Supply-driven Factors of Inflation in Sri Lanka: An ARDL Approach

Tyrone De Alwis[1,*] and NJ Dewasiri[2]

[1]*Department of Economics, University of Colombo, Sri Lanka*

[2]*Department of Accountancy & Finance, Faculty of Management Studies, Sabaragamuwa University of Sri Lanka, Belihuloya, Sri Lanka*

ABSTRACT

Inflation has become one of the major enemies of the Sri Lankan economy today. This study focuses on the supply-driven determinants of inflation in Sri Lanka during 1977-2019. For this study, time series data is used using the technique of ARDL in order to determine the long-run and short-run determinants of inflation. The estimated long-run supply-driven variables are crude oil prices and exchange rate as they were impacting the inflating during the study period except the rice prices. However, the empirical findings indicated that crude oil prices, exchange rate and rice prices impacted inflation in the short-run. Even though Central Bank of Sri Lanka (CBSL) was confident about the controlling demand pressures, at the same time it needs to be cautious about the price pressures emanating from supply-side shocks. Policymakers need to vigilantly monitor each and every movement in the economy and sense the pulses of policy measures.

Keywords: Inflation, Exchange Rate, Rice Prices, ARDL, Error Correction, Co-integration

INTRODUCTION

The word "inflation" means persistent rise in the general price levels in the economy (Chaudhary & Xiumin, 2018; De Alwis & Dewasiri, 2022). It is the percentage change in the overall level of prices (Mankiew, 2010). Therefore, it is a state in which general price level is rising persistently and as a result the value of money is gradually falling down. The volatile inflationary situation in any economy is damaging the growth and development and also individual businesses and consumers at large (Mubarik, 2005; Weerasinghe, 2018). Inflation is a term which is widely considered by every nation as it has negative impacts on economy given the inflation level exceeds the above the accepted level (De Alwis & Dewasiri, 2022). Inflation is a very sensitive issue in the macroeconomic discipline and hotly debated economic topic among the policy makers and academia as it can do far reaching negative consequences (Paudyal, 2011). Based on the above premise it is the main target of every country to establish a low and relatively stable inflation condition in the economy. Among all the issues of the economy, inflation is one of the most important macroeconomic issues in any country. The issue of inflation is an important to Sri Lanka as the rising inflation has far reaching economic and social impacts. Due to higher price levels, people need more money to make day to day transaction and as result consumers need to take more money with them as the value of money declines.

Studies in relation to determinant of inflation especially supply-driven factors in Sri Lanka are limited to few empirical studies. Thus, many research gaps are still to be filled and it is hoped to bridge the research gaps through the present study. Further limited empirical studies are not being able to contribute much to tackle this burning issue in Sri Lanka.

This is a country specific study using Sri Lankan data to validate empirically the objectives that:

1. Find the link between supply-driven factors and inflation

2. Estimate the correlations between supply-driven factors of inflation in Sri Lanka

This paper is structured as follows. Section 1 is introduction, section: 2 presents an overview of inflationary situation in Sri Lanka, section 3 deals

with review of literature, section 4 elaborates model, variables, data and methodology and finally sections 5 and 6 examines the empirical results and conclusions respectively.

OVERVIEW OF INFLATIONARY SITUATION IN SRI LANKA

Sri Lanka has gone through a steady rise in inflation especially after 1977 as it moved from 2.2 percent in 1960s to 26.1 percent in 1980. There were various factors that contributed to this situation such as in addition to oil price shocks of 1979, the government policy of deficit financing, increased demand for credit by the private sectors, relaxing of price controls and abolishing of subsidies and depreciation of the exchange rate (De Alwis & Dewasiri, 2022). However, the demand management policies that were adapted to tame inflation to a certain extent were successful as the inflation was brought down to a single-digit towards 1987 period. Inflation accelerated to peak level of 21.5 percent in 1990 due to depreciated currency together with upward revision of paddy prices, rise in fuel priced due to Gulf Crisis. Inflation dropped to its lowest in 1997 reaching 4.7 percent during which period it was a single-digit. However double-digit period started again in 2005 and this trend continued till 2008 reaching second highest in Sri Lanka at 22.6 percent. Inflation towards 2009 dropped to 3.5 percent due to favourable developments emanated from both supply and demand side factors. Further the Central Bank of Sri Lanka adopted strict monetary policy measure to tame double-digit inflation in the country. The annual average inflation had an upward movements in 2011 compared to 2010 and 2009. This was due to supply-side shocks yet it returned to single-digit in 2013 at 6.9 percent. Years 2015,2016, and 2017, on the contrary, indicated the opposite direction as the price levels measured using both the National Consumer Price Index(NCPI) (NCPI 2013=100) and CCPI (CCPI 2006/07=100) increased at a slow rate with mixed movements. The inflation was comparatively higher when compared to the past few years.

Since recently Sri Lanka continues to experience an unprecedented rise in high inflation with the outcomes of rising commodity prices, power shortages and scarcity of fuel. Thus situation was further aggravated by a grave reduction in agricultural production. Sri Lanka recorded the Asia's highest inflation rate which continued to threaten food security in the country. CCPI reaching 64.3 percent over the year to August 2022, driven in part by the food inflation of 93.7 percent. Early signs of agriculture indicated that the

