)$$

$$- \frac{\lambda_t}{R_t} + \lambda_{t+1} = 0 \dots\dots\dots (E 5)$$

Together these FOCs yield the following money demand function.  $\Pi$  is obtained from  $(p_t/p_{t+1})$ .

$$\frac{m_t}{p_t} = m^d(c_t, \frac{\Pi}{R_t}) \dots\dots\dots (E 6)$$

The consolidated government budget constraint in this economy is as follows:

$$g_t + \frac{b'_t}{R_t} = \tau_t + b'_{t-1} + \frac{M_t - M_{t-1}}{p_t} \dots\dots\dots (E 7)$$

where  $g_t$  is the government spending financed by tax collection ( $\tau_t$ ), the issuance of one period bonds ( $b'_t$ ) and/or printing money.  $M_t$  is currency issued by the government at the beginning of the period  $t$ .

In equilibrium, when money supply equals money demand and  $b_t=b'_t$ . Hence, the economy wide budget constraint can be derived as follows:

$$\frac{b_t}{R_t} = y_t - c_t - g_t + b_{t-1} \dots\dots\dots (E 8)$$

Under the assumption of no trade restrictions and taxes, the domestic ( $r$ ) and international ( $R$ ) real interest rates are equalised. Then, in stationary equilibrium the money supply function can be obtained by using equation (E 7).

$$g - \tau + \frac{b'}{R} - b' = \frac{M}{p} (1 - \Pi) \dots\dots\dots (E 9)$$

After several steps of simplification and substitution, this yields a stationary equilibrium for the small open economy as,

$$(1 - \Pi) = \frac{p(g - \tau + b'(1 - R) / R)}{m} \dots\dots\dots (E 10)$$

Without loss of generality one can approximate  $(1-\Pi)=\pi$  and obtain the following testable specification, which explains that the rate of inflation is proportional to the size of the general government deficit to the average stock of transaction money during the period.<sup>4</sup>

<sup>4</sup>Even though this study starts with the MIU model it obtains the same testable specification as in Catao and Terrones (2005). This provides evidence to support the validity of the specification under different types of general equilibrium models. For a detailed explanation of the derivation see Catao and Terrones (2005).

$$\pi = \varphi \frac{FD}{M} \quad (E 11)$$

$\pi$  – Annual inflation FD – Fiscal deficit

M – Narrow Money  $\varphi$  is expected to be positive parameter

The importance of this specification between inflation and the fiscal deficit to narrow money ratio, compared to the conventional measure of fiscal deficit to GDP, is that the former captures the non-linearity of the above relation. For example, inflation will rise when the fiscal deficit to GDP ratio widens as well as when the narrow money to GDP ratio shrinks, or as a result of a combination of the two. Similarly, when inflation is higher, narrow money to GDP is lower (since narrow money represents money demand), thereby making the impact of fiscal deficit on inflation higher.

However, only a few previous studies have considered the importance of a similar specification (Catão and Terrones 2005, Metin 1998). The relationship between the fiscal deficit and inflation becomes dynamic since external borrowings allow governments to allocate seigniorage intertemporally (Sargent and Wallace 1981). However, the short-run dynamics between the two variables are very complex. Therefore, this study's main focus is to unravel the long-run relationship between the fiscal deficit and inflation.

There are many ways in which the empirical relationship between the fiscal deficit and inflation can be analysed. These include the auto regressive distributed lag (ARDL) models (Catão and Terrones 2005, Alavirad and Athawale 2005), vector auto regressive (VAR) models (Fischer, et al. 2002, Metin 1998), vector error correction method (VECM) (Sowa 1994, Agha and Khan 2006), two stage least squares (TSLS) method (Chaudry and Ahmad 1995), and the Johansen co-integration approach.

The ARDL approach is prominent in the literature as it allows inclusion of the dynamics of the variables to mitigate the impact of the endogeneity of the explanatory variables. Furthermore, the error correction version of the ARDL model or the general to specific modelling procedure provide consistent estimators even when the variables under concern are of different orders of integration. This minimises the possibility of estimating spurious relations, while retaining long-run information (Hendry 1995). Besides, it is revealed that in the case of a finite sample, this methodology provides precise estimators and valid  $t$  statistics (Pesaran, et al. 2001, Hendry 1995). This estimation procedure starts with an autoregressive distributed lag (ARDL) specification of an appropriate lag order, which is then 'tested down' by dropping statistically insignificant lag terms, and imposing data-acceptable restrictions on the regression parameters. This process produces a parsimonious error correction representation, which retains the *a priori* theoretical model as its long-run solution.

However, ARDL employs only a single reduced form equation and therefore it is necessary to avoid bidirectional causality between the main variables of concern. This study carries out Granger causality test to examine the causality between variables. Given the possibility of having variables with different orders of integration and unidirectional causality from fiscal deficit to inflation, this study quantifies the long run relationship between fiscal deficit and inflation in Sri Lanka by nesting the above theoretical specification into the ARDL model.

Consider a general model as follows:

$$\pi_t = \beta_0 + \sum_{k=1}^p \delta_k \pi_{t-k} + \sum_{l=0}^q \gamma_j X_{j,t-l} + \varepsilon_t \dots\dots\dots \quad (E 12)$$

In this model the dependent variable ( $\pi_t$ ) and explanatory variables ( $X_j$ ) are included in the regression with lag of order  $p$  and  $q$ . For example, when  $p=q=1$  the Equation E 12 takes the form as below.

$$\pi_t = \beta_0 + \delta_1 \pi_{t-1} + \gamma_{j1} X_{j,t} + \gamma_{j2} X_{j,t-1} + \varepsilon_t \dots\dots\dots \quad (E 13)$$

Then, the long run elasticities can be obtained as follows

$$\theta_j = \frac{\gamma_{j1} + \gamma_{j2}}{1 - \delta_1} \text{ for all } j = 1, 2, \dots, k \dots\dots\dots \quad (E 14)$$

To find the error correction version of the ARDL model, equation E 12 can be reparameterised by subtracting the lagged dependent variable from both sides of equation (E 13). After a few steps of rearrangement and grouping variables in levels together, equation (E 15) is derived; and it can then be estimated by using the ordinary least squares method.

$$\Delta \pi_t = \beta_0 + \gamma_1 \Delta X_t - (1 - \delta_1) [\pi_{t-1} + \eta_j X_{j,t-1}] + \varepsilon_t \dots\dots\dots \quad (E 15)$$

In this specification,  $(1 - \delta_1)$  provides the speed of adjustment towards the long run equilibrium while  $\eta_j / (1 - \delta_1)$ , defines the long run relationship between the variables in the estimation.

