

The Main Determinants of Inflation in Sri Lanka

A VAR based Analysis

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Abstract

This paper attempts to examine the main determinants of inflation in Sri Lanka over the period 1980 – 2005 using Vector Autoregressive analysis. The results presented in this paper indicate that money supply growth and rice price increases are the main determinants of inflation in Sri Lanka in the long run. In contrast, It is evident that exchange rate depreciation and out put gap have no statistically significant effect on inflation. In the short run, rice price is the most important variable as it is a totally endogenous variable. However, money growth and exchange rate are not so important variables as they are weakly exogenous in the adjustment process. Output gap does not have a statistically significant effect on inflation in both the long run and the short run.

I. Introduction

There is a widespread agreement that high and volatile inflation can be damaging both to individual businesses as well as to consumers and hence, to the economy as a whole. Persistent inflation in goods and services can result in high social costs, too.

When inflation is volatile from year to year it becomes difficult for individuals and businesses to correctly predict the rate of price inflation in the near future. When people are able to make accurate predictions of inflation, they can anticipate what is likely to happen and take steps to protect themselves. Therefore, identification of determinants of inflation and forecasting accurately becomes vital for the economic agents. Accurate predictions of inflation could also enable the Central Bank to conduct its monetary policy effectively and efficiently to achieve its objective of price stability. This study, is aimed at identifying the main determinants of inflation in Sri Lanka.

Inflation Measures in Sri Lanka

Inflation is measured using a number of indices such as Colombo Consumers' Price Index (CCPI), Colombo District Consumer Price Index (CDCPI), Greater Colombo Price Index (GCPI), Wholesale Price Index (WPI) and Sri Lanka Consumer Price Index (SLCPI). The CCPI is the official measure of price changes with food items representing 62 per cent, clothing 9 per cent, fuel and light 4 per cent, rent 6 per cent, miscellaneous 19 per cent in total weights. Food is an important item in all of the indices representing relatively larger portion in all of the above mentioned baskets.

Theoretical background

Inflation is a multidimensional phenomenon with different views of economists. Orthodox view holds that inflation results from money creation by governments with limited borrowing options. New structuralists' views are different. They maintain that inflation results from the worker – capitalist conflict over the distribution of income between real wages and profits. The new structuralists' approach links between stresses the importance of the inflation, food supply and competing claims for the distribution of income. According to their model of inflation, monetary policy accommodates changes in the price level. In this model, the link between prices, money supply, and fiscal deficits are captured by introducing food subsidies, which account for the government budget constraint.

II. Literature Review

Several attempts have been made to investigate the determinants of inflation in several countries.

Bandara (2000) investigated the short run dynamics of the inflation, using a cointegration approach and found that both money supply and exchange rate movements have significant influences on the behaviour of the rate of inflation in the long run. Based on the error correction model he indicated that money supply doesn't have any significant impact on the rate of inflation. The OLS model he used is $\text{Log}(p_t) = \alpha_0 + \alpha_1 \log(P^F_t) + \alpha_2 \log(e_t) + \alpha_3 \log(M_t) + U_t$ and variables are foreign price (P^F_t), Money supply (M_t) and Exchange rate (e_t). While the exchange rate depreciation and the foreign price levels have significant effects, the driving force behind domestic inflation appears to be inflation inertia.

Chaudhry and Chaudhry (2005) examined the determinants of inflation in Pakistan using ARDL approach to cointegration using the following model:

$$\text{Log}(p_t) = \alpha_0 + \alpha_1 \log(m_t) + \alpha_2 \log(Y_t) + \alpha_3 \log(F_t) + U_t$$

p_t = Price level, Y_t = real output put,
 m_t = M_2 definition of money supply, F_t = unit price of imported goods

They found that the growth rate of import prices is the most important determinant of inflation in Pakistan both in the short run and long run, which is followed by the growth rate of output in terms of importance. The effect of Money supply on inflation is negligible and statistically insignificant.