output to decrease by 40 percent compared to 2020 Yala season. As a result prices of food items continued to increase due to high fuel prices, shortages of fertilizers and a shortage of animal feed. In the year 2022 August indicated that the inflationary situation in the country was very high due to prevailing high prices in the economy. Higher price situation emanated mainly from food and non-food category. As a result, Year-on-Year inflation in the food category in the economy reported as high as 82.5 percent in July compared to 84.6 percent in July in the same year. On the other hand, non-food category rose from 52. 4 percent to 57.1 percent. Therefore both categories have contributed to the high inflation in the country as food and non-food indicated as 40.41 and 29.79 percent respectively. Figures 1, 2 and 3 clearly illustrate recent inflation overview in the country.
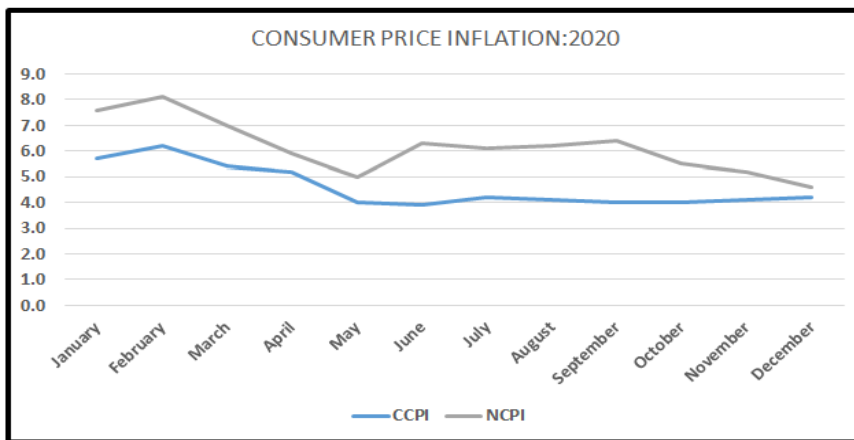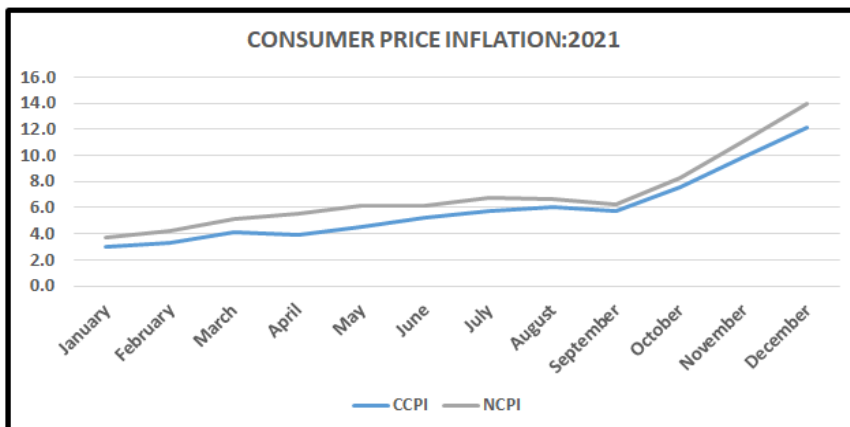

Figure 1: Consumer Price Inflation: 2020

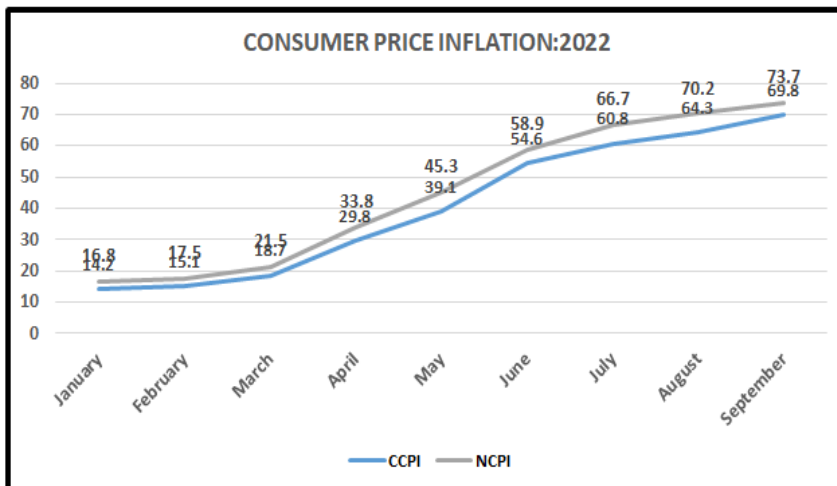**Figure 2:** Consumer Price Inflation: 2021

Figure 3: Consumer Price Inflation: 2020

LITERATURE REVIEW

It is expected to review existing literature of the previous studies conducted by the former researchers on a particular topic. Therefore, through the literature survey gaps can be identified duly while contribution to existing literature. Further, it is also possible to understand in the past research. Researches use various assumptions in their studies and hence it is an opportunity to know those assumptions. In addition, various techniques are used in arriving at the conclusion in relation to short-run and long-run studies.

Study of Ratnasiri (2009) focused on the main determinants of inflation in Sri Lanka during 1980 to 2005 using Vector Autogression Analysis (VAR model). His findings were that the growths in broad money supply and rice prices have become significant factors for inflationary situation in Sri Lanka in the long-run during the specified period. His further findings were that the exchange rate depreciation and output gap have no significant effect on the same. Rice price in the short-run has played an important role.

A study of Cooray (2008) used two models such as "An Open Economy Model" and "An Closed Economy Model" to estimate price equations in Sri Lanka. The author has considered the period from 1978 to 2006. Between the two models results obtained by Cooray(2008) have supported the Open economic model which included those of Nicholas

(1990), Nicholas and Yatawara (1991) and Gurusinghe (2005). According to findings as per open economic model, import prices and exchange rate had significant impact on price levels. Therefore, the study discussed about the importance of supply-side factors. Both Ratnasiri (2008) and Cooray (2008) found that price increases to be the main reason for inflation in Sri Lanka.

