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Abstract:
The maintenance of price stability is regarded as a key economic policy goal, as inflation is costly and hinders economic growth. There is a vast literature on the relationship between inflation and growth across time, regions, and inflation ranges. The conventional neo-classical view postulates a linear negative relationship between inflation and economic growth. The Keynesian and Neo-Keynesian frameworks, however, have established a linear positive relationship between inflation and growth in the short-run. Some researchers maintain that neither positive nor negative associations exist between inflation and growth.

Although there seems to be an obvious positive relationship between inflation and growth in Sri Lanka in the long-run, it is difficult to establish a clear link between the two without a thorough investigation. Moreover, the high and volatile inflation rates have sparked a confusing debate within policy circles over the nexus of growth and inflation in the country. Given this background, this paper develops an econometric model to identify the real nature of the growth-inflation link in Sri Lanka and to determine the optimum or threshold rate of inflation that would minimise the economic cost of inflation in terms of economic growth. To the best of the author's knowledge, there has been no attempt previously to find such a threshold level of inflation for Sri Lanka. The proposed model uses long time series data to establish the plausible link between growth and inflation and also to estimate the inflation threshold.

The current study finds a non-linear relationship between inflation and growth in Sri Lanka, contradicting the general belief about the linear relationship between inflation and growth. Growth increases with inflation, showing a positive relationship between the two variables up to 11 per cent of inflation, and then, growth becomes negative if inflation increases beyond that level. This finding implies that in Sri Lanka, there is a significant structural break of inflation at the 12 per cent level. The paper also finds that GDP growth and per capita GDP maximising inflation rate for the country falls between 7.4-9.6 per cent.

Keywords: Inflation, Sri Lanka, Nexus of inflation and growth, Threshold level of inflation
JEL classification: E31; E32, C01; C22; O40,

An Empirical Analysis of Inflation-Growth Nexus in Developing Countries: The Case of Sri Lanka

N. S. Cooray[1]

1. Introduction:

It is the accepted view that a stable macroeconomic framework is necessary for a country's economic growth. Instability in the macro environment brings uncertainty, which in turn hinders growth through low efficiency in the price mechanism and a low rate of investment Fisher (1993); Little et al. (1993); Kan & Omay (2010); & Seleteng et al. (2013). Therefore, maintaining stability (or often low inflation) is regarded as one of Sri Lanka's main macroeconomic policy objectives, because inflation is costly and hinders the country's high growth expectation CBSL (2005). The cost of inflation may relate to the average rate, variability, and uncertainty of inflation Barro (2001, p. 89). Based on this line of reasoning, the financial authorities in a growing number of developed and developing countries have adopted implicit or explicit inflation targeting Bernanke et al. (1999); Mishkin (2000); Mishkin (2003); & Truman (2003).

Sri Lanka managed to maintain single-digit rates of inflation during the 1950s and the 1960s that were among the lowest inflation rates in developing countries. The country experienced moderately high rates of inflation in the 1970s. Following the introduction of open economic policies in 1977, the rate of inflation has increased and remained in the double digit. On average, the economic growth rate has also increased since the 1950s. In light of the recent high inflation, a debate has arisen regarding its implications for growth Nicholas (2008); Karunaratne & Bandara (2000); Korale (2009); Kelegama (2006, p. 59);& Lakshman (2012).

This debate in Sri Lanka has been based on ideological predilections and circumstantial evidence. Those who strongly believe the conventional neo-classical view, postulate a negative relationship between inflation and economic growth. The Keynesian and Neo-Keynesian frameworks, however, have established a positive link between the two in the short term. In general, neither the positive nor negative links between growth and inflation have been unanimously supported by the empirical evidence (Sarel, 1996, p. 1; Hayat & Kalirajan, 2009, p. 1). According to the author's knowledge there is currently no published article available on the threshold level of inflation and on quantifying the growth implication of inflation in Sri Lanka. Therefore, it is important to have a country specific study to investigate the true nature of the inflation-growth nexus and to discover the threshold level of inflation for the country.

Given the above background, the aims of this paper are twofold: first, to undertake a survey of the available theoretical and empirical literature on the subject with a view to educate policy makers on the on-going debate; and second, to discover the threshold level of

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inflation, if any, for the country. Finding a threshold level or growth maximising inflation is vital for faster economic growth in spite of policy advice from international financial organisations to reduce inflation to undesirably low levels, which might create unintended consequences.

The paper is organised as follows. Following this introduction, Section 2 provides a survey of the inflation-growth nexus across time and across inflation ranges. Section 3 explains growth-inflation debate and the inflation threshold level for Sri Lanka. Section 4 provides a discussion on the methodology and data, while an analysis of the results is given in section 5. In the final section some inferences are drawn as they pertain to the Sri Lankan debate.

2. Growth-Inflation Nexus: A Survey

Positive relationship: The Keynesian and Neo-Keynesian theory suggest a positive relationship between inflation and growth in the short-run (Lucas, 1973, p. 334; Hayat & Kalirajan, 2009, p. 3). The aggregate supply equation under the assumptions of sticky wages, imperfect information, and sticky prices indicates a positive link between price level and output. The Phillips curve equation explains that low inflation can be achieved at the cost of reducing output or higher unemployment.