In addition to estimating the link between fiscal deficits and inflation, this study also analyses how the co-movement of the public sector wage bill can affect the estimated relationship. As already discussed, Buffie (1999) theoretically postulates that public wage cycles may underlie the weak empirical correlation between fiscal deficits and inflation. Therefore, forming a new fiscal deficit variable that excludes the public sector wage bill, this study re-estimates the above equation to find out how the public sector wage bill can affect the inflation fiscal deficit relationship. The vector  $X'$  consists of all the explanatory variables as in the previous model, including the new fiscal deficit variable.

$$\pi_t = \beta_0 + \sum_{k=1}^p \delta_k \pi_{t-k} + \sum_{l=0}^q \gamma_l X'_{j,t-l} + \varepsilon_t \dots\dots\dots (E 16)$$

Equation (E 16) then can be reparameterised to derive the error correction version of the ARDL model, Equation E 17.

$$\Delta \pi_t = \beta_0 + \gamma_1 \Delta X'_t - (1 - \delta_1) [\pi_{t-1} + \eta_j X'_{j,t-1}] + \varepsilon_t \dots\dots\dots (E 17)$$

If Buffie (1999) is relevant for Sri Lanka, then the link between the fiscal deficit and inflation has to be stronger when the public sector wage expenditure is excluded from the analysis.

**5: Data**

This study uses two measures of the rate of inflation (the dependent variable); the Colombo consumer price index (CCPI) and the GDP deflator. The CCPI, the most widely used inflation indicator for Sri Lanka has several weaknesses. The CCPI may not represent the whole country, as it is based on a budget survey of working class families in Colombo. It also includes goods that are subsidised or subject to price controls. On the other hand, the GDP deflator can be biased when there is an export price rise in primary commodities, mainly tea and rubber. However, these are the only inflation indicators that are available in longer time series. The explanatory variables include the fiscal deficit to narrow money ratio, growth in the import price index, and imports and exports to GDP ratio (measure of openness).<sup>5</sup> The data cover the period from 1959 to 2008 and are of annual frequency.

The annual inflation rate is given by the growth in the CCPI or GDP deflator, while the fiscal deficit is defined as the difference between the total government revenue and expenditure during a single budget period, i.e. a year. Even though there are several controversies on this conventional measurement of fiscal deficit<sup>6</sup> it is used in this study as it is the only available deficit measure for the country. Narrow money consists of currency and demand deposits held by the public with commercial banks, as at the end of the year. All the variables except the import price index and public sector wage expenditures are taken from the International Financial Statistics of the IMF (International Monetary Fund 2010).

The import price index and public sector wage expenditure are obtained from the *Annual Report* of the Central Bank of Sri Lanka (Central Bank of Sri Lanka 2010). The import price index and openness, defined as trade to GDP, are used as the other explanatory variables to control the impact of external factors on inflation in Sri Lanka. These variables capture changes in both exchange rate and world prices. The summary statistics are reported in Table 1.

<sup>5</sup> All variables are used as percentages in econometric estimation

<sup>6</sup> For a detailed explanation of measurements of fiscal deficits, see Blejer and Cheasty (1991) and Tanzi (1993)

**Table 1: Summary statistics**

Variable	Obs	Mean	Std. Dev.	Min	Max
CCPI inflation (per cent)	50	8.78	6.20	-1.62	26.15
GDPD inflation (per cent)	50	8.76	6.37	-2.02	25.86
Fiscal deficit to GDP (per cent)	50	-8.02	2.75	-19.16	-3.29
Narrow money to GDP (per cent)	50	13.34	3.85	6.29	21.22
Fiscal deficit to narrow money (per cent)	50	-66.16	28.63	-135.19	-23.68
Growth in import price index (per cent)	50	13.59	18.79	-10.20	85.19
Openness (trade to GDP)	50	54.78	13.56	26.57	77.44
Public sector wage expenditure (Rs. Millions)	29	55547.69	64344.33	3759.00	239078.00
Fiscal deficit without wage expenditure to narrow money (per cent)	29	-35.70	20.55	-95.32	-9.93

### 5.1 Testing time-series properties of data

Before estimating the model, it is necessary to test the stationarity of the data involved in the study to employ the most relevant econometric technique in the estimation. Therefore, in this study, both the conventional unit root tests (Augmented Dicky Fuller (ADF), Kwiatkowski, Philips, Schmidt and Shin (KPSS)) that do not account for structural breaks and those including structural breaks, are carried out.

#### 5.1.1: Conventional unit root tests

The ADF test can be considered as the most widely used unit root test to examine the time series properties of the data. When testing for unit roots, it is crucial to specify the null and alternative hypotheses best suited to the characteristics of the data. For example, if the series exhibits a trend, it should be included in the estimation along with the constant as in the following equation.

$$\Delta Y_t = \mu + \alpha T + \beta Y_{t-1} + \sum_{i=1}^k \delta_i \Delta Y_{t-i} + \varepsilon_t \quad \dots \quad (E 18)$$

where  $Y_t$  is the time series being tested,  $T$  is a time trend,  $k$  is the number of lags and  $\Delta$  and  $\varepsilon_t$  denote the first difference operator and white noise respectively. Here, the main concern is given to the estimator of the  $\beta$ , and the null hypothesis is  $\beta=0$ . The rejection of the null hypothesis implies that the series  $Y_t$  is stationary around the deterministic trend and integrated of order zero, i.e.  $I(0)$ . Non rejection of the null hypothesis leads to test the unit root for 1<sup>st</sup> difference series and the variable

becomes integrated of order one i.e. I (1) and so on. However, it is accepted that the ADF test can not distinguish very well between highly-persistent stationary processes and non-stationary processes very well and may be biased towards non-rejection of the null hypothesis.

The ADF test is for the null hypothesis that a time series is I(1) whereas the KPSS test examines each series for stationarity, i.e I(0) for the null hypothesis. The KPSS test starts with the following linear regression equation, which includes a random intercept ( $\mu_t$ ) and trend.

$$Y_t = \mu_t + \alpha T + \varepsilon_t \dots\dots\dots (E 19)$$

$$\mu_t = \mu_{t-1} + \nu_t \dots\dots\dots (E 20)$$

where  $T$  is a deterministic trend,  $\varepsilon_t$  is a stationary error, and  $\nu_t$  is iid(0, $\sigma_\nu^2$ ). Here if the series is stationary around the deterministic trend,  $\sigma_\nu^2 = 0$ , implying the intercept is a fixed element. When the series is non-stationary,  $\sigma_\nu^2$  takes a positive value. The results (Table 2) of the ADF test show that, apart from the CCPI, GDP deflator, narrow money to GDP ratio and growth in the import price index, none of the other variables are stationary in their level form.

However, the KPSS test provides opposite results, except for the narrow money to GDP ratio and growth in the import price index. Therefore, based on the conventional unit root tests this study finds that the variables under concern are either I(0) or I(1).