Luintel (2002) examined the importance of money stock in combating inflation in South Asia, including Sri Lanka. His findings were that inflation cannot be controlled via the money stock in South Asia. However, Gurusinghe (2005) said that even though excess money supply causes inflation in Sri Lanka in the short-run, the author identified the non-monetary factors too which can ultimately contribute to creating inflation in Sri Lanka.

Madurapperuma (2007) focused on monetary policy situation in Sri Lanka emphasized the positive relationship between the monetary aggregates with price levels in the country. He used the correlation analysis from 1950 to 2007 period. Through his research he recommended to have the money-supply controlled if the country is to achieve price stability. The author found money supply growth and inflation relationship in Sri Lanka during his study period.

Two detailed studies were done by Amarasekera (2008) and Vinyagathesan (2013) focusing on effectiveness of monetary policy with VAR approach. Both researchers have focused on how monetary policy impacted inflation in Sri Lanka where both studies have gone well beyond the previous studies by focusing their attention on how monetary policy impacted the inflation and output. Amarasekera (2008) paid the attention on interest rate and less on monetary aggregates during 1978-2005. He went on to say that following the correlation in interest rate and GDP growth, inflation has declined but with an increase in interest rates. He further studied the effectiveness of monetary policy taking three sub-samples starting from 1978-1993, 1993-2000, and 2001-2005 in order to further confirm his findings. However, the study of Vinayagathasan (2013) highlighted, as opposed to Amarasekara (2008) that the reserve money should be better targeted in Sri Lanka than narrow or broad money target in taming inflation.

A study of Perera (2005) concentrated on petroleum prices impacted on price levels in Sri Lanka. He used Auto regressive Distributed Lag (ADL) model. His research indicated that the indirect impact of changes in diesel prices on price indices (CCPI and SLCPI) were much bigger than the direct

impacts. His findings firmly confirmed as 10 percent price increase in diesel has changed the CCPI by 1.21 percent and it was 1.01 percent for SLCPI.

The analysis of Kesavarajah (2008) confined to inflation situation in Sri Lanka from 1978 to 2010. The researcher has used Johanson and Juselius Co-integration and Vector Error analysis in order to arrive at a conclusion that money supply, exchange rate and budget deficit were co-integrated to each other. Findings indicated long-run dynamic relationships among the variables towards inflation. These variables, according to researcher's findings, were playing a significant role in the long-run. He concluded to say that maintaining stable price level is a must for low inflation in Sri Lanka.

Another study similar to Ratnasiri (2009) and Kesavarajah (2008) was done by Duma (2008). The researcher investigated the pass-through of external shocks to inflation in Sri Lanka. The external shocks were exchange rate, oil price and import price shocks. He has used Vector Autogressive Model (VAR) to base his findings. He found incomplete pass-through of external shocks to domestic inflation. Pass-through was 10 percent during the first month and then rose to maximum of 40 percent in four (04) months periods. In relation to oil prices, the impact was much smaller and even negative. But, the impact of import prices, were 4 percent to 28 percent within three (03) months. The researcher concluded saying that external shocks appeared to have brought about less impact on consumer price index, but other shocks (supply constraints) were likely to have impacted more in explaining inflation in Sri Lanka. Perera (2005) and Duma (2008) both have estimated the effect of oil price changes on general price levels in the country. While Perera (2005) confirmed that diesel price impacts were much bigger however Duma (2008) on the other hand has captured opposite result, as much smaller. These were contradictory to each other. Also these findings, were completely opposed to Ratnasiri (2009) and Kesavarajah (2008).

Using Vector Autoregressive (VAR) model Bandara (2011) identified the inflationary situation in Sri Lanka during 1993-2008 period. He found the positive relationship between money supply, exchange rate and GDP as it explained the behavioral changes in inflation in Sri Lanka.

Similar study by Walpita (2015) estimated the inflation in Sri Lanka for the period of 1960-2013. The analysis which was based on annual data indicated that broad money supply, GNP, rising government budget deficit

and exchange rate depreciation behaved as major determinant factors which played a significant role in the long-run. On the other hand Jayasooriya (2015) too found similar outcomes similar to Walpita (2015) by way of using VAR model. The author identified the macroeconomic variables (i.e. GDP, inflation and narrow money supply) as the most important variable during this period. Having analyzed the inflationary situation in Sri Lanka, it was found that expansionary monetary policy caused inflation and the reason for expansionary monetary policy was monetization of the budget deficit. The researcher concluded that the narrow money and budget deficit were positive and statistically significant when correlated to inflation in Sri Lanka.

Is fiscal deficit inflationary? According to Jayasooriya (2015), it was. However, previous studies which were targeted on the same issue, have provided mixed outcomes. Study of Sargent and Wallace (1981) was a solid empirical study which indicated that fiscal deficit cause inflation in the economy. However, in addition to Sargent and Wallance (1981), another similar study was conducted by Fisher et al (2002) and Habibullah et al. (2011) where they all attempted to study the long-run association between fiscal deficit and inflation considering 13 developing countries in Asian region including Sri Lanka. These researchers have all established that there was a relationship between fiscal deficit and inflation.

Studies in relation to inflation situation in Sri Lanka, depended heavily on single approach with few explanatory variables. But, Jayawardana and Jayasinghe (2016) adopted a new approach to the issue from 1977 to 2014 by carrying out a comprehensive study for Sri Lanka. They used, compared to previous studies, two approaches namely; Autoregressive Distributed Lag (ADRL) approach and Error Correction Model (ECM) and have used a wide range of variables (money supply, exchange rate, prices of crude oil, budget deficit, real GDP, public wage index, private wage index). The findings were that increased money supply and domestic currency depreciation together with higher public wages caused inflation. These results were common to short and long run. A most recent study of De Alwis and Dewasiri (2022) investigated the determinants of inflation in Sri Lanka during 1977-2019 using ARDL approach with annual data. The authors concluded that real GDP, fiscal deficit, treasury bills on 91 days rates, broad money supply could explain the inflation in the long-run while short-run factors were real GDP, imports, fiscal deficit, broad money supply, wages of the private sector and wages of the government sector.