According to Pazos (1972), Latin-American countries had high double-digit inflation with respectable growth in the 1950s and 1960s, as cited by Bruno & Easterly (1998, p. 2). Bruno and Easterly (1996) examine a different aspect of the link between growth-inflation; the behaviour of growth before, during, and after high inflation episodes. They found no permanent damage to growth from high inflation crises, as countries tend to regain their pre-crisis growth rate (Bruno & Easterly, 1996, p. 8). Wallich (1969) attempts to establish a plausible relationship between economic growth and a variety of monetary variables, including inflation, by taking pooled data for 43 countries for a period of 5-10 years between 1956 and 1965. Wallich concluded that "the theoretical treatment of the influence of inflation upon growth arrives, in most cases, at a positive relationship" (Wallich, 1969, p. 298).

Mallik & Chowdhury (2001, p. 133) examine the long-run relationship between growth and inflation, using co-integration and error correction models with annual data for four South Asian countries-Bangladesh (1974-97), India (1961-97), Pakistan (1957-97), and Sri Lanka (1966-97), and find a long-run positive relationship between the two. The finding implies that the four countries needed inflation for growth. This finding stands in contrast to the findings of Hayat & Kalirajan (2009) for Bangladesh for the period 1976-2005. Because any level of inflation negatively impacts on economic growth, they recommend well though out monetary policy package to maintain price stability.

Pollin & Zhu (2006) find that higher inflation is closely related to moderate increases in output, up to approximately 15-18 per cent of the inflation threshold level. Based on their estimates for 80 middle and low-income countries for the period 1961-2000, they conclude that there is no justification for those countries to target inflation with a 3-5 per cent band. Stanners (1993, p. 106) provide similar evidence and is unable to support "the statement

that low or zero inflation is an essential or very important condition for high and sustained growth".

Negative relationship: There is also a body of vast literature on the negative relationship between inflation and growth over time and across inflation ranges. The conventional neo-classical view is that inflation and growth constitute a negative relationship (Bruno & Easterly, (1998); Barro, (2001)). Many argue that inflation weakens a stable macroeconomic environment by creating uncertainty in an economy. According to Fischer (1993, p. 488), there are two main channels through which uncertainty can affect growth. First, an unstable macroeconomic environment reduces the efficiency of the price mechanism. Second, uncertainty reduces the rate of investment as investors are reluctant to invest at a risky time. Macroeconomic instability in a domestic economy also leads to capital flights, as seen during many financial crises. According to the Phillip curve analysis there is a negative relationship between growth and inflation in the short-run.

Gregorio (1993) finds evidence of a negative link between inflation and growth. The author focused his studies on a group of 12 Latin American states for the period 1950-1985. Barro (2001, p. 95), identifies the effect of inflation on growth by incorporating inflation as an explanatory variable with other determinants, in his growth equation estimated using pooled data. The study found that an increase of 10 per cent in annual inflation (measured by consumer price indexes for most of the counties in the sample) causes a 0.3 per cent growth decline for a particular country over the periods estimated, 1965-1975, 1975-1985, and 1985-1990. He also found that inflation variability, which is measured by the standard deviation of inflation, has a positive relationship with the rate of inflation, suggesting that countries with high inflation tend to have high inflation variability, which hinders their growth. Inflation variability is an indicator measuring macroeconomic stability.

A comprehensive study by Jha & Dang (2011) examines the effect of inflation variability and economic growth on both developing and developed countries. Their annual data cover 182 developing and 31 developed countries for the period 1961-2009. They suggest that when the rate of inflation exceeds 10 per cent, inflation variability has a negative effect on economic growth. Bruno & Easterly (1996, p. 1) find a short- to medium-run negative relationship between high inflations and growth, even though there is no continuous loss to growth from discrete high inflation because countries tend to regain their pre-crisis growth rate. Barro (1996) includes inflation as an explanatory variable in his growth equation estimated using data for a panel of approximately 100 countries from 1960 to 1990 and finds that the growth rate is enhanced by lower inflation. The study finds that an increase in the average inflation rate by 10 percentage points per year is estimated to lower the growth rate of real per capita GDP by 0.2 - to 0.3 percentage points per year (Barro, 1996).

Another study by Hodge (2005) reveals that a one percentage-point increase in the average annual inflation rate drags down the growth rate in South Africa by approximately a quarter of a percentage point. The study used quarterly data for the period 1970–2003. Jarrett & Selody, (1982, p. 366) examine the relationship between productivity, growth and inflation, using Canadian time series data from 1963 to 1979. They found that a 1 per cent increase in inflation was associated with a 0.31 per cent decline in productivity growth. They further argued that the increase in inflation rates during the 1970s was sufficient to explain the

slowdown in productivity growth. In a study on India, Singh & Kalirajan (2003) discover evidence of a negative link between inflation and growth. Another other study conducted in Bangladesh by Hayat & Kalirajan (2009) suggested that an increase in inflation has negative effects on economic growth. The Authors further asserted that substantial gains can be obtained by focusing monetary policy on maintaining price stability.