Samuel and Ussif (2001) investigated determinants of inflation in Tanzania OLS estimation and Error correction model.

$$\text{Log}(p_t) = \alpha_0 + \alpha_1 \log(M_t) + \alpha_2 \log(GDP_t) + \alpha_3 \log(EXRATE_t) + U_t$$

In this model, the variables are price level (p_t), money supply (M_t), GDP (GDP_t) and exchange rate ($EXRATE_t$). They found that in Tanzania, output and monetary factors are the main determinants of inflation. In addition, the exchange rate also becomes a significant variable in inflation in the long run.

Determinants of Inflation in Sri Lanka

Determinants of inflation in Sri Lanka are grouped into the following categories, based on different models of the inflationary process. Inflation in developing countries is often linked to money growth (M_2).

- (a) Overheating economy and its influence by an activity variable (output gap).
- (b) Exchange rate depreciation (USD/SLRS rate)
- (c) Climatic changes (Rice Price).
- (d) Inertial component arising from the sluggish adjustment of inflationary expectations (CCPI).
- (e) Interest rate (91 day Treasury bill rate)

Methodology

Several statistical methods and econometric tests were carried out to explore the determinants of inflation in Sri Lanka. These include Unit root tests, Co integration tests, Vector Auto Regressive model, impulse response function, variance decomposition and Vector Error Correction Model (VECM).

VAR Model Representation

$$A_0 y_t = c + A_1 y_{t-1} + A_p y_{t-p} + \hat{a}_t$$

Where y_t is a (6) dimensional vector of variables: Output gap, Colombo Consumer Price Index, Rice Price, Interest rate, Exchange rate depreciation. A_0 is a (6*6) dimensional matrix with contemporaneous coefficients, c is a (6) dimensional vector of constants and A_1, \dots, A_p are (6*6) dimensional autoregressive coefficient matrices. \hat{a} is a vector of pair wise uncorrelated structural innovations with unit variance.

Data

The data used in this analysis is quarterly data over the sample period, January 1980 through February 2005. The software employed in this analysis is Eview 4.0.

Variables in the study are Colombo Consumers Price Index, GDP, Money Supply, exchange rate, Rice price, Interest rate.

III. Stationarity of series

Augmented Dicky fuller test (ADF) under Schwartz information criteria and the Philip Perron (PP) test under Bartlett Kernel and newly west bandwidth were conducted to test the stationary of the series. All the series except TB91 were obtained in Log form. The test results are given in the table.

Table 1 – Unit root test results

	ADF Test			Philip perron test		
	Lag	Level	Lag	First difference	Level	First difference
ln GDPSA	4	0.026482	3	- 3.66075 *	- 0.09584	- 11.1136 *
ln CCPI	4	- 1.69407	3	- 4.34113 *	- 1.90985	- 14.7036 *
ln M2	4	- 0.69465	3	- 3.56109 *	- 1.680448	- 9.77374 *
ln Rice Price	4	- 2.11159	3	- 5.54127 *	- 1.83094	- 8.99881 *
ln Exchange Rate	4	- 2.06576	3	- 8.98401 *	- 1.961024	- 8.98910 *
TB 91	4	- 3.29482	3	- 11.3389 *	- 3.23703 *	- 11.5046 *

* 1% critical value - 3.4940

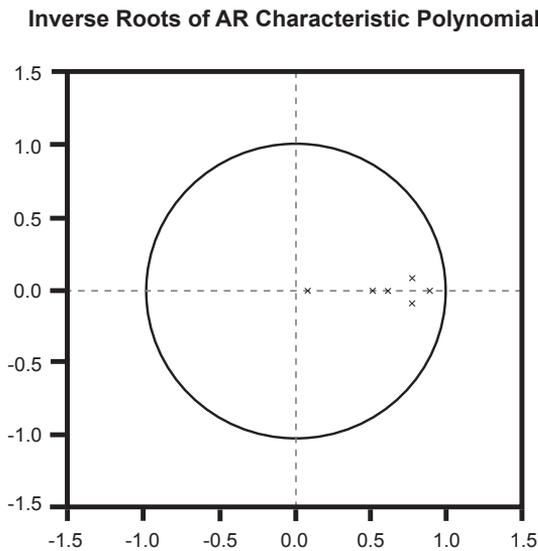
** 5% critical value - 2.8892

*** 10% critical value - 2.5813

It shows that all the variables are stationary at first differences at 1 per cent level. Both ADF and PP tests confirmed the results. However, the PP test shows that interest rate TB 91 is stationary at levels. Therefore, it could be said that TB91 is stationary at level while other variables are stationary at first differences.