**Table 2: Conventional unit root tests (ADF and KPSS)**

Data Series	ADF Test Statistics H0: a Unit root		KPSS Test Statistics H0: series is stationary	
	In level form	First difference	In level form	First difference
Annual growth in CCPI	-3.647***		0.733**	0.36
Annual growth in GDP Deflator	-4.031***		0.487**	0.177
Fiscal deficit to GDP ratio	-2.657	-1.404***	0.181**	0.065
Narrow Money to GDP ratio	-3.261*	-6.698***	0.07	
Fiscal deficit to Narrow money ratio	-3.804	-10.434***	0.109	
Growth in import price index	-3.614***		0.211	
Exports to GDP ratio	-1.713	-6.268***	0.163	
Imports to GDP ratio	-1.875	-6.463***	0.464**	0.091
Openness(Trade to GDP ratio)	-1.698	-5.983***	0.306	
Fiscal deficit(excluding public sector wages) to Narrow money ratio	-3.406*	-6.895***	0.453*	0.332

Notes: The optimum lag length is suggested by SIC. The critical values for the ADF test are from Davidson and MacKinnon (1993, page 708, Table 20.1), while the critical values for the KPSS test are from Kwiatkowski, et al. (1992).  
 \*\*\*, \*\*, \* suggest that the null hypothesis is rejected at the 1, 5, and 10 per cent levels respectively.



**5.1.2: Unit root tests in the presence of structural breaks**

Structural breaks in a time series can occur for many reasons such as domestic policy changes, external shocks or an economic crisis, etc. The Sri Lankan economy has been subjected to a number of such shocks throughout the past five decades. Therefore, if such structural breaks are present in the data generating process, they need to be considered in the specification of an econometric model. Otherwise, results may be biased towards the erroneous non-rejection of a non-stationarity hypothesis (Leybourne and Newbold 2003). Therefore, this study further investigates the stationarity of the data in the presence of possible structural breaks.

To test for stationarity in the presence of structural breaks, three main tests, Zivot and Andrews (1992) (ZA), Lumsdaine and Papell (1997) (LP), and Lee and Strazicich (2003) (LS) are carried out. These tests differ from one another first, by the number of structural breaks that they account for, and second, by the underlying hypothesis of the particular test. ZA and LP tests are defined as modified versions of ADF type tests and they assume no structural break(s) under the null hypothesis. Meanwhile, the LS test is defined as a Lagrangian multiplier (LM) type test and it considers the impact of structural breaks even under the null hypothesis.

The Zivot and Andrews (1992) test includes one endogenous structural break. They consider all three possible ways that a structural break can appear in a time series (Perron 1989). Model A accounts for a structural break that changes the level of the series, while Model B considers the change in the slope of the trend function. Model C, the model commonly used in the literature, accounts for changes in both the level and the slope of the trend function.

Model A

$$\Delta Y_t = \mu + \alpha T + \theta DU_t + \beta Y_{t-1} + \sum_{i=1}^k \delta_i \Delta Y_{t-i} + \varepsilon_t \dots \dots \dots (E 21)$$

Model B

$$\Delta Y_t = \mu + \alpha T + \gamma DT_t + \beta Y_{t-1} + \sum_{i=1}^k \delta_i \Delta Y_{t-i} + \varepsilon_t \dots \dots \dots (E 22)$$

Model C

$$\Delta Y_t = \mu + \alpha T + \theta DU_t + \gamma DT_t + \beta Y_{t-1} + \sum_{i=1}^k \delta_i \Delta Y_{t-i} + \varepsilon_t \dots \dots \dots (E 23)$$

$DU_t$  and  $DT_t$  are dummy variables for level shift and trend shift of the series respectively, at the possible break point (TB).

$DU_t = 1$  if  $T > TB$  and otherwise zero

$DT_t = (T - TB)$  if  $T > TB$  and otherwise zero

The null hypothesis and alternative hypothesis are the same i.e.  $\beta=0$  and  $\beta<0$  respectively, for all three models. However, in the null hypothesis it excludes any structural breaks whereas in the alternative hypothesis, it considers the stationary process with one structural break at an unknown point in time. The ZA test considers every point as a potential break point and runs a regression for every possible break date sequentially. From amongst all possible break-points (TB), the procedure selects as its choice of break-date (TB) the date that minimises the one-sided t-statistic for testing  $\beta=0$  (Zivot and Andrews 1992).

As explained earlier, the null hypothesis of the ZA test excludes the possibility of a unit root with structural breaks. This might lead to rejection of the null hypothesis of a unit root when the data generating process exhibits a unit root with a break (Lee and Strazicich 2001). Therefore, Lee and Strazicich (2003) suggest a Lagrangian multiplier (LM) type unit root test, as an alternative to the ZA test. The LS test is a modified version of Schmidt and Phillips (1992), including the possibility a structural break at an unknown point in time in both the null and alternative hypotheses. The LS test starts with the following unobserved components model (Lee and Strazicich 2003).

$$Y_t = \delta' Z_t + X_t \dots\dots\dots (E 24)$$

$$X_t = \beta X_{t-1} + \varepsilon_t \dots\dots\dots (E 25)$$

Where  $Z_t$  is a vector of exogenous variables and  $\varepsilon_t \sim \text{iid } N(0, \sigma^2)$ . In the case of the Model C, the vector  $Z_t = [1, t, D1_t, DT1_t]'$ , where  $D1_t = 1$  if  $T \geq TB + 1$  or otherwise zero and  $DT1_t = T - TB$  if  $T \geq TB + 1$  or otherwise zero. The LS unit root test statistic can then be obtained from the following regression.

$$\Delta Y_t = \delta' Z_t + \phi S_{t-1} + u_t \dots\dots\dots (E 26)$$

Where  $S_t = Y_t - \psi_t - Z_t \rho$  for all  $t = 2 \dots T$ ,  $\rho$  denotes the coefficient obtained from the regression of  $\Delta Y_t$  on  $\Delta X_t$ ,  $\psi_t$  is given by  $(Y_1 - Z_1 \rho)$ , and  $Y_1$  and  $Z_1$  represent the first observation of  $Y_t$  and  $Z_t$  respectively. The null hypothesis of a unit root is then tested by using LM  $t$  statistics for  $\phi = 0$  (Lee and Strazicich 2003). The break point estimation is analogous to the ZA test and determined by the minimum  $t$  statistic

The estimation procedure for this study follows Model C, as it is superior to the other models for econometric modelling (Sen 2003). The optimal lag length is determined by using  $t$  statistics starting from  $k=6$ . The *trimming region* is specified  $(0.15T, 0.85T)$  as suggested by ZA(1992). The results are in Table 3.