Smyth (1994, p. 261) argues that inflation distorts price signals and affects the ability of private agents to formulate effective business plans. Smyth estimated a production function based on the output of the American private business sector, using annual data from 1951 to 1992. The rate of inflation was included as one explanatory variable and the results showed that in the steady-state, a 1 per cent increase in inflation reduced private sector output growth by 0.193 per cent. The negative relationship is further supported by the large, calculated rations of growth sacrificed to inflation stabilisation in OECD countries (Bruno & Easterly, 1996, p. 2). The case study literature notes that high inflation is inherently unstable. New growth theory literature suggests a negative relationship (Fischer, 1993). Other studies on the same relationship include (De Gregorio, 1992).

Neutral Relationship: Other studies suggest that the relationship is neither positive nor negative, but rather that there is no causal association between the inflation and growth. According to the view of the International Monetary Fund (IMF) as represented by Wai (1959); Dorrance (1963) and (1966), there is no relationship between growth and inflation. Levine & Zervos (1993) uncover no causal link between them. Bruno and Easterly note that stabilisation of hyper-inflation has little or no output cost, whereas the stabilisation of merely high inflation is indeed costly. The view proposed during the 1960s was ambiguous (Bruno & Easterly, 1996, p. 2).

Jung & Marshall (1986) summarise three competing alternative hypotheses on the effects of inflation on growth. They explain that according to the structuralist view, inflation has a positive effect on growth based upon inflationary inducement to savings and capital accumulation. The second competing hypothesis, the distortionary inflation view, suggests a negative impact on growth as inflation generates various inefficiencies in financial markets and diverts funds from more productive uses (investment) to less-productive uses. The third alternative, the causal neutrality hypothesis, is based on the Lucas supply framework, implies no impact of anticipated inflation on output.

These theoretically different deductions have been confirmed by many empirical studies. After analysing the past literature on growth and inflation, Bruno & Easterly (1996) stated that early empirical studies up through the 1980s found almost no relationship between growth and inflation. They further discussed that only after the 1980s did the literature find some growth-inflation nexus; however, the short-run or long-run relationship between them remains unresolved. In their own research, they found no relationship below an inflation rate of 40 per cent, and a short to medium-term negative relationship with no permanent harm done to growth from a discrete inflation crisis.

Non-Linearity and the Notion of a Threshold Level of Inflation: We observed in the above section that the different levels of inflation affect economic growth differently. High and/or rising levels of inflation raise concerns that inflation, if uncontrolled, may be detrimental to

growth. It is also possible, particularly during periods of financial crises, that higher levels of inflation could create more space for policy makers to use monetary policy to effectively manipulate interest rates. According to the NAIRU (non-accelerating inflation rate of unemployment) approach, nominal demand disturbances are "neutral," affecting both output and inflation in the short (and medium) run, but only inflation in the long run. Over-expansion of nominal demand would lead to inflation that would erode real balances and redirect the economy toward the NAIRU, and vice versa. Therefore, it is argued that "in the long-run, a moderate steady rate of inflation permits maximum employment and output" (Akerlof, Dickens, Perry, Gordon, & Mankiw, 1996, p. 2). Given this background, it is vital for policy makers to identify the level at which should inflation be a concern. The following discussion addresses this concern taking some empirical evidences into consideration.

Fischer (1993) was the first to identify a non-linear relationship, where by low inflation rates have a positive impact on growth that becomes negative as inflation increases. The study argued that inflation reduces growth by reducing investment and productivity growth; budget deficits also reduce both capital accumulation and productivity growth. Espinoza, Leon, & Prasad (2012) estimate a nonlinear growth regression for 165 countries using data for the period 1960-2007. Their results show that for developing countries, inflation above 10 per cent damages growth; however, they are unable to find such a specific threshold for developed economies. Espinoza, Leon, & Prasad (2012); Sarel (1996) explores the possibility of nonlinear effects of inflation on economic growth in 87 countries using annual data for the period of 1970-90. The study finds the point of the structural break at 8 per cent inflation.

Mohanty et al. (2011) examines the existence of a threshold level in the relationship between the inflation rate and real GDP growth in India. In view of the structural changes in the Indian economy and also in contrast with most of the earlier studies based on annual data, they use quarterly data from the first quarter of 1996-97 to the fourth quarter of 2010-11. The findings suggest that for India, the inflation threshold in the sense of a structural break point between 4.0 and 5.5 per cent does exists, implying a non-linear relationship (Mohanty et al.; 2011). Another study on India using annual data, confirms the presence of a threshold level of inflation at 6 per cent (Singh P. , 2010, p. 6). Although 6 per cent is out of the comfort rage of the Reserve Bank of India, it is still it is below the present level of inflation. Singh & Kalirajan (2003) undertake an empirical analysis, using annual data for the period of 1971-1998, to identify the threshold inflation rate for India. Surprisingly, they find no structural breaking point; instead, the study reveals that any level of increase in inflation has a negative effect on economic growth. Mubarik (2005) estimates the threshold level of inflation for Pakistan using annual data for the period 1973-2000. The estimated model suggests a 9 per cent threshold level of inflation (Mubarik, 2005)