METHODOLOGY

This study is based on the historical data of supply driven factors of the inflation in Sri Lanka. Hence, quantitative study is conducted to suite the nature of the research problem (Dewasiri et al., 2017; Dewasiri et al., 2018). The rate of inflation (Colombo Consumer's Price Index: CCPI) is used as the dependent variable of the study. The CCPI series has been rebased to one base year (2013=100). The CCPI is the commonly used inflation indicator for Sri Lanka. The index is based on a survey of working class families in Colombo district. Therefore, in this study CCPI is used given the availability of a longer series available in Sri Lanka. The explanatory variables include crude oil prices, nominal exchange rate and rice prices. The data covers the period from 1977 to 2019 and are of annual frequency.

The basic features of the data series can be described using descriptive statistics. Therefore, descriptive statistics is used in this study. It further provides simple summaries concerning the sample used in the study in addition to the measures and basis of quantitative analysis of data in the study. Thus, it enable to simplify a larger data series in a sensible way.

Table 1: Descriptive statistics

	Inflation	Crude Oil Prices	Nominal Exchange Rate	Rice Prices
Mean	9.89	41.75	76.74	32.22
Median	9.4	28.83	67.78	23.25
Max	26.1	111.63	182.75	95
Min	1.2	12.8	15.45	3.85
Std. Dev.	5.61	29.74	48.43	27.04
Skewness	0.84	1.12	0.44	0.95
Kurtosis	3.60	3.07	2.12	2.76
J-Bera	5.74	8.98	2.80	6.62
Proba	0.06	0.01	0.25	0.04
Obser.	43	43	43	43

** *Notes: inflation (INF), crude oil prices (OIL), nominal exchange rate(EX_RATE), rice prices (R_PRICE)*

Table 1 provides the descriptive statistics for all variables under consideration. Table reveals that the average INF rate is 9.89. The average value of variables starting from CRUDE OIL PRICES (41.75), NOMINAL EXCHANGE RATE (76.74) and RICE PRICES (32.22) are shown respectively. It is important that when using time series data, checking the

stationarity is a must in the variables used in the study. It is therefore, necessary to scientifically ascertain that the series do not show a unit root to avoid obtaining spurious results (Priyantha and De Alwis (2021). Therefore variables used in this study must show stationarity conditions (Adeleye et al., 2019; Adeleye et al., 2018; Romanus et al., 2020). Unit root testing can be done more efficiently through ADF and Phillip Perron test. Basically two hypotheses are established in ADF and PP when testing the unit root testing. According to null hypothesis, it establishes that there is unit root means that the series is not stationary. On the other hand, an alternative theory suggests that the series is stationary and that there is no unit root meaning. The initial difference in the series must be taken to produce a stationary process once the null hypothesis is rejected at level order (*=0). The alternative hypothesis is accepted if the null hypothesis is rejected. This shows that at initial difference I, the series is stationary (I). Therefore, the Augmented Fuller (1982) and Phillips-Perron (1988) techniques are utilized to evaluate the stationarity of the variables used in the study.

Table 2: Unit root test

Variables	ADF		PP		Order of Integration
	Unit Root Test Results				
	Levels	**First Difference**	**Levels**	**First Difference**	
Inf	-4.664979*** (0.0005)	-9.347774*** (0.0000)	-4.768232*** (0.0004)	-19.66441*** (0.0000)	I(0),I(I)
LnOil	-	-5.927597*** (0.0000)	-	-5.908707*** (0.0000)	I(I)
LnEx_rate	-	-6.834514*** (0.0000)	-	-6.819857*** (0.0000)	I(I)
LnR_price	-	-6.324166*** (0.0000)	-	-7.599682*** (0.0000)	I(0), I(I)

Notes: inf(inflation),Lnoil(log of crude oil), LnEx_rate(log of nominal exchange rate),LnR_price(log of rice price).P-values are in parenthesis.
P-value, *p< 0.1,**p<0.01,***p<0.05 null hypothesis of a unit root can be rejected at 10%,1% and 5% levels of significance respectively

As per Table 2 all the variables became stationary after taking into their first difference except inflation. Optimal lag lengths are determined by the Akaike Information Criterion (AIC). I (0) stand for order of integration at order zero while I (I) stands for integration at order one. The results of the

unit root tests are presented in Table 2. All series were converted into log form. The table reveals that after taking first differences of the variables, crude oil prices, exchange rate and rice prices become stationary meaning that they are all integrated of order I (I). The variables that are at stationary at level are inflation and GDP Deflator meaning that they are integrated of order I (0). The following section deals with 'supply-driven factors of inflation' in model 1 (with inflation) in the long-run and short-run.

Model 1

The joint null hypothesis that there is no long-run relationship between the variables used in this study, $H_0: \partial_1 = \partial_2 = \partial_3 = \partial_4 = 0$ is tested against alternative hypothesis that is there is a long-run relationship between the variables $H_1: \partial_1 \neq \partial_2 \neq \partial_3 \neq \partial_4 \neq 0$ in model-01

Lag Selection Criterion – Model 1

The optimal lag length for ARDL model, AIC criterion is used using the following lags for model-01. ARDL MODEL 1-1(1, 0); MODEL 1-2(1, 2); MODEL 1-3 (1, 1) to test the objectives.

To study the supply-driven factors of inflation, quantitative approach is applied to estimate the estimate coefficients of the supply-driven factors of inflation in Sri Lanka using the following model.

Supply-Driven Factors of Inflation Model

H0: There is a no long-run association between supply-driven factors of inflation in Sri Lanka.