Figure A shows that *gdpsa*, *ccpi*, *m2*, *Rice_p*, *Usd_rs* are integrated of order one and *Tb_91* is integrated at level. Stationarity of the series is confirmed by the graph of the inverse roots of AR characteristic polynomial as well. According to theory^{1/}, the estimated VAR is stable (stationary) if all roots have modulus less than one and lie inside unit circle.

The figure 1 shows that all roots of AR characteristics polynomial of the series lie inside the unit circle.



Co-integrating relations

Co integration test was performed for the series that are integrated at first difference. It has been shown by the Johanson Cointegration test that there is at least one cointegration vector in the series. Linear deterministic trend was assumed in the test.

1/ If the VAR is not stable, certain results (impulse response, standard errors are not valid).

Table 2 – Co-integration test results

Cointegrating relations		Trace	5 Per cent	1 Per cent	Max-Eigen	5 Per cent	1 Per cent
Null hypothesis	Eigen value	Statistics	Critical Value	Critical Value	Statistic	Critical Value	Critical Value
None	0.312695	68.95713	68.52	76.07	38.99767	33.46	38.77
At most 1	0.136102	25.95946	47.21	54.46	15.21526	27.07	32.24
At most 2	0.093073	14.74420	29.68	35.65	10.16011	20.97	25.52
At most 3	0.041328	4.584088	15.41	20.04	4.389504	14.07	18.63
At most 4	0.001869	0.194584	3.76	6.65	0.194584	3.76	6.65

Trace statistics for null hypothesis for no cointegration relations is rejected at 5 per cent level. It is confirmed from the Maximum –Eigen statistic, that the null is rejected at the 1 per cent and 5 per cent levels. This implies that there is a cointegrating relationship among the variables.

IV. Long run relationship

The results of the Unrestricted cointegration rank test confirmed that there is a long run significant relationship among CCPI, money supply, exchange rate, and rice price. All the series are in natural logarithmic form. The coefficients measure the long run income, money supply, exchange rate and rice price elasticities respectively. A percentage increase in money supply will raise inflation by 0.49 per cent at 1 per cent level. Also, one percentage increase in rice price will increase inflation by 0.33 per cent at 1 per cent level. In line with theory, these tests demonstrate that in the long run, Inflation in Sri Lanka is positively related money growth, and rice price. However, the relationship between inflation and exchange rate depreciation and GDP is not significant. The findings of this study relating to Money supply growth and exchange rate depreciation are consistent with the findings of Amarakoon Bandara(2000). However it is I have observed inconsistent results for exchange rate depreciation with his findings. Amarakoon Bandara (2000) found that exchange rate depreciation has a significant long run impact on inflation where as my study reveals that has no statistically significant impact. Both studies that Amarakoon Bandara’s and this agree that Money supply growth has a significant effect on inflation in Sri Lanka.

Table 3 – Cointegrating relationship
Dependent variable : CCPI

Regressor	Coefficient	Standard error	T-ratio
LNGDPSA	-0.118221	(0.26011)	(0.45450)
LN_M2	0.494197	(0.09396)	(-5.25974)*
LNUSD_RS	0.136229	(0.09682)	(-1.40699)
LN_RICE_P	0.332155	(0.05986)	(-5.54843)*
Constant	-1.296057		

* Significant at 1 per cent level.

Unrestricted Vector Autoregressive Model

The Unit root test results show that variables are integrated at order and lower. Thus we can apply VAR method for estimation.

Unrestricted Vector Autoregressive Model was estimated using following variables.