According to a very recent study by Seleteng, Bittencourt, & Eyden (2013) on the Southern African Development Community (SADC) reveals a threshold level of 18.9 per cent, above which inflation is detrimental to economic growth. This paper uses panel data for the period 1980-2008 to examine the inflation–growth nexus and utilises the Panel Smooth Transition Regression (PSTR) method to examine the inflation-growth nexus.

Several other studies by Judson & Orphanides (1999); Ghosh & Phillips (1998); (Khan & Senhadji (2001) have confirmed similar structural breaks in the growth-inflation relationship. Furthermore, these studies have found different threshold levels of inflation for developed and developing countries. Khan & Senhadji (2001) find a very low (1 per cent) threshold level for industrialised countries and an 11 per cent threshold for developing countries. Among other studies, Ghosh & Phillips (1998) show a 2.5 per cent level and Judson & Orphanides (1999) find a level in the double digits level. These findings have basically induced policy makers to keep the inflation rate below the structural breaking point.

3. The Growth-inflation Relationship and the Inflation Threshold Level for Sri Lanka

Given the above confusing empirical evidence and the complex nature of the growth-inflation nexus at a global level, it is quite difficult to come to a clear conclusion as to how inflation affects growth in Sri Lanka without a thorough investigation. By surveying the available empirical evidence as well as using our own estimates, in this section, we attempt to understand the plausible relationship between the two and then try to identify a threshold level of inflation for Sri Lanka, if indeed one exists.

The rate of inflation measured by Colombo Consumer Price Index (CPI) in Sri Lanka was markedly low during the period of 1948-1966. Inflation rates of 0.7 per cent in the 1950s and 2.2 per cent in the 1960s were the lowest of all the decades and lower than that of a number of developing countries, every other South Asian country, and perhaps some industrialised countries. The country managed to maintain single-digit inflation during these two decades, even posting negatives rates in some years. However, it experienced moderately high inflation at 6.9 per cent (still at single digit levels) in the 1970s. With the introduction of open economic policies in 1977, this moderate trend has changed. The highest inflation rate recorded to date was 26.1 per cent in 1980, while the entire decade of the 1980s recorded the highest average rate of 12.8 per cent. Inflation declined to 10.84 per cent in the last decade, from 11.25 per cent in the 1990s. In the last four-year period, the average inflation hovered approximately 6 per cent (see figure below).

During the last five decades, the Sri Lankan economy grew at an average annual rate of 4.2 per cent. The per capita income, in nominal terms, has increased from Rs. 397 (US$120) in 1948 to Rs. 373,001 (US$2923) in 2012. The last decade (covering the period 2000-2009) recorded 5.0 per cent growth (4 per cent per-capita growth) showing a small decline from the growth rate of 5.3 per cent (4.4 per cent per-capita growth) during the 1990s. The growth rates remained consistent and unchanged at approximately 4.0 per cent (approximately 2 per cent per-capita income) in the 1960s, 1970s, and 1980s, while the lowest growth rate of 3.4 per cent was recorded in the 1950s. The introduction of neo-liberal policies in 1977 sought to accelerate long-run growth; “contrary to expectation”, it did not facilitate high growth performance in the following decade Lakshman (2010, p. 338); Sarvananthan (2005, p. 25). It is worth mentioning that the last decade’s growth rate would have been higher than 5.0 per cent in the absence of the negative growth of 1.5 per cent recorded in 2001. This negative growth was caused by several factors, including the political unrest that prevailed in the country (particularly the terrorist attack at the Katunayaka International Airport), prolonged drought and subsequent power cuts, the terrorist attack on World Trade Center and the subsequent global recession. Having recovered in 2002 from

the negative growth in the previous year, the economy continued to grow gradually, reaching 7.7 per cent growth in 2007. The situation has since changed due to unfavourable commodity and oil prices starting in 2007 and the global financial crisis beginning in September 2008 (IPS, 2010, p. 9). A pattern of increased annual growth (of 7.5 per cent) exhibited again in the last three years, implying that the country may be heading into a high growth era.

Figure 1: Inflation and growth for Sri Lanka, 1950-2012 about here

Although the above figure 1 shows an upward trend in both growth and inflation over the last five decades, it is difficult to establish a strong linear relationship between growth and inflation in Sri Lanka. Data relating to the different levels of inflation and per capita growth rates during the period from 1960 to 2010 show that per capita growth increased simultaneously with inflation until the latter reached 4.01 per cent (see table below); above the level of 4.01 per cent, there was an inverse relationship between inflation and growth. Similar trend exhibits in GDP growth as well when it reaches 5.25 per cent. The data suggests that there is an observable non-linear relationship between growth and inflation in Sri Lanka. Hayat and Kalirajan (2009: p. 5) find a similar non-linear relationship for Bangladesh for the period of 1976-2005. In this context it is vital for policy makers to discover the growth maximising level of inflation. The following table reveals such a rate for Sri Lanka.