The supply-driven models with inflation as follows:

$$\text{Inf}_t = \gamma_0 + \gamma_1 oil_t + \gamma_2 ex\_rate_t + \gamma_3 R\_price_t + u_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (01)$$

γ_0 is the constant term and $\gamma_1 - \gamma_3$ are the coefficients of the equation 01 above . Equation (01) specifies 'Inflation' as dependent variable with other explanatory variables.

FINDINGS

Bound Test Approach to Co-Integration

ARDL bound test is conducted for supply-driven factors of inflation in Sri Lanka as suggested by Pesaran et al. (2001) and Isaiah et al. (2021). According to the bound test results, co-integration can be identified if the calculated F-statistics is greater than critical value of upper bound, which can be confirmed by the results shown in Table No 03. If F-statistics is lower than the upper bound critical value, it shows existence of no co-integration among the variables (Raza et al., 2015; Raza, 2015; Raza, et al., 2016; Isaiah, et al., 2021). The results of the both the tables confirm co-integrating relationships among supply-driven factors of inflation. To check the long-run relationships among the variables in the study, Wald Test (F-statistics) is used. Supply-driven factors of inflation in Model 1 clearly provide evidences of long- run relationships among the variables.

Table 3: ARDL bound test

ARDL BOUND TEST		
SUPPLY- DRIVEN FACTORS OF INFLATION		
MODEL:01– DEPENDENT VARIABLE :Inflation		
MODEL 1-1	**MODEL 1-2**	**MODEL 1-3**
Significance Levels 5%	5%	5%
F- Statistics 7.90	8.3	29.9
Critical Value: LOWER BOUND I(0) 3.15 UPPER BOUND I(1) 4.11	3.15 4.11	4.94 5.73
Conclusion Co-integration	Co-integration	Co-integration
Source: Computed by the Author using Eviews 10		
Model: 1-1: Inflation vs. LNOIL, Model: 1-2: Inflation vs. LNEX_RATE, Model: 1-3: Inflation vs. LNR_PRICE		
When All the Variables Run Together: F-Statistics(15.89)		

As per results shown in Table 3 confirm the existence of co-integration at the 5% level of significance when the F-statistics for co-integration is compared with the F-test critical values. With the confirmation of the long-run relationship between inflation with the other explanatory variables in Sri Lanka during 1977-2019, the study proceeded with the estimation of long-run

and short-run dynamics to the determine the determinants factors of inflation in the country.

Co-Integrating Equation - Individual

> **Cointeq = INF - (6.2699*LNOIL)**
>
> **Cointeq = INF - (2.5177*LNEX__RATE)**
>
> **Cointeq = INF - (-6.3989*LNR_PRICE)**

Co-Integrating Equation - When Variables Run Together

The co-integration equation for Model 1 is expressed as:

> **Cointeq = EC = INF - (5.0877*LNOIL+16.6557*LNEX_RATE-21.7542*LNR_PRICE)**

Supply-Driven Factors of Inflation in the Long-Run

Table 4: ARDL long-run results - Supply driven factors: Model 1

Supply Driven Factors of Inflation in the Long-Run		
ARDL Long-Run:Model-01		
Dependent Variable: INFLATION		
Model-01- Inflation = f(LNOIL, LNEX_RATE, LNR_PRICE)		
MODEL 1-1	**MODEL 1-2**	**MODEL 3-3**
LNOIL 6.2 (0.0000)**		
LNEX_RATE	2.5 (0.0833)*	
LNR_PRICE		-6.39 (0.0000)

Note: LNOIL(log of crude oil), LNEX_RATE(log of exchange rate),LNR_PRICE(log of rice price)
Model: 1-1: Inflation vs. LN OIL, Model: 1-2: Inflation vs. LNEX_RATE, Model: 1-3: Inflation vs. LNR_PRICE
*Long Run Results when all the variables run together: **EC = INF - (5.0877*LNOIL + 16.6557* LNEX_RATE - 21.7542* LNR_PRICE)***
$*p< 0.10; **p \leq 0.05; ***p \leq 0.01$

Table 04 column 01 in which ARDL long-run results are presented, shows the name of the variables of the study, their respective coefficient values and probability values (given in parenthesis). In this study, supply-

driven factors of inflation are discussed under Model 1 and hence the long-run relationships are also discussed under respective model.

ARDL long-run results are presented in Table 4 which discusses the supply-driven factor of inflation in the long-run relationships in Model 1. Table 4 indicates the supply-driven factors with their individual coefficient values which clearly show the relationships each variable has on 'inflation' in Sri Lanka during 1977-2019. Also shows the long-run results when the all the variables run together with inflation. The estimated coefficient of crude oil indicates as 6.2 at 5 % significance level. Therefore 1% percent increase in crude oil will raise inflation by 6.2 %. These findings relate to the previous empirical studies of Perera (2005), Amarasinghe et al. (2018), Duma (2008), and Kulatunge (2012). The relationship between exchange rate and inflation signifies a positive correlation as the estimated coefficient shows 2.5 at 5 % significance level. These findings are consistent to previous findings of Colombage (2005), Wimalasuriya (2007), Deyshapriya (2014), Amarasinghe et al. (2018), Ariyasinghe and Cooray (2021), and De Alwis and Dewasiri (2022) where they all found long-run statistically significant relationships. Therefore 1% increase in the exchange rate can push the inflation up by 2.5 %, however rice prices show negatively significant relationship to inflation in the long-run.