**Table 3: Unit root tests with one structural break (ZA(1992) and LS(2003))**

	ZA Test H <sub>0</sub> : a Unit root		LS(One break) test H <sub>0</sub> : a Unit root with 1 structural break	
	Test Statistics	Break year	Test Statistics	Break year
Annual growth in CCPI	-5.94***	1979	-5.79**	1978
Annual growth in GDP Deflator	-6.43***	1971	-5.97**	1971
Fiscal deficit to GDP ratio	-6.74***	1977	-4.62	1988
Narrow Money to GDP ratio	-5.34**	1967	-4.19	1969
Fiscal deficit to Narrow money ratio	-4.69	1983	-4.88	1981
Growth in import price index	-7.61***	1981	-6.78***	1971
Exports to GDP ratio	-2.59	1965	-3.50	1975
Imports to GDP ratio	-6.80***	1977	-6.0**	1976
Openness(Trade to GDP ratio)	-4.34	1977	-5.21*	1976
Fiscal deficit(excluding public sector wages) to Narrow money ratio	-4.14	2003	-4.11	2000

Notes: The data are in levels. Optimal lag length is determined by using t test with max lags: 6, Trim at 10% at each end. \*\*\*,\*\* and\* suggest that the null hypothesis is rejected at the 1, 5 and 10 per cent levels respectively. Critical Values taken from Zivot and Andrews (1992) and Lee and Strazicich (2003)

The results of the ZA test confirm that six out of ten variables are stationary. CCPI inflation, GDP deflator inflation, fiscal deficit to GDP ratio, imports to GDP ratio and growth in import price index, reject the null hypothesis of unit root at one per cent significance level, providing strong evidence for stationarity, while the narrow money to GDP ratio rejects it at the five per cent level. The exports to GDP ratio, openness and fiscal deficit to narrow money ratio, are found to be non-stationary. However, the results of the LS (one break) test provide relatively weak evidence (at 5 per cent level) against the null hypotheses of unit root for a few variables. In some instances, it fails to reject the null hypothesis of a unit root and ends up with opposite results to the ZA test.

Moreover, except for the GDP deflator, these tests do not come up with the same break years for each variable. However, in general, both of these tests confirm that during the last five decades the most likely period to have a structural break is sometime during the 1970s. During the 1970s Sri Lanka experienced many shocks, such as the oil price shock in 1973, exchange rate devaluation, political instability in 1971, and economic liberalisation in 1977, etc. However, the main goal of this study is to examine the stationarity of the data prior to econometric analysis and it can be concluded that the variables of this study are of both I (0) and I(1), when we account for one structural break.

Lumsdaine and Papell (1997) argue that when there is more than one structural break, the null hypothesis of unit root may not be rejected by a test that only incorporates one break. Therefore, they propose an extension to the ZA test, including two structural breaks as follows:

$$\Delta Y_t = \mu + \alpha T + \theta DU1_t + \gamma DT1_t + \omega DU2_t + \phi DT2_t + \beta Y_{t-1} + \sum_{i=1}^k \delta_i \Delta Y_{t-i} + \varepsilon_t \dots\dots (E 27)$$

Where  $DU1_t=1$  if  $T>TB1$  and zero otherwise,  $DU2_t=1$  if  $T>TB2$  and zero otherwise,

$DT1_t = T-TB1$  if  $T>TB1$  and otherwise zero and finally,  $DT2_t = T-TB2$  if  $T>TB2$  or otherwise zero.

This model captures structural breaks in both the intercept and the time trend of a data series.

However, the LP test does not consider structural changes under the null hypothesis as this is an ADF type unit root test. Therefore, Lee and Strazicich (2003) extend their model to incorporate two structural breaks as an alternative to the LP test. As previously mentioned, in its estimation this study follows Model C and the optimal lag length is determined by using t statistics starting from  $k=6$ . The *trimming region* is specified (0.15T, 0.85T) as suggested by ZA(1992) and LP(1997). The results are in Table 4.

The results (Table 4) confirm that when we incorporate two structural breaks, about eight out of ten variables become stationary. Both tests (LP and LS) reject the null hypothesis of a unit root in CCPI inflation, GDPD inflation, fiscal deficit to GDP ratio, growth in import price index, imports to GDP ratio, and narrow money to GDP ratio. Similarly, both tests fail to reject the null hypothesis of unit root in exports to GDP ratio.

**Table 4: Unit root tests with two structural breaks LP (1997) and LS (2003)**

	LP Test		LS(Two breaks) test	
	H <sub>0</sub> : a Unit root		H <sub>0</sub> : a Unit root with 2 structural breaks	
	<b>Test Statistics</b>	<b>Break years</b>	<b>Test Statistics</b>	<b>Break years</b>
Annual growth in CCPI	-7.12**	1979 1986	-6.82***	1978 2003
Annual growth in GDP Deflator	-7.34**	1971 1974	-7.02***	1971 1985
Fiscal deficit to GDP ratio	-7.34***	1978 1993	-7.43***	1976 1985
Narrow Money to GDP ratio	-6.53*	1967 1986	-5.63*	1967 1986
Fiscal deficit to Narrow money ratio	-6.39	1979 1991	-6.70***	1976 1985
Growth in import price index	-8.16***	1977 1986	-8.04***	1981 1985
Exports to GDP ratio	-4.48	1976 1999	-4.31	1975 2003
Imports to GDP ratio	-8.77***	1977 1992	-6.01**	1968 1976
Openness(Trade to GDP ratio)	-6.75*	1977 1999	-5.30	1968 1976
Fiscal deficit(excluding public sector wages) to Narrow money ratio	-5.18	1999 2006	-5.36*	1994 2004

Notes: \*\*\*, \*\*, and\* suggest that the null hypothesis is rejected at the 1, 5 and 10 per cent level respectively.

Critical Values are taken from Lumsdaine and Papell (1997) and Lee and Strazicich (2003).

Optimal lag length is determined by using t test with max lags: 6, Trim at 10% at each end.

However, the two tests provide conflicting results on the fiscal deficit to narrow money ratio and trade openness. Furthermore, they do not agree upon the break years, except for the narrow money to GDP ratio. Consequently, the unit root tests in the presence of two structural breaks also confirm that the variables of this study are of different orders of integrations.

The summary of all the unit root tests is given in Table 5. The main variables used in the econometric analysis are highlighted. Table 5 shows that none of the unit root tests could prove that these variables are of the same order of integration and also confirms that they are either I(0) or I(1). Therefore, this study relies upon the ARDL model, which provides consistent estimators in the presence of I(0) and I(1) variables. Furthermore, most of the above tests identify that if there exists a structural break, the most likely position is during the late 70s and it closely corresponds with economic liberalisation, which took place in Sri Lanka in 1977. Therefore, this study includes a dummy variable for 1977 to capture that effect.