Table 1: GDP Growth, GDP Per-Capita Growth and Inflation Relation (1960-2010) about here

In order to have comparative picture, we computed threshold level of inflation for other South Asian countries using data from World Development Indicators Database of the World Bank. Although the threshold level is given in a rage, we take the averages for easy reference. For example threshold level for Sri Lanka is within 7.4-9.6 (see table 1), and average is 8.5. The figure 2 reveals that Sri Lanka has the highest threshold level while India has the lowest (5.2 per cent) with higher growth of 6.1 per cent. Bangladesh, Nepal and Sri Lanka show relatively high threshold level (approximately 6 or above) with low economic growth (approximately 5 or below) while Bhutan, India, and Pakistan show low threshold level (below 6 per cent) with high (above 6 per cent) economic growth rate. With South Asian experience, one can conclude that countries with low threshold level of inflation tend to grow at higher rate than with high threshold level.

Figure 2: Threshold Level of Inflation: Sri Lanka Compared with Other South Asian Countries about here

4. Methodology and Data

To examine the inflation-growth nexus in Sri Lanka we propose the following model based on the works of Barro (1991 and 2001); Bruno & Easterly (1998); De Gregorio (1992); Hayat & Kalirajan (2009); Levine & Renelt (1992); Levine & Zervos (1993); Sala-i-Martin (1997), and Singh & Kalirajan (2003). Many of the quantitative studies we reviewed have highlighted inflation, education and health related variables, initial growth levels, capital formation (both human and physical), agriculture value addition, export growth, and money supply as the main determinants of growth, among others. Life expectancy and literacy rates also affect growth through human capital development. Those who have included human capital argue that economic growth proceeds at a faster pace with the availability of better human

and physical capital. The capacity of a country to adapt efficient technology, skills and know how is determined by the physical and human capital at its disposal. Human capital, education and health are more likely to contribute to GDP by improving productivity. Thus, literacy rates and life expectancy at birth have been used as explanatory variables in many studies, thereby acknowledging the importance of human capital.

The present model utilises those potential growth variables suggested in the literature together with some dummy variables to capture country-specific characteristics such as natural disasters and internal conflict. In theory, the past growth and inflation have caused the present growth and inflation, and there may be dual causality between growth and inflation. Therefore, the study employs the Vector Autoregressive Model to explore the dual causality and lag effects. Accordingly, the proposed VAR model takes the following form:

$$YPC_t = \alpha_1 + \beta_{1i}P_{t-i} + \beta_{2i}YPC_{t-i} + \beta_3 AGVI_t + \beta_{4t}GCF_t + \beta_{5t}X_t + \beta_6 LR_t + \beta_7 M2_t + \beta_8 D1972_t + \beta_9 D2001_t + \epsilon_t \quad (1)$$

$$P_t = \alpha_1 + \beta_{1i}YPC_{t-i} + \beta_{2i}P_{t-i} + \beta_3 AGVI_t + \beta_{4t}GCF_t + \beta_{5t}X_t + \beta_6 LR_t + \beta_7 M2_t + \beta_8 D1972_t + \beta_9 D2001_t + \epsilon_t \quad (2)$$

Where,

YPC_t = Growth in GDP per capita at constant price at period 't'
P_t = Rate of inflation at period 't'
$AGVI_t$ = Growth in agriculture value addition (as % of GDP) at period 't'
GCF_t = Growth in gross capital formation (as % of GDP) at period 't'
X_t = Growth in export (as % of GDP) at period 't'
LR_t = Growth in literacy rate (%) at period 't'
$M2_t$ = Growth in broad money supply at period 't'
$D1972_t$ = Dummy variable, equal 1 for year 1972 (to capture insurrection in 1971) otherwise 0
$D2001_t$ = Dummy variable, equal 1 for year 2001 (to capture negative growth figure) otherwise 0

Our empirical model uses the data obtained from World Development Indicators (WDI) and Central Bank of Sri Lanka (CBSL) for the period 1960-2010. The data for literacy rate, taken from the CBSL is not available consistently; therefore, the missing data is extrapolated based on the average annual growth rate.

5. Estimation Results and Analysis

According to Granger and Newbold (1974), non-stationary time series data often lead to spurious results. Therefore, the data series must be stationary to make a meaningful econometric estimation, particularly when using long time series data. In this study, the Augmented Dickey-Fuller test was employed for testing the time series data are stationary. The table below shows the unit root test results for all the variables of the basic model. The tests were carried out in all three formats, i.e. (a) levels, (b) 1st difference, and (c) 2nd difference. The test results given in Table 2 indicate that all variables are stationary at levels.