Supply-Driven Factors of Inflation in the Short-Run

Table 5: Model 1 ARDL short-run results – Supply driven factors: Model 1

Supply Driven Factors of Inflation in the Short -Run		
ARDL Short -Run: Model 1		
Dependent Variable: INFLATION		
Model-01-Inflation = f(LNOIL, LNEX_RATE,LNR_PRICE)		
MODEL 1-1	**MODEL 1-2**	**MODEL 1-3**
LNOIL 3.5 (0.0016)**		
LNEX_RATE	66.14 (0.0669)*	
LNR_PRICE		42.27 (0.0003)**

Note: LNOIL(log of crude oil), LNEX_RATE(log of exchange rate),LNR_PRICE(log of rice price)
Long Run Results when all the variables run together: **EC = INF - (32.67* LNR_PRICE).Only Rice price is significant in the short-run. The error correction term in the short-run is (-1) with p-value (0.0000)**

*p< 0.10; **p≤0.05; ***p≤ 0.01

Table 5 summarizes the results of error correction for Model 1.The results of both tables for ECT imply that the supply-driven factors of inflation have a long-run equilibrium in the model. ECT (-1) in Model 1 is statistically significant and negative (-) sign indicates a convergence from short-run to long-run. The ECT in both tables show the speed of adjustment to equilibrium in each period in the presence of co-integration relationship between inflation, crude oil prices, exchange rate and rice prices in Model 1 (shown in its log forms): LNOIL,LNEX_RATE,LNR_PRICE. The short-run results reveal a positive and statistically significant association between inflation and crude oil prices which is similar to long-run results. These results indicate that crude oil prices contributed to inflation in Sri Lanka in the short-run too given the positive coefficient value of 3.5. The short-run results of the exchange rate indicate high positive value as 66.14 and 42.27 for rice prices. According to the short-run results, all the variables under consideration are positively and statistically significant to inflation in Sri Lanka. Therefore, crude oil prices, exchange rate and rice prices can be considered as short-run supply-driven dynamics.

Model Efficiency Test: Serial Correlation LM Test

Table 06 provides the results of the diagnostic test of autocorrelation. If the null hypothesis (H_0) confirms that there is no autocorrelation, then the alternative hypothesis (H_1) can be rejected based on the p-value of the observed R-squared given its value is less than 0.05 level of significance. This clearly confirm that there is no serial correlation in the selected model as the p-values are greater than 0.05 level of significance. Therefore, as per table 06, corresponding p-values of the Breusch-Godfrey serial correlation LM test are greater than 5% significance level, it can be concluded that the model selected in the study does not have any autocorrelation issues.

Table 6: Results of serial correlation: Model 1

Breusch–Godfrey Serial Correlation: MODEL-01				
Model:01-INFLATION=f(LNOIL,LNEX_RATE, LNR_PRICE)				
MODEL: ARDL				
		F-statistics	Obs*R-squared	Probability
LNOIL 1-1	-MODEL:	0.87	1.84	(2,38) 0.4259
LNEX_RATE 1-2	-MODEL:	0.24	0.56	(2,35) 0.7858
LNR_PRICE 1-3	-MODEL:	1.81	3.84	(2,36) 0.1772

Notes: LNOIL(log of crude oil prices), LNEX_RATE(log of exchange rate), LNR_PRICE(log of rice price)
*Serial Correlation Results when all the variables run together: **F-Statistics: 2.90 Probability(2,35) : 0.0680***

The null hypothesis (H$_0$), which is supported by the test for heteroscedasticity, states that the residuals are homoscedastic, while the alternative hypothesis (H$_1$) asserts that they are heteroscedastic. As a result, it is claimed that the variance in the study is not constant. Rule of Rejection: If the probability value of the observation R-squared is less than the 0.05 level of significance, the null hypothesis should be rejected. According to results shown in the model-01, the values of probabilities of Chi-Square are greater than 0.05 as per table 07. Model 01 deem to be homoscedastic as the test fails to reject the null hypothesis.

Table 7: Results of heteroskedasticity test of ARCH (Model 1)

Heteroskedasticity Test: ARCH MODEL-01				
Model:01-INFLATION=f(LNOIL,LNEX_RATE, LNR_PRICE)				
MODEL: ARDL				
		F-statistics	**Obs*R-squared**	**Probability**
LNOIL 1-1	-MODEL:	1.09	2..23	(2,39) 0.3448
LNEX_RATE 1-2	-MODEL:	0.52	2.85	(5,34) 0.7568
LNR_PRICE 1-3	-MODEL:	0.99	2.04	(2,39) 0.3775

*Notes:**MODEL:1-1**(Inflation vs log of real GDP);**MODEL:1-2**(Inflation vs log exchange rate) **MODEL:1-3**(Inflation vs log of rice price)*
*Heteroskedasticity Test Results when all the variables run together:**F-Statistics-0.07 : Probability(1,39)-0.7877***

CUSUM and CUSUM SQUARES – Model 1: Stability and Residual Checking

Centered on cumulative sums of scaled recursive residuals, the CUSUM test statistics (Brown et al., 1975) map the cumulative sum along with the 5% critical lines against time. If the total sum goes below the critical lines of 5%, so the test reveals volatility of the parameter. The cumulative sum (CUSUM) and the cumulative sum of squared (CUSUM SQUARE) added in the analysis to measure the consistency of the long-run coefficients along with the short-run dynamics. The graphical illustrations of the CUSUM AND CUSUM OF SQUARE are presented in Figures 1 and 2 in Model 1. Each

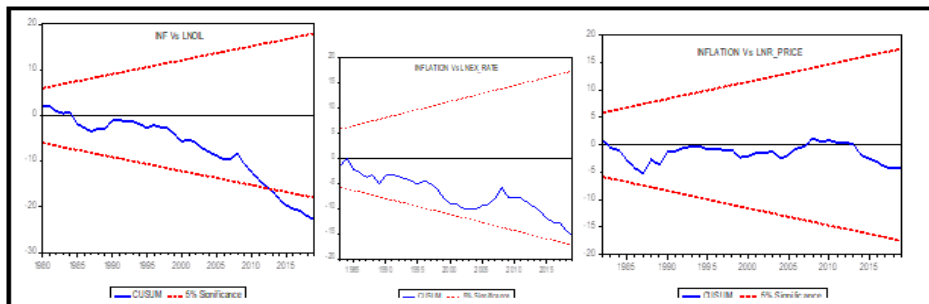variables used in the model is plotted against inflation.