**Table 5: Summary statistics of Unit Root tests**

Data Series	Conventional unit root tests		Unit root tests with one structural break		Unit root tests with two structural breaks	
	ADF	KPSS	ZA	LS(1)	LP	LS(2)
<b>Annual growth in CCPI</b>	<b>I(0)</b>	<b>I(1)</b>	<b>I(0)</b>	<b>I(0)</b>	<b>I(0)</b>	<b>I(0)</b>
<b>Annual growth in GDP Deflator</b>	<b>I(0)</b>	<b>I(1)</b>	<b>I(0)</b>	<b>I(0)</b>	<b>I(0)</b>	<b>I(0)</b>
Fiscal deficit to GDP ratio	I(1)	I(1)	I(0)	I(1)	I(0)	I(0)
Narrow Money to GDP ratio	I(0)/I(1)	I(0)	I(0)	I(1)	I(0)	I(0)
<b>Fiscal deficit to Narrow money ratio</b>	<b>I(1)</b>	<b>I(0)</b>	<b>I(1)</b>	<b>I(1)</b>	<b>I(1)</b>	<b>I(0)</b>
<b>Growth in import price index</b>	<b>I(0)</b>	<b>I(0)</b>	<b>I(0)</b>	<b>I(0)</b>	<b>I(0)</b>	<b>I(0)</b>
Exports to GDP ratio	I(1)	I(0)	I(1)	I(1)	I(1)	I(1)
Imports to GDP ratio	I(1)	I(1)	I(0)	I(0)	I(0)	I(0)
<b>Openness(Trade to GDP ratio)</b>	<b>I(1)</b>	<b>I(0)</b>	<b>I(1)</b>	<b>I(0)</b>	<b>I(0)</b>	<b>I(1)</b>
<b>Fiscal deficit(excluding public sector wages) to Narrow money ratio</b>	<b>I(0)/I(1)</b>	<b>I(0)/I(1)</b>	<b>I(1)</b>	<b>I(1)</b>	<b>I(1)</b>	<b>I(0)</b>

Source: Author's calculations, highlighted ones are used in the analysis.

As already mentioned, the ARDL model uses only a single reduced form equation; therefore, to test for causality between the main variables, the pair-wise Granger causality test is carried out (Appendix 1). Results show that there is unidirectional causality from fiscal deficit scaled by narrow money to inflation in both the univariate and multivariate models. Proper lag order selection also provides a greater impact on the analysis (Hendry 1995, Peseran, et al. 2001). The Schwartz selection criterion chooses one lag for each variable as an optimal lag length for the study. Restricting the number of lags to one is consistent with earlier studies of this nature, mainly to preserve the degree of freedom. Therefore, the data used in this study meets the criteria for producing consistent estimates with the error correction version of the ARDL model.

## 6: Results and Discussion

### 6.1: Estimation of the link between fiscal deficit and inflation in Sri Lanka

Equation E 15 is estimated to analyse the relationship between fiscal deficit and inflation in Sri Lanka. The estimation starts with bi-variate model and expands to multivariate model. Both these models are estimated with two different inflation indicators, i.e. growth in CCPI and growth in GDP deflator, to check the robustness of the results. The multivariate models are then estimated under two different scenarios, i.e. model 1 and model 2. Model 1 does not consider the impact of civil war on the link between fiscal deficit and inflation whereas in model 2 includes a dummy variable to represent the civil war period. This analysis would have been more meaningful if war expenditure were removed from fiscal operation and the fiscal deficit is created without war expenditure as an independent variable. However, such data are available only from 1973 and, therefore, this study used a dummy variable to represent the civil war period. The estimated results show there is a positive relationship between inflation and the fiscal deficit in Sri Lanka. The bi-variate models provide the unconditional impact of the fiscal deficit on two main inflation indicators while the multivariate models estimate the robustness of those results to the inclusion of other explanatory variables. Other explanatory variables include the import price index, openness to trade, a dummy variable to represent economic liberalisation ( $D_{77}$ ) and a dummy variable for the civil war period ( $DW$ ).

As the first step of the analysis it is necessary to test the existence of a long run relation between the variables under investigation (i.e.  $H_0: \beta_1=\beta_2=\beta_3=\beta_4=0$ ) by using the Wald test. Then the Wald test statistic is compared with the bound test critical values tabulated by Pesaran, et al. (2001). If the Wald test statistics are greater than the upper bound of the critical value, the null hypothesis can be rejected to conclude that there exists a long run relation between the variables of concern. If it is smaller than the lower bound critical value, the null hypothesis cannot be rejected. Finally, if it falls within the lower and upper bound, the results become inconclusive. The Wald F test statistics for both models exceed the upper bound critical value (Table 6) and, therefore, the null hypothesis can be rejected, confirming a long-run relationship among the variables of interest.

In order to increase the reliability of the estimated results, the standard diagnostic tests are carried out. The errors of the model are serially uncorrelated (order 2) and normally distributed. However, model 2 shows heteroskedasticity, and hence the standard errors are corrected for this. The results of the Ramsey test shows there are no signs of a mis-specified functional form. The cumulative sum of recursive residuals (CUSUM) and the cumulative sum of squares of recursive residuals (CUSUMSQ) suggest that the estimates are stable (Appendix 2). Therefore, the relationship between fiscal deficit and inflation in the long run as given in Table 7 is assured.

**Table 6: Bound test results**

Model	Wald test F statistic
Uni-variate models	
Growth in CCPI	9.40**
Growth in GDPD	8.09**
Multivariate model	
Growth in CCPI ( Model 1)	4.76**
( Model 2)	6.55***
Growth in GDPD( Model 1)	10.28***
( Model 2)	11.64***

Notes: Critical Value for Bound Test (Pesaran et, al 2001, p 300)  
 intercept and no trend( k=4) :[ 3.74, 5.06] at 1% and [2.45, 3.52] at 10%  
 \*\*\*, \*\*, \* indicate significance at 1%,5%, and 10% respectively

Almost all the variables in the model confirm the expected signs, even though some variables, such as openness, become statistically insignificant. However, the main variables of concern continue to display statistically significant results in both the bi-variate and all multivariate models.

The next step is to estimate the long run coefficient from the ARDL model. It is calculated (as explained earlier) by dividing the coefficient of the lagged variable by the coefficient of the lagged level dependent variable. Accordingly, the long run impact coefficient between fiscal deficit and inflation in Sri Lanka is found to be about 12.6 in the bi-variate models. This implies a one percentage point increase in the fiscal deficit to the narrow money ratio can raise inflation by about 12.6 percentage points in the long run. This correlation remains the same with both inflation indicators. In multivariate models under each scenario, the link between fiscal deficit and inflation becomes a positive and statistically significant one. However, the magnitude of the link and the level of significance change in response to the inclusion of some variables.