Table 2: Unit Root Test is about here

We attempt to identify a model with higher explanatory power for analysing the relationship between growth and inflation. The estimation was begun with a VAR model with three lagged variables for inflation and per capita GDP growth separately. Subsequently, other important control variables have been incorporated into the model to test the robustness of the inflation coefficient following Hayat & Kalirajan (2009, p. 9).

Table 3: Vector Autoregressive Model (VAR) about here

According to the results in Table 3, only the inflation lag of one period shows a significant positive impact on current inflation, but there is no significant impact of lag variables on per capita GDP growth. All other lag variables are statistically insignificant in terms of both per capita GDP growth and current inflation because their p-values are a great deal higher than the 10 per cent significance level. In model 3, other important factors that may potentially affect per capita GDP growth and inflation were added to enhance the explanatory power of the model. The results of model three show that inflation spurs growth more than growth spurs inflation. Model 3, with YPC as the dependent variable, was selected as the best model to analyse the inflation-growth relationship and threshold level of inflation in Sri Lanka, because most of the important determinants of per capita GDP growth are significant and recorded the highest adjusted R^2.

The YPC data shows that some uncommon fluctuations occurred in the years 1972 and 2001 due to socio-economic reasons such as the 2001 economic slow-down and youth insurrection in 1971. Therefore, dummies were added to model three to avoid the outlier effects. The important feature of the above model is that the inflation has positive significant relationship with YPC. This model also shows a highly positive relationship between agriculture value addition growth and YPC, as was expected. Current capital formation has not significant impact on economic growth but the capital formation lag of one period shows a positive relationship with YPC at the 10 per cent significant level. It indicates that capital formation takes time to exert influence on growth. The model also exposes the significant positive contribution of export growth to YPC.

Table 4: Estimation of threshold level of inflation about here

The threshold level of inflation has been examined by Sarel (1996) for 87 countries, Singh & Kalirajan (2003) for India, Mubarik (2005) for Pakistan and later Hayat & Kalirajan (2009) for Bangladesh by utilizing a well specified functional form. This study follows those models in general and Hayat & Kalirajan (2009) in particular to examine the threshold level of inflation for Sri Lanka. Accordingly, the dummy variables are introduced to the basic model to incorporate the concept of extra inflation. The "EXTRA" dummy variable is defined as follows:

$$EXTRA_i = \text{if } INF_t > INF_i^* = 1, \text{otherwise equal to } 1 \quad (3)$$

Where, INF_i^* presents the rate of inflation at which structural break occurs. INF_t is the actual rate of inflation at period 't'. Then EXTRA dummy variable is equal to 1 in case of $INF_t > INF_i^*$ and it is equal to 0 if $INF_t < INF_i^*$.Therefore, the estimator of inflation is equal to only coefficient of inflation (INF_t) variable when $INF_t < INF_i^*$ otherwise it takes the sum of two

coefficients of INF and EXTRA variables. It is argued in the literature "that after running iterative regressions at different chosen threshold values, the significant structural break occurs where R^2 and F-value are the highest" (Hayat & Kalirajan, 2009, p. 8). It is also required that the sum of the coefficients of both the INF and EXTRA variables be positive and statistically significant to be considered as the threshold level of inflation.

The regression results in table 4 show that the coefficients for EXTRA12 and current inflation are statistically significant, but that the other EXTRA11 coefficients are not significant in the respective regressions. Therefore, it can be interpreted that the structural break occurs at the 12 per cent level of inflation in the Sri Lankan economy. The results of the Wald test that was employed to estimate whether structural break occurs at 12 per cent, also indicates that the sum of coefficients of inflation are statistically significant at the 12 per cent level. As the sum of the coefficients' values is negative at a 12 per cent level of inflation and it is statistically significant in the Wald tests. It may be concluded without doubt that there is a threshold level of inflation for Sri Lankan at the 11 per cent level of inflation, and beyond that the growth inflation nexus becomes negative.

Table 4: Wald Test Results about here

6. Concluding Remarks and Policy Implications

This study found a non-linear relationship between inflation and growth in Sri Lanka. This is contradictory to the general belief on the relationship between the two in Sri Lanka. Growth increases with inflation, showing a positive relationship up to 11 per cent of inflation; from that point, growth becomes negative if inflation continues to increase. This implies that in Sri Lanka, there is a significant structural break of inflation at 12 per cent level. Based on this finding, one may argue that inflation does not have a negative growth implication as long as the government can maintain inflation at 11 per cent or lower. Our finding justifies the goal of the Ministry of Finance and Planning (MOFP) to maintain inflation at the single digit level. The belief that inflation is always harmful to economic growth is supported by neither the theoretical argument nor the empirical findings of this study.

The paper further found that GDP growth and per capita GDP maximising inflation rate for Sri Lanka falls between 7.4-9.6 per cent. Therefore, the unofficial target of 6 per cent annualised inflation set forth by the Central Bank is quite close to our findings. However, it may not be desirable in the short-run to set a very low inflation target, as this may generate a negative impact on growth.