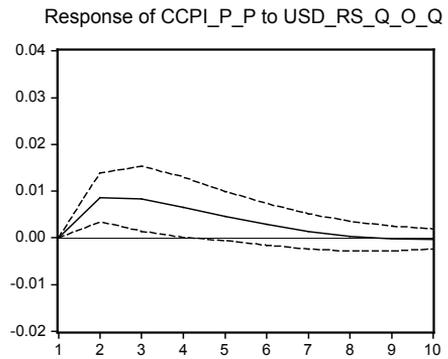
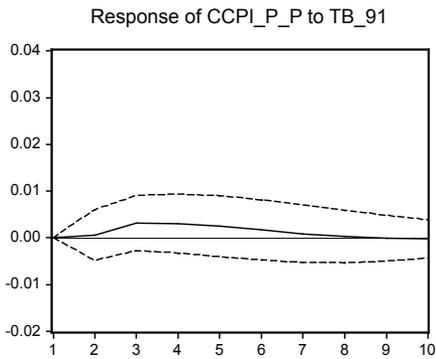
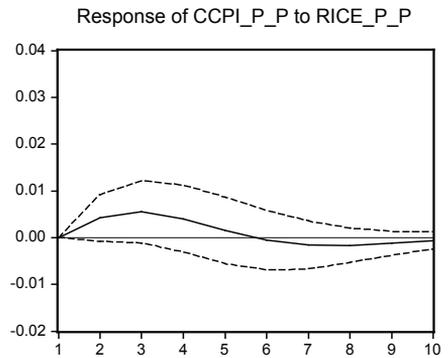
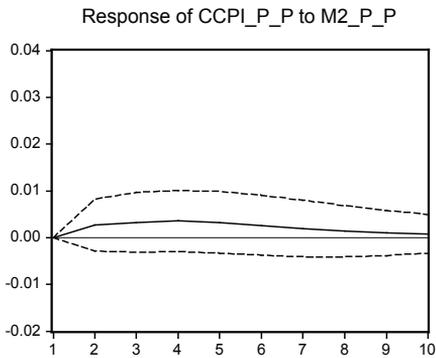
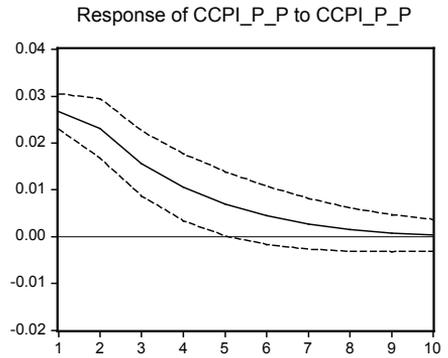
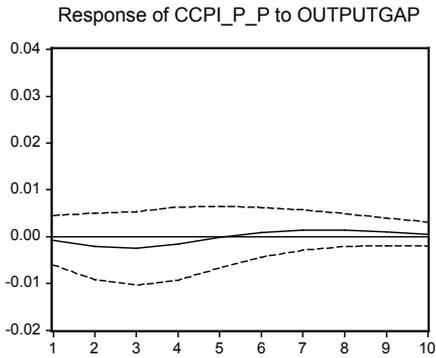
VAR specification variables :

- (1) Output gap : Derived from Seasonally adjusted log form GDP – Using HP filter (Output gap).
- (2) CCPI – point-to-point growth (ccpi_p_p)
- (3) Money Supply – M_2 – point-to-point growth (m2_p_p)
- (4) Rice price – point-to-point growth (rice_p_p)
- (5) Interest rate – 91-day Treasury bill yield (tb_91)
- (6) Exchange rate depreciation – quarter-on-quarter growth (usd_rs_q_o_q)

Impulse Response

This section analyses the dynamic property of the model using variance decomposition and impulse response functions. Figure 2 shows the response of the inflation rate to a standard deviation shock to the output gap, money supply, rice price, 91 day treasury bill rate, and exchange rate. The x-axis gives the time horizon or the duration of shock whilst the y-axis gives the direction and intensity of the impulse or the per cent variations dependent variable.

Response to One S.D. Innovations ± 2 S.E.



Analytic (Asymptotic) simulations within one hundred repetitions from the unrestricted VAR were used to generate the standard error for the impulse and variance decomposition coefficients.