Based on the results of the model 1(CCPI inflation), the link between fiscal deficit and CCPI inflation is about 15 per cent points, whereas it is a bit less with GDP deflator inflation (11 per cent). However, with the inclusion of a dummy variable for the civil war period, the correlation becomes weaker both in magnitude and significance. Consequently, in model 2 the correlation between fiscal deficit and inflation declines to 10.6 per cent (based on CCPI inflation) at a ten per cent significance level. In the short run, an increase in the fiscal deficit to narrow money ratio by one percentage point leads to an increase in CCPI inflation by about 8 percentage points. However, this study is mainly concerned with the long-run relationship between the main variables. The estimated coefficient for the error correction term is negative and strongly significant in all models, indicating that the economy needs more than a year to adjust to the deviation from the long-run equilibrium following a shock.

Growth in the import price index, which captures the changes in both exchange rate and world market prices, contributes to inflation significantly and positively in all cases. World price movements are passed on to the domestic prices of imports and influence the aggregate price level of a country. As a

trading economy with heavy dependence on imported commodities, it is not surprising to find a positive and significant contribution of growth in import prices to rising inflation in Sri Lanka, both in the short-run and the long-run. In general, in the short run, an increase in the growth rate of the import price index by 1 percentage point leads to an increase in annual inflation of around 15 to 27 percentage points in the first period and 6 to 11 percentage points in the following period. In the long-run, the impact of a one percentage point increase in growth in import price index (GIP) leads to an increase in inflation by 20 to 34 percentage points. This view is supported by Athukorala and Jayasooriya (1994) who identify external factors as the major sources of inflation in Sri Lanka.

Openness, measured as the trade (exports and imports) to GDP ratio, exhibits a negative relationship with inflation, mainly in developing countries (Romer 1993, Lane 1997). However, in this study it comes up with the expected sign according to the theory, but is insignificant in all cases. This does not change even with the inclusion in the estimation of other measures of openness, such as imports to GDP. The dummy variable for the civil war is positive and significant in all cases, implying that during the civil war period the country experienced high inflation when compared to other periods. The link between fiscal deficit and inflation turns out to be weaker once the civil war period is accounted for, because historically high deficits were primarily driven by war financing.

Overall, the results suggest that the link between the fiscal deficit and inflation in Sri Lanka is positive and statistically significant and, therefore, inflation is not fully a monetary phenomenon. Increasing money supply might be the immediate cause of rising inflation, yet fiscal prudence is important in controlling inflation. The results of this study are consistent with the findings of the group of literature argue that there is a positive relation between inflation and fiscal deficit in developing countries, including Catão and Terrones (2005).

However, Sri Lanka does not belong to that group, as its annual inflation never exceeds 30 per cent. Consequently, this study shows that the link between fiscal deficit and inflation is possible even in developing countries that do not have very high inflation rates.

## **6.2 Estimation of the impact of public sector wage movements on the fiscal deficit-inflation relationship**

The link between fiscal deficit and inflation is well defined by the theory, yet empirical support is provided mainly by high inflation countries, during high inflation periods. Buffie (1999) argues that this situation can be attributed to the co-movement of the public sector wage cycles. Therefore, once the effect of public sector wages is factored out, this link should remain intact, as defined by the theory. The second part of this study tests the validity of this hypothesis using Sri Lankan data.



**Table 7: Results of ECM version of the ARDL (1, 1) Models**

Variables	Bi variate Model		Multivariate Model			
	Dep.Var. : CCPI	Dep.Var. : GDPD	Dep.Var. : CCPI		Dep. Var.: GDPD	
			Model 1	Model 2	Model 1	Model 2
Constant	-0.712 [-0.44]	1.21 [0.56]	-2.03 [-0.94]	-1.39 [-0.57]	0.65 [0.27]	0.61 [0.25]
Lag inflation	-0.63*** [-3.98]	-0.58*** [-4.02]	-0.73*** [-3.88]	-0.80*** [-4.55]	-0.72*** [-5.55]	-0.78*** [-5.96]
Lag Fiscal deficit to Narrow money	0.08* [1.85]	0.07* [1.92]	0.11*** [3.64]	0.085* [2.43]	0.08** [2.83]	0.061* [1.68]
Lag growth in import price index			0.15** [2.68]	0.20** [3.43]	0.22*** [5.18]	0.27*** [5.80]
Lag Openness			-0.01 [-0.22]	-0.02 [-0.48]	-0.05 [-0.89]	-0.05 [-0.89]
Difference of Fiscal deficit to narrow money	0.11* [2.14]	-3.98 [-0.87]	0.09* [2.13]	0.085* [1.65]	-0.03 [-0.73]	-1.60 [-0.43]
Difference of growth in import price index			0.18*** [4.35]	0.19*** [4.98]	0.26*** [6.45]	0.26*** [6.27]
Difference of openness			-0.13 [-0.98]	-0.29 [-1.40]	-0.31 [-1.96]	-0.41* [-2.77]
Dummy variable for regime shift	1.33 [0.65]	4.32 [1.08]	-5.04* [-2.13]	-2.91 [-1.40]	-0.84 [-0.13]	1.61 [4.63]
Dummy variable for civil war	0.77 [0.38]	-0.86 [-0.45]		3.01* [1.90]		2.95* [2.11]
Number of observations	50	50	50	50	50	50
R- squared	0.3811	0.3652	0.5902	0.6158	0.6773	0.7352
Diagnostic tests						
Serial correlation LM test (1)	1.183(0.551)	1.781(0.410)	3.027(0.220)	3.177(0.204)	0.728(0.694)	0.513(0.773)
JB normality tests	2.335(0.311)	6.487(0.039)	1.249(0.535)	4.367(0.112)	0.562(0.752)	0.312(0.855)
Ramsey tests (1restriction)	0.427(0.512)	1.443(0.229)	0.465(0.495)	0.246(0.884)	0.001(0.981)	0.810(0.367)

Notes: Standard errors have been corrected for presence of heteroskedasticity \*\*\*, \*\*, \* indicate significance at 1%, 5%, and 10% respectively. t statistics are in [ ] parenthesis. Critical values for diagnostic tests are taken from Chi-square distribution table and p values are in ( ).

Public sector wage expenditure plays a major role in fiscal operations in Sri Lanka. In 2007, it accounted for one-third of current expenditure (Central Bank of Sri Lanka 2008). The public sector employment to total employment is about 15 per cent. Public sector wages influence inflation in two ways. Firstly, they affect inflation via increasing aggregate demand. Secondly, they increase the fiscal deficit and result in possible monetary financing and affect inflation indirectly.