Figure 4: Plots of CUSUM – Model 1

The CUSUM test in Figure 5 plots limits and is thus statistically proved to be the consistency of the model's short-run and long-run coefficients. As they lie between the two borders, thus the model is stable. The dependent variable (inflation has equilibrium and become a continuous variable.
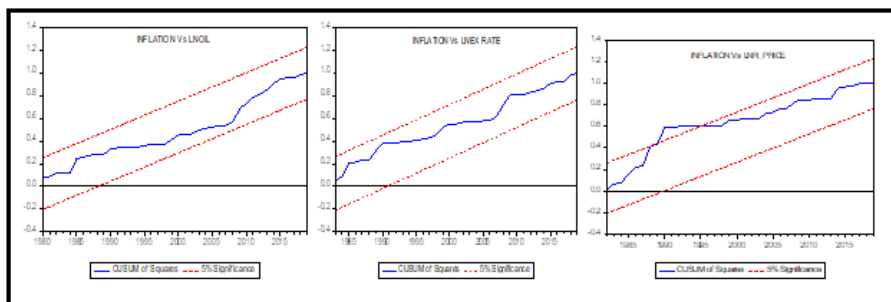

Figure 5: Plots of CUSUM of Square – Model 1

The CUSUM OF SQUARE in Figure 5 is also within the boundaries. The plot of CUSUM SQUARE in model is within the boundaries and hence statistically proven the stability of the short-run and long-run coefficients of the repressors that have an impact on the level inflation in Sri Lanka during the study period. Therefore, according to the CUSUM and CUSUM OF SQUARE the model seems to be stale and properly specified though marginal deviation in the CUSUM OF SQUARE as none of the two tests deviate out the bounds of 5% level of significance.

The stability of the inflation equation (Equation 1) is examined by application of CUSUM and CUSUM OF SQURE test which detects

systematic changes in regression coefficients (Brown et al, 1975; Fahmida & Mazbahul, 2012; Romanus et al., 2021). The plot of CUSUM and CUSUM OF SQUARE fall within the critical bound lines at 5% level of significance meaning that the estimated coefficients in ARDL Model 1 is stable over the sample period from 1977-2019. Thus estimated model in the study, as per given evidences can be used well for policy formulation in Sri Lanka.

Normality Test for Supply-Driven Factors of Inflation

Figure 6 illustrates the normality test for supply-driven factors of inflation in Sri Lanka for Model 0.
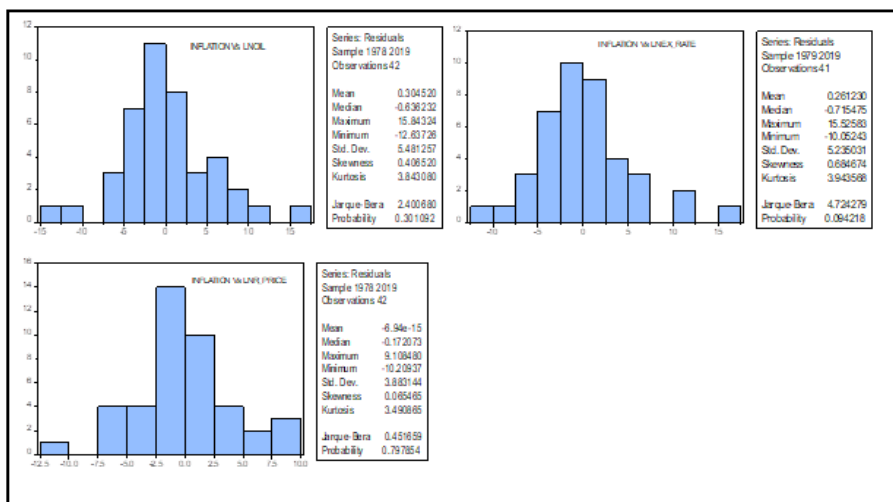

Figure 6: Normality Test - Model 1

Post Estimation Diagnoses

Table 08 illustrates the results of the post estimation outcome of the study. Using the Ramsey RESET tests (CUSUM AND CUSUM OF SQUARE) has been used to estimate and assess the linearity of the ARDL model in the study. Results have confirmed the linearity of the estimated model indicating that the estimated model is desirable. Heteroscedasticity in the estimation was identified using the ARCH-LM test. It was determined that the null hypothesis of "no heteroscedasticity" could not be rejected given the probability level, which was higher than the permissible limit of 5%. It was determined that the calculated model is homoscedastic in the end. The Jaque-Berra test was used to determine whether the model residuals' distribution was

normal, and the findings indicated that it was. The estimated Breusch-Godfrey test and the estimated serial correlation test were used to confirm that the residuals were not auto-correlated. The estimated model is free of basic econometric issues, according to the positive results of the post-estimation diagnostic tests.