Our estimates reveal that Sri Lanka has the highest level of inflation rate, which maximises GDP and per capita GDP growth in South Asia, at 7.4-9.6 per cent (average 8.5 per cent) level with economic growth of 5.24 per cent. India has the lowest figure of 3.7-6.1 per cent (average 4.9 per cent) with economic growth of 6.1 per cent. Bangladesh, Nepal and Sri Lanka show relatively high threshold level (approximately 6 or above) with low economic growth of approximately 5 or below. Bhutan, India, and Pakistan show low threshold level (below 6 per cent) with high (above 6 per cent) economic growth rate. With South Asian experience, one can conclude that countries with low level of inflation tend to grow at higher rate than with high inflation threshold level. The threshold level of inflation in

developing countries is comparatively higher than that of developed countries. Khan and Senhadji (2001) found a very low (1 per cent) level of inflation for industrialised countries and an 11 per cent for developing countries.

In light of the above, price stability is a vital factor in stimulating the Sri Lankan economy because inflation has a negative relationship with economic and per capita growth if it goes beyond an 11 per cent. Therefore, the Central Bank of Sri Lanka (CBSL) must play a vital role in controlling inflation within a viable range. Then the large problem is what inflation rate should CBSL be pursued to stimulate the economy. Based on our empirical findings any inflation rate between 7.4-9.6 per cent can be recommended as more appropriate (or moderate steady rate of inflation) level for Sri Lanka at least in the short-run, because between these levels, the GDP and per capita GDP growth are the maximum.

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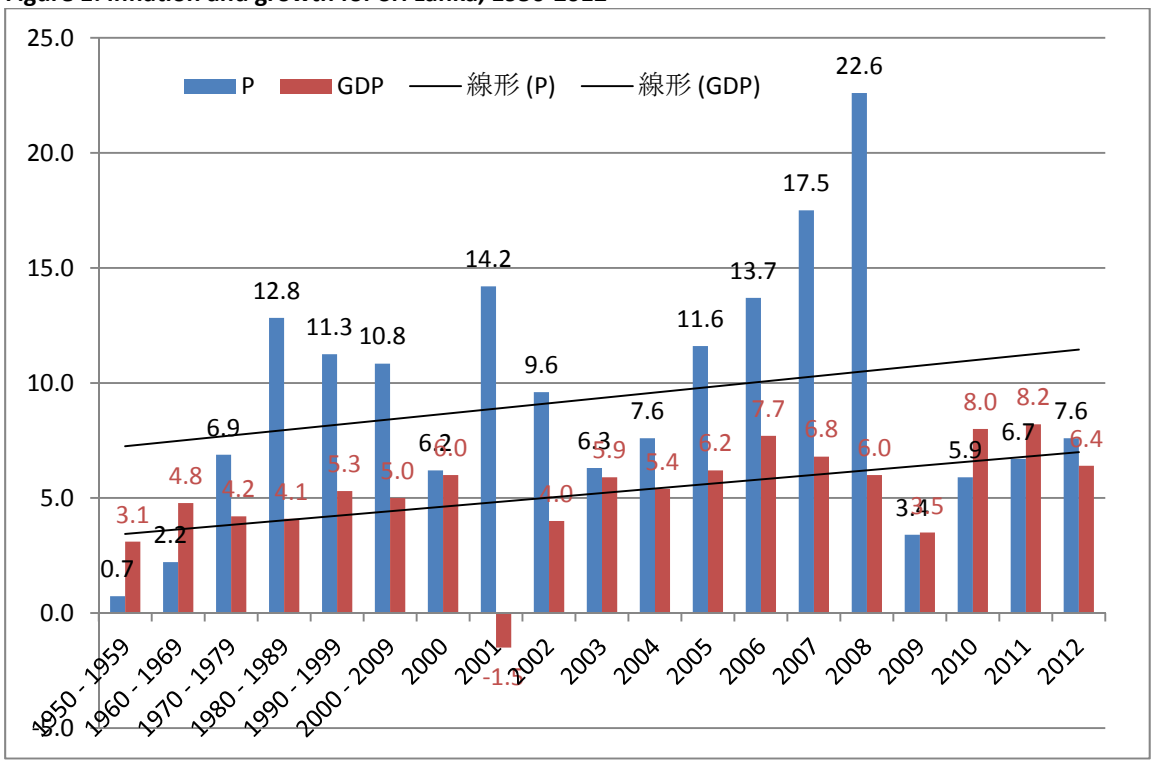
Figure 1: Inflation and growth for Sri Lanka, 1950-2012