Moreover, when the public sector wage announcements are made, they affect inflationary expectations of the general public and lead to rising inflation. In any case there is a positive correlation between public sector wages and inflation. However, the situation becomes more complex when the fiscal deficit is taken into consideration. Buffie (1999) explains that when there is a real wage cut (rise), the general public expect it to be increased (cut) after some period of time and formulate their inflationary expectations accordingly. As a result, one might observe rising inflation during the period that the economy experiences low wages and a low fiscal deficit. Buffie (1999) explains this theoretically under many scenarios. All cases show either negative or weak correlation between fiscal deficit and inflation due to the public sector wage cycle effect. Therefore he argues that once the public sector wage effect is taken out of the analysis, the link between fiscal deficit and inflation remains intact.

As explained earlier in the model and methodology section, this study uses new fiscal deficit variable excluding public sector wages from government fiscal operations, thereby removing the impact of public sector wages on the fiscal deficit. Consequently, the fiscal deficit no longer changes due to the public sector wage cycles. Therefore, we expect a relatively stronger link between fiscal deficit and inflation over the previous estimation, if Buffie's (1999) hypothesis is valid for Sri Lanka.

Following the same econometric procedure as before, this study estimates the link between fiscal deficits and inflation in the absence of public sector wages. Here, instead of a dummy variable for the civil war period, I use the fiscal deficit without defence expenditure as a baseline variable. The data for this section are available from 1980 onwards and the civil war period is from 1983 onwards. Therefore, it is more meaningful to remove defence expenditure and create a new fiscal deficit variable, instead of using a dummy variable. Econometric estimation is carried out based on equation E 17 and the findings are presented in Table 9. As a first step of the ARDL (1, 1) procedure, the Wald F test is carried out and it shows that there is a long run relationship among these variables (Table 8).

Results (Table 9) become opposite those of Buffie (1999). Instead of being strongly correlated once the public sector wages are taken away from the analysis, the link between fiscal deficit and inflation becomes negatively related and insignificant, or at most weakly significant (in the case of CCPI inflation).

**Table 8: Bound test results – Excluding public sector wages**

Model	Wald test F statistic
Uni variate models	
Growth in CCPI	14.72**
Growth in GDPD	11.05**
Multivariate model	
Growth in CCPI	9.96***
Growth in GDPD	7.87***

Critical Value for Bound Test (Pesaran et, al 2001, p 300)  
intercept and no trend( k=4) :[ 3.74, 5.06] at 1% and [2.45, 3.52] at 10%.  
\*\*\*, \*\*, \* indicate significance at 1% ,5% and 10% respectively.

The prime suspicion goes towards the data limitation of this section (data are available only for 29 years) and, therefore, care must be taken in interpreting the results. However, this result may be associated with the following possibilities. First, it implies that an increasing fiscal deficit, except for public sector wages, has no significant effect on inflation in Sri Lanka. Therefore, public sector wages may be the key factor that link fiscal deficits and inflation in Sri Lanka. As explained above, the public sector wage expenditure is the largest component in current expenditure of the fiscal accounts. It affects inflation directly through aggregate demand and indirectly through the deficit financing method. Once these impacts are removed from the analysis, it is reasonable to expect an insignificant link between fiscal deficit and inflation.

On the other hand, this result can be ascribed to a scenario when consumption and real balances are Edgeworth complements (Buffie 1999). In such a case, inflation and fiscal deficit jump in the same direction, implying a positive link between the two. However, there is no empirical evidence to support Edgeworth complementarity either for Sri Lanka or for developing countries. If it is the case for Sri Lanka, then the link between fiscal deficit and inflation can no longer exist when the wage cycle effect is factored out from the analysis.

Lastly, there are two baseline scenarios in the Buffie (1999) analysis. The first explains the impact of wage cycle co-movement, when real wage cuts are followed by a real wage rise of equal length and duration. The second explains the same when real wage cuts are followed by a wage rise to pre-stabilisation level. However, neither of these can be applicable to Sri Lanka. Fig. 2 shows the movement of the real wage rate index for government employees. It shows that real wage cuts are followed by a real wage rise, but not of an equal length or duration. Furthermore, it is not necessarily the case that the real wage rate comes back to the previous level. Buffie (1999) argues using examples from African countries that whenever there is a real wage cut it is reflected in a wage to current expenditure ratio. However, in some years the Sri Lankan experience shows the opposite pattern. Therefore, when the baseline scenario is different, one cannot expect similar results from the analysis.

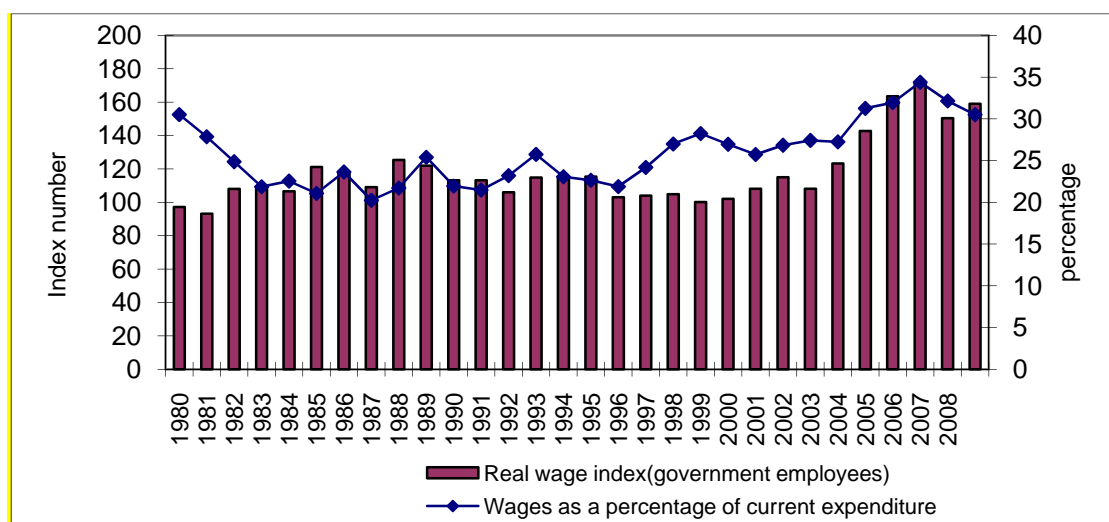
**Table 9: Results of ECM version of the ARDL (1, 1) Models: without public sector wage expenditure**