Table 8: Summary diagnostic and stability tests: Supply-driven factors of inflation

Results of Diagnostic and Stability Tests			
Model 1			
	1-1	1-2	1-3
Heteroscedasticity (ARCH-LM)	0.4157	0.6302	0.1326
Normality (JARQUE-BERA)	0.30 (2.4)	0.09 (4.7)	0.79 (0.45)
Serial Correlation (BREUSCH-GODFREY)	0.4259	0.7858	0.1772
CUSUM	Stable	Stable	Stable
CUSUM OF SQUARE	Stable	Stable	Stable

Notes: **MODEL:1-1**(*Inflation vs. log of crude oil prices*); **MODEL:1-2**(*Inflation vs. log exchange rate*); **MODEL:1-3**(*Inflation vs. log of rice price*)

Pairwise Granger Causality Test on Direction of Causality

Table 9: Results of Granger Causality Test – Model 1

Null Hypothesis	Observations	Probability	Conclusion
(1) H_0: LNOIL does not Granger Cause INFLATION	41	0.0075	**Reject H0:** because LNOIL causes INFLAITON
(2) H_0: INFLATION does not Granger Cause LNOIL	41	0.1065	**Do Not Reject H0:** INFLATION does not Granger causes LNOIL
(1) H_0: LNEX_RATE does not Granger Cause INFLATION	41	0.0350	**Reject H0:** because LNEX_RATE causes INFLATION
(2) H_0: INFLATION does not Granger Cause LNEX_RATE	41	0.5261	**Do Not Reject H0:** INFLATION does not Granger causes LNEX_RATE
(1) H_0: LNR_PRICE does not Granger Cause INFLATION	41	0.0035	**Reject H0:** because LNR_PRICE causes INFLATION
(2) H_0: INFLATION does not Granger cause LNR_PRICE	41	0.1419	**Do Not Reject H0:** INFLATION does not Granger causes LNR_PRICE

Table 9 presents the results of Granger causality test for supply-driven factors of inflation for model-01 with single equation. As is reported in Table 9, there is uni-directional causality as follows:

- Changes in the crude oil prices (OIL) Granger cause changes in the inflation (INFLATION) as the corresponding p-value is less than 0.05

- Changes in exchange rate (EXRATE) Granger cause changes in the inflation (INFLATION) as the corresponding p-value is less than 0.05

- Changes in the rice prices (R_PRICE) Granger cause changes in the inflation (INFLATION) as the corresponding p-value is less than 0.05

It can be concluded that in model-01, crude oil prices, exchange rate and rice price may cause inflation in Sri Lanka during 1977-2019 period. According to Table 9, all the variables show one way causation (uni-directional causality) with inflation.

Impulse Response Function

This section analysis the dynamic properties of the supply-driven factors of inflation in Model 1 using Impulse Response Functions (IRF). Figure 7 shows the IRF of the inflation to a standard deviation shock to the crude oil prices, exchange rate and rice prices.
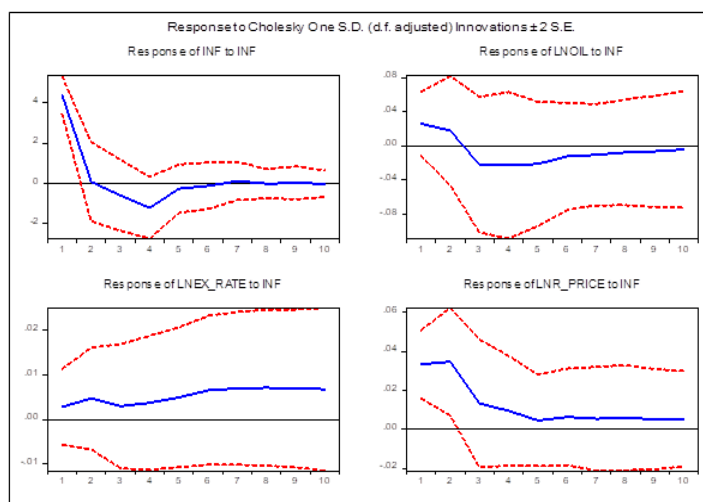

Figure 7: Impulse Response Function – Model 1

CONCLUSION

The objective of this paper is to assess the supply-driven factors of inflation in Sri Lanka. Model 1 established such factors during the study period. The relationship between exchange rate and inflation signifies a positive correlation. However rice prices show negatively significant relationship to inflation in the long-run. The short-run results reveal a positive and statistically significant association between inflation and crude oil prices which is similar to long-run results. These results indicate that crude oil prices contributed to inflation in Sri Lanka in the short-run too. According to the short-run results, all the variables under consideration are positively and statistically significant to inflation in Sri Lanka. Therefore, crude oil prices, exchange rate and rice prices can be considered as short-term supply-driven dynamics. General domestic prices rise with an oil price increase. Increase in crude oil prices quickly reflects in an increase in cost of production because industrial sector heavily relies on crude oil.

Further Sri Lanka as a nation importing crude oil are always exposed to oil shocks and are transmitted towards inflation in the country. Large price increases due to exchange rate depreciation would spill over to another sector of the economy causing overall domestic production cost to go up which lead to inflationary spiral in the economy. This can be established through theoretical foundation using the low of one price and purchasing power parity where relationship between prices and exchange rates can be found. Therefore the law of one price is still useful in understanding the relationship between prices and exchange rates. The demand-pull inflation (due to demand-side factors) clearly explains that when too much money is created in the economy, prices of goods and services tend to go up which will cause inflationary situation in the country. However, according to modern economic system, money is not only cause of inflation but cost-push inflation (due to supply-side factors) may be leading the inflation in the country.

It is obvious that inflation is driven by both supply and demand side factors especially the short-tern fluctuations. Hence it is vital to consider supply side factors which depict a true picture of movement of inflation in a country. Central Bank of Sri Lanka (CBSL) announced its monetary policy framework in the Road Map, the bank expects inflation to decelerate to 10-11 percent by the end of 2008. Such inflation projection by the CBSL based on certain assumptions (international commodity prices to remain stable). Even

though CBSL was confident about the controlling demand pressures, at the same time it needs to be cautious about the price pressures emanating from supply-side shocks. Policy makers need to vigilantly monitor each and every movement in the economy and sense the pulses of policy measures.

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CONFLICT OF INTEREST

The authors declare no potential conflict of interest concerning the research, authorship, and publication of this article.

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