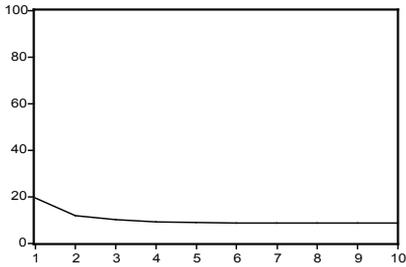
The impulse responses meet a priori expectations in terms of the directive of impact a positive shock to output gap represent the aggregate supply relationship. A positive shock to output gap will have a contractionary effect on inflation in the initial 5 periods and expansionary effect on periods later on. This is consistent with the theory that increase in output will reduce the price level. The response of direct shock (CCPI) to the inflation such as expectations and discrete price adjustments resulting from increased mark-ups, removal of subsidies etc. will have a significant effect in inflation high in the first quarter then it declines gradually. The response of inflation (CCPI) to money supply (M2_P_P) shows that the effect of one standard deviation shock to money supply on the CCPI occur after first period and reached its peak between 3–5 periods after and stabilizes thereafter. The impact of the rice price has a rather immediate and positive effect on first 5 periods and it will show a negative effect after 6th period. The relationship between monetary policy reaction shows that Increase in 91 day Treasury bill rate will have a contractionary effect after 2nd period and will prevail for the 8th period. The impact of the exchange rate is rather immediate and reaches its peak during 2–3 periods and will prevail only for 8 periods. (new charts to be inserted)

Variance decomposition

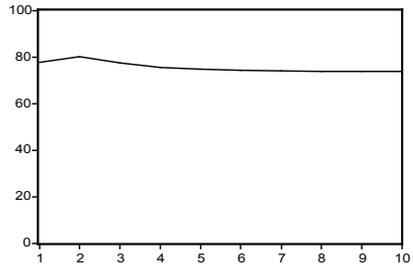
Figure 3 shows that the variance decomposition over the 10 Quarters. The statistics and graphs indicate the percentage contribution of innovations in each of the variables in the systems of the variance of inflation. About 80 per cent of the variance in inflation is from itself. This variance is partly reflecting the impact of variables not included in the model such as prices of imported goods etc. The results show inflation itself and the USD-Rs exchange rate depreciation account for over 90 per cent most of the variability in the inflation overall horizons. This implies that imports of commodities will have a relatively greater impact on the variation of inflation in Sri Lanka.

Variance Decomposition

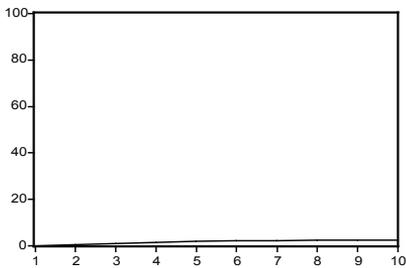
Percent CCPI_P_P variance due to OUTPUTGAP



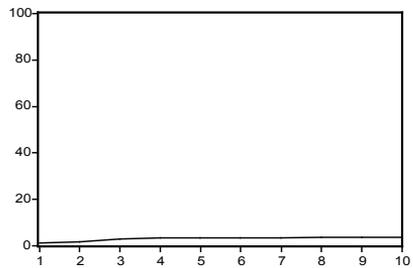
Percent CCPI_P_P variance due to CCPI_P_P



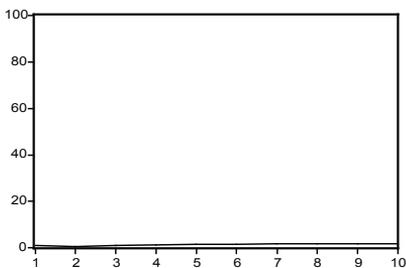
Percent CCPI_P_P variance due to M2_P_P



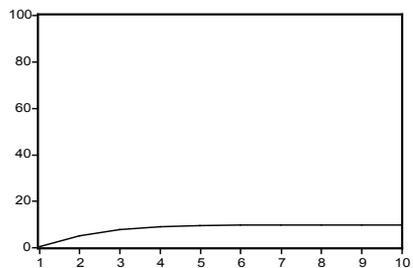
Percent CCPI_P_P variance due to RICE_P_P



Percent CCPI_P_P variance due to TB_91



Percent CCPI_P_P variance due to USD_RS_Q_O_Q



Vector Error Correction Model (VECM)

The short-run dynamics of the model using log form of ccpi, gdp, M2, USD_Rs exchange rate, rice price was examined by estimation of error correction model using the following model.

$$\Delta \ln_{ccpi}_t = \delta_1 + \gamma_1 (\beta_1 \ln_{gdpsa}_{t-1} + \beta_2 \ln_{m2}_{t-1} + \beta_3 \ln_{usd_Rs}_{t-1} + \beta_4 \ln_{rice-p}_{t-1}) + \beta_5 \Delta \ln_{ccpi}_{t-1} + V_t$$

Estimates of error correction representation is given in the table 4.