Variables	Uni variate Model		Multivariate Model	
	Dep.Var. : CCPI	Dep.Var. : GDPD	Dep.Var. : CCPI	Dep. Var.: GDPD
Constant ( $\beta_0$ )	9.75*** [4.42]	7.47** [3.06]	13.90* [2.60]	6.9 [1.52]
Lag inflation ( $\beta_1$ )	-0.81*** [-4.71]	-0.80*** [-4.69]	-0.97*** [-6.13]	-0.94** [-3.59]
Lag Fiscal deficit to Narrow money ( $\beta_2$ )	-2.58 [-0.52]	0.02 [0.34]	-0.10* [-1.93]	-4.27 [-1.08]
Lag growth in import price index ( $\beta_3$ )			0.41*** [4.41]	0.34** [3.39]
Lag Openness ( $\beta_4$ )			-0.05 [-0.58]	0.3 [0.04]
Difference of Fiscal deficit to narrow money ( $\beta_7$ )	-7.19 [-1.24]	-0.05 [-1.22]	-0.11* [-1.99]	-7.59 [-1.51]
Difference of growth in import price index ( $\beta_8$ )			0.27*** [4.94]	0.27*** [5.67]
Difference of openness ( $\beta_9$ )			-0.40* [-2.58]	-0.33* [-3.68]
Number of observations	29	29	29	29
R- squared	0.4894	0.4585	0.7586	0.7514
Diagnostic tests				
Serial Correlation LM test (1)	1.466(0.480)	3.020(0.220)	0.777(0.677)	1.6841(0.4308)
JB normality test	0.369(0.831)	0.439(0.802)	0.344(0.841)	1.9059(0.3855)
Ramsey test (1restrictions)^	0.524(0.468)	4.671(0.030)	2.930(0.102)	1.4321(0.2314)

Notes: \*\*\*, \*\*, \* indicate significance at 1%, 5% and 10% respectively

Standard errors have been corrected for presence of heteroscedasticity

t statistics are in [ ] parenthesis, Critical values for diagnostic tests are taken from Chi-square distribution table and p values are in ( )

**Figure 2: Movement of real wage index and wages to current expenditure ratio**

Source: Central Bank of Sri Lanka (2010)

The growth in the import price index continuously plays a significant role in explaining inflation even in the absence of the public sector wage effect. In contrast to the previous estimation (Equation E 15), now openness (total trade to GDP) shows a significant relationship with inflation in the short-run. Inflation tends to respond negatively to openness in the short-run, an increase in openness by 1 percentage point leads to a reduction in inflation by 0.40 percentage points in the first period and by 0.06 percentage points in the following period.

Note that the coefficient of the lagged level of the dependent variable (CCPI (-1)) indicates the speed at which inflation adjusts to any discrepancy between inflation and other explanatory variables in the previous period. The magnitude of the coefficient suggests that that it takes just over a year for inflation to come back to the long-run equilibrium after a shock. Even though the estimated model passes all the goodness of fit tests, the result would not be precise as it is affected by the shortage of data. Therefore, careful interpretation of the result as well as further analysis of this issue is essential for making policy recommendations.

## 7: Conclusion

This study has analysed two propositions of fiscal-based theories of inflation in light of the Sri Lankan experience from 1959 to 2008. The purpose of this analysis has been to quantify the link between the fiscal deficit and inflation and to explore that link in the absence of the public sector wage effect.

The estimated results suggest that a one percentage point increase in the fiscal deficit to narrow money ratio, results in about an 11 percentage points increase in the rate of inflation (CCPI) in Sri Lanka. This finding is robust to the use of other inflation indicators such as the GDP deflator. In the

literature it is argued that the link between fiscal deficits and inflation mainly exists in high inflation countries. The Sri Lankan experience suggests that a moderately high-inflation country also exhibits a significant link between the two.

This study finds contradictory results to the hypothesis that suggests public sector wage cycles underlie the weak relationship between fiscal deficit and inflation. The study suggests that public sector wages as a key factor that link fiscal deficit and inflation in Sri Lanka. Admittedly, the limited availability of data for public sector wage expenditure might affect this result; therefore, care must be taken in interpreting the results.

The main finding of this study is that inflation is not completely a monetary phenomenon in Sri Lanka. The apparent cause of rising inflation could be increasing money growth, but the true dynamics go deeper, to the persistent fiscal deficits that are needed to be financed by seigniorage income. Given the limited options the country has in financing the fiscal deficit, it is necessary to implement sound and consolidated fiscal adjustments. This will ensure a low and sustainable fiscal deficit and price stability in the long-run.

Among the other findings, there is evidence that the import price index, which captures both changes in world prices and the exchange rate, is a significant explanatory variable of rising inflation in all scenarios. This empirical framework could be modified to include more variables that are intertwined with inflation in a complex manner; such a study could be of policy importance.

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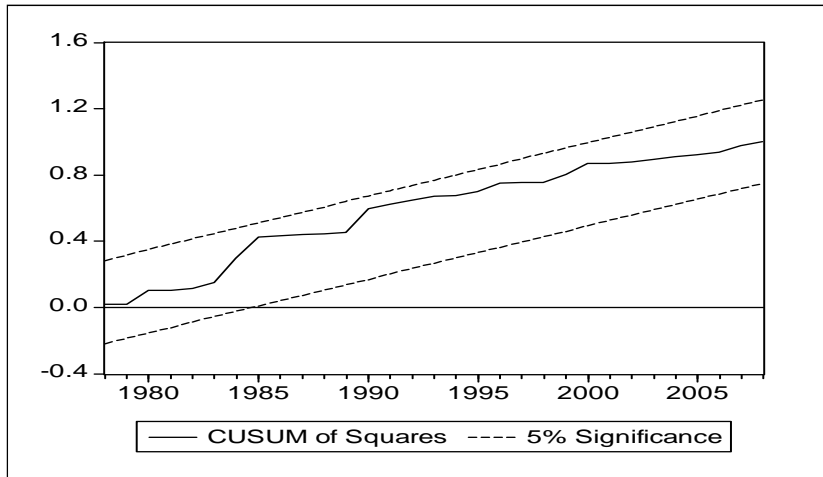
**Appendix 1: Granger causality test**

Dependent variable/ Independent variable	F statistics
Growth in CCPI/ Fiscal deficit to narrow money ratio	3.926*
Fiscal deficit to narrow money ratio / Growth in CCPI	1.075
Growth in GDP deflator/ Fiscal deficit to narrow money ratio	1.853
Fiscal deficit to narrow money ratio/ Growth in GDP deflator	1.528
Growth in CCPI/ Growth in import price index	2.784
Growth in import price index / Growth in CCPI	1.563
Growth in GDP deflator / Growth in import price index	1.326
Growth in import price index / Growth in GDP deflator	1.717
Growth in CCPI/ Openness	0.842
Openness / Growth in CCPI	0.897
Growth in GDP deflator / Openness	1.183
Openness / Growth in GDP deflator	2.081

\* Causality is significant at 5 per cent level

Appendix 2: Stability tests

a) Multivariate Model 2: CCPI Inflation



b) Multivariate Model 2: GDP deflator inflation