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

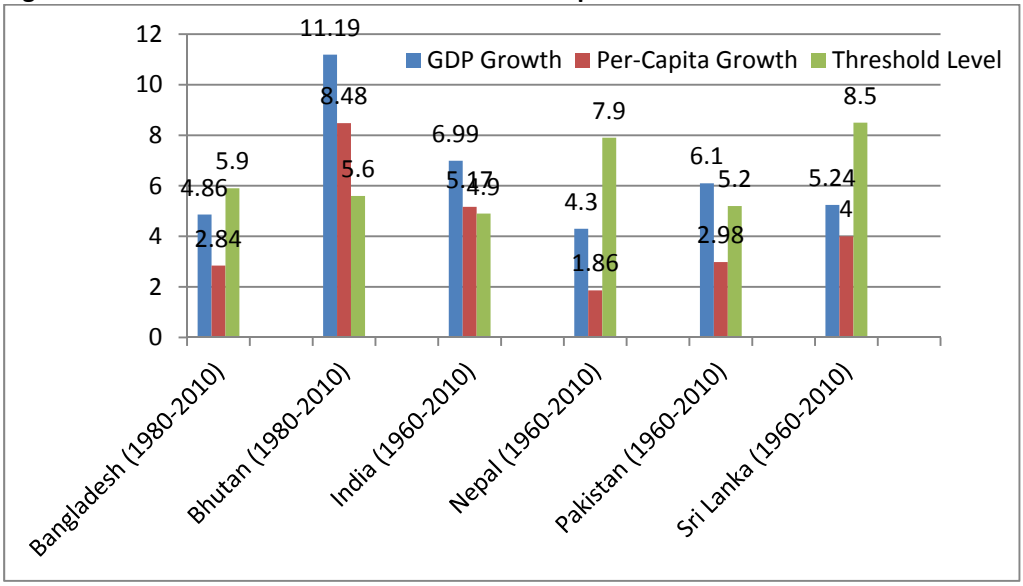
Notes: Inflation data is based on Colombo Consumer Price Index, CCPI (base year 1952=100 until 2007 and 2002=100 since 2008).

Table 1: GDP Growth, GDP Per-Capita Growth and Inflation Relation (1960-2010)

Inflation Range	Frequency	Per-Capita Growth	GDP Growth
- 1.6 - 3.4	13	1.61	3.78
4.7 - 6.7	8	3.45	4.95
7.4 - 9.6	10	4.01	5.25
10.0 - 12.3	10	3.78	5.22
13.7 - 26.1	10	3.27	4.53

Source: Computed by the author base on the data obtained from the Central Bank of Sri Lanka Annual Report (various issues)

Figure 2: Threshold Level of Inflation: Sri Lanka Compared with Other South Asian Countries



Source: Computed by the author using data from World Development Indicators

Table 2: Unit Root Test

Variable	Level	1st Difference	2nd Difference
YPC	-5.1972*** (0.0001)	-10.7765*** (0.0000)	-5.5621*** (0.0000)
P	-4.2325*** (0.0015)	-9.4390*** (0.0000)	-6.7762*** (0.0000)
LR	-3.9929*** (0.0031)	-9.0616*** (0.0000)	-6.1892*** (0.0000)
AGVI	-6.7609*** (0.0000)	-9.2311*** (0.0000)	-10.0626*** (0.0000)
GCF	-5.9403*** (0.0000)	6.0654*** (0.0000)	-7.4984*** (0.0000)
X	-2.7238* (0.0776)	-10.3919*** (0.0000)	-5.7909*** (0.0000)
M_2	-4.1136*** (0.0022)	-10.6978*** (0.0000)	-9.7384*** (0.0000)

Notes: *** Significant at 1% level, ** Significant at 5 % level, * Significant at 10% level
Values in brackets are p-values. All variables are stationary at their levels. See section four for variable explanation.

Table 3: Vector Autoregressive Model (VAR)

Variable	Model 1		Model 2		Model 3	
	YPC	P	YPC	P	YPC	P
YPC (-1)	0.1706	0.3674	0.1759	0.3779		
YPC (-2)	0.0871	0.0942	0.0906	-0.0746		
YPC (-3)			-0.0849	0.1218		
P (-1)	0.0315	0.3989**	0.0310	0.3813**	0.0997**	0.4760**
P (-2)	0.0593	0.0320	0.0581	-0.0063		
P (-3)			0.0153	0.0362		
AGVI					0.1919**	-0.1052
GCF					0.0255	0.0635
X					0.0619**	-0.0075
LR					0.0167	-1.2766
M_2					-0.0088	0.0752
Constant	1.6223**	3.7476**	1.7421**	4.2055**	1.5494**	3.7973**
Adj : R^2	0.064	0.170	0.011	0.103	0.222	0.184

Table 4: Estimation of threshold level of inflation

Variable	Model 4
	YPC
P	0.0730*
AGVI	0.1816***
CF (-1)	0.0337***
EX	0.0384*
M_2	- 0.0216
D_{1970}	- 2.1797*
D_{1972}	- 4.6483***
D_{2001}	- 5.6383***
AR(1)	0.4625***
C	2.4423***
Adj; R^2	0.59
D/W	1.83

***, **, * denote significant at 1%, 5%, and 10% level, respectively

Table 4: Wald Test Results

Model	Sum of Coeff:	H_0 of Wald Test	P - Value
Extra11	C(2)+C(10)= - 0.92	C(2)+C(10)=0	0.1110
Extra12	C(2)+C(10)= - 1.02	C(2)+C(10)=0	0.0981*