**Table 4 – Error correction representation of VECM model
Dependent variable D (LN_CCPI)**

Regressor	Coefficient	Standatd error	T-Ratio
Error correction term	-0.125841	(0.06341)	(-1.98443)*
D(LN_CCPI(-1))	-0.152034	(0.11337)	(-1.34099)
D (LN_CCPI (-2))	0.442314	(0.09479)	(4.66637)**
D (LNGDPSA(-1))	-0.116603	(0.16349)	(-0.71321)
D(LNGDPSA(-2))	-0.050264	(0.16522)	(-0.30424)
D(LN_M2(-1))	0.158496	(0.09913)	(1.59893)
D(LN_M2(-2))	0.289201	(0.10156)	(2.84763)**
D(LNUSD_RS(-1))	0.388893	(0.11755)	(3.30825)**
D(LNUSD_RS(-2))	-0.113653	(0.11773)	(-0.96534)
D(LN_RICE_P(-1))	0.098195	((0.3696)	(2.65707)**
D(LN_RICE_P(-2))	-0.145213	(0.03897)	(-3.72581)**
C	0.000652	(0.00741)	(-0.08809)
R-squared	0.574495		
Adj. R-squared	0.521904		
Sum sq. resids	0.045016		
S.E. equation	0.022490		
Log likelihood	246.3378		
Akaike AIC	246.5754		
Schwarz SC	246.8861		
Mean dependent	0.025427		
S.D. dependent	0.032526		

* Significat at 10 per cent level.

** Significat at 1 per cent level

Examination of the error correction model in table 4 indicates that the increase in the rice price has the strongest effect on inflation in the short-run which is followed by growth in money supply and exchange rate depreciation. The coefficient of the error correction term has correct sign and significant at 10 per cent level. However, the coefficient of the ECM term suggests that adjustment is quite slow. Approximately 13 per cent of the previous quarter's disequilibrium in inflation from its equilibrium path will be corrected in the current year. The R2 at 54 per cent indicate a fairly good fit. Money growth, exchange rate depreciation are weakly exogenous variables in the adjustment process. Only lag 1 of Money growth, and lag 2 of exchange rate depreciation are significant. Rice price is a totally endogenous variable. Therefore, the evidence presented in this section suggests

that inflation in Sri Lanka is mainly determined by Money growth increases in the price of rice and exchange rate depreciation in the long run and short run. Output growth is not an important determinant in the short run and the long run. Amarakoon Bandara (2000) found that exchange rate depreciation has a significant impact on inflation growth and money supply growth has a insignificant effect. In this study reveals both money supply growth and exchange rate depreciation have significant impact on inflation in short run.

V. Summary and conclusion

Identification of determinants of inflation and forecasting accurate inflation are vital for the economic agents. On the other hand it facilitates the central bank to conduct its monetary policy efficiently and effectively. This paper attempted to examine the determinants of inflation for Sri Lanka over the period 1980 – 2005 using VAR based cointegration approach.

The results presents in section IV of this paper indicate money supply growth and the increases in rice price are the most important determinants of inflation in Sri Lanka in the short run and long run. The effect of GDP growth and exchange rate depreciation on inflation negligible and statistically not significant. The short run effect of money growth, rice price and exchange rate effect on inflation is statistically significant. However GDP growth is not significant in short run too. It is obvious that the supply side effect on inflation in Sri Lanka is reflected through rice prices. Therefore, it is evident that inflation in Sri Lanka is influenced by both demand and supply side factors in the long run and short run.

The estimation results points to two policy considerations. First, money supply is to be maintained at desired level. Also, if the supply of rice can be raised the inflation will come down. This is because food accounts for more than 60 per cent of the weight used in the Colombo Consumer Price Index.

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