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Budget Deficits and Inflation: The Case of Sri Lanka

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Abstract

This paper explores the relationship between budget deficits and inflation in Sri Lanka using three approaches: the Granger causality test, Auto Regressive Distributed Lag (ARDL)/Bound test, and ARDL long run cointegration coefficients analysis with time series data for the time period of 1957-2016. Three statistical procedures are also exploited in the study, namely, Toda-Yamamoto (1995) Granger causality test, ARDL/Bound test procedure developed by Pesaran and Shin (1999) and Pesaran et al. (2001), and ARDL Error Correction Model. Moreover, four model specifications are formed that are distinguished by two budget deficit indicators, namely, the budget deficit scaled by narrow money (BDMI), which was developed by Catao and Terones (2003), conventional budget deficit indicator, which is the budget deficit as a per cent of Gross Domestic Product (BDGDP), and two inflation indicators, namely the Consumer Price Index (CPI) and GDP deflator. The findings of the study are statistically significant at acceptable levels (p=10%, p=5%, and p=1%). The results suggest a unidirectional causality coming from the budget deficits to inflation in Sri Lanka and the existence of a long run cointegration with high magnitudes, which interprets that a one percentage point change in natural logarithms of BDM1 and LNBDGDP, will result in a 1.5-2.5 per cent change in inflation in Sri Lanka as measured by natural logarithms of Colombo Consumer Price Index (LNCCPI) and Gross Domestic Product Deflator (LNGDPD). Further the study concludes that the importance of maintaining low budget deficits in view of reaching inflation targeting in Sri Lanka.

Key Words: *Budget deficits, Inflation, Sri Lanka*

JEL Classification:

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1. Introduction

The relationship between budget deficit and inflation has become one of the key concerns in public economics. As inflation is considered the main culprit that hinders economic development particularly in developing countries, economists are concerned about the determinants of inflation to minimise possible adverse effects in respective economies. The determinants of inflation and their effects, however, may vary among economies owing to country specific economic policies and their priorities. Some economists argue that mismatches of policies and their priorities may also lead to deteriorating economic growth and development objectives of a country. Hence, understanding the interrelationship between policies is very important in formulating and implementing overall economic policies in an economy. This study aims to examine the relationship between monetary policy and fiscal policy in terms of the relationship between the budget deficit and inflation as the main variables concerned.

The relationship between budget deficit and inflation has received extensive attention in the history of economics. As the Keynesian approach explains, public sector variables affect money demand and prices and thereby, aggregate demand. With the concept of Intertemporal Budget Constraints, the monetary-fiscal policy relationship is widely discussed. Moreover, the argument of Unpleasant Monetarist Arithmetic (Tomas J. Sargent and Neil Wallace) suggests that monetary policy may limit its control over price stability under a fiscal dominance regime. In recent decades, many economists have contributed with different ideas in favor of the role of fiscal policy in an economy. One of the milestones in this regard is the Fiscal Theory of Price Level that emphasises the importance of fiscal factors in price determination.

Traditionally, the budget deficit-inflation relationship is explained through the argument of the inflationary effect of seigniorage i.e. the printing of money by means of financing the budget deficit. Creation of money in such a way is sometimes referred to as inflation tax as it creates an inflationary effect, and is similar to imposing a tax whereas the amount of money created through inflation generates an income to the government as any other government tax. Particularly, in the case of developing countries', economists highlight adverse effects of fiscal policy on the basis of inflationary financing. Such criticism may be backed by undesirable

outcomes experienced in some countries where seigniorage has become an uncontrollable problem. Therefore, it is very important to understand the effects of seigniorage and the interaction between fiscal and monetary policies in an economy.

Sri Lanka, as a developing country, has experienced large budget deficits and policy makers are making continuous efforts to curtail such deficits at an economically desirable level. Lower budget deficits, on the other hand, help to keep up with the Inflation Targeting (IT) framework of the monetary policy, which the Central Bank of Sri Lanka (CBSL) has been in the process of adopting. In line with this process, CBSL has taken various measures in terms of institutional framework and policy making processes during recent years. One of the prerequisites for adopting an IT framework is fiscal sector management that the system can improve through better monetary-fiscal policy coordination. In other words, to facilitate monetary policy in achieving its targets, fiscal sector measures need to be rule-based by managing budget deficit and debt. This study provides an important understanding of the policy links between monetary policy and fiscal policy which is based on statistical testing procedures with theory-based methodological approaches.

This paper investigates the relationship between budget deficit and inflation in Sri Lanka, using time series data for the period of 1957-2016 in terms of the nature of the causality between the budget deficit and inflation, nature of cointegration between budget deficit and inflation, and the magnitude of the long-run coefficients. Accordingly, the hypothesis of the current study is that a considerable magnitude of positive long-run relationship may exist between budget deficit and inflation in Sri Lanka. In establishing the hypothesis, this study considers the theoretical perspectives and growing concerns in public finance history on the topic, findings of previous empirical studies, and background information on Sri Lanka.

This study considers six representative variables to investigate the deficit-inflation relationship that includes fiscal balance, inflation, money supply, exchange rate, interest rate and GDP. When comparing historical data, it seems that the behavior of the selected data variables depends on the country's overall development strategies that were adopted and key policy changes that were domestically and globally introduced from time to time. Table 1 shows an overview of fiscal sector performance, by means of ten-year averages of data during the period of 1948-2016. As shown in

the table, during the period after 1978, there has been a slight decrease in total revenue. The deterioration of total revenue in recent times has been very steep, recording a drop of about one-third when compared to the situation in 1970s. Total government expenditure as depicted in Table 1, from 1948 to 1987, has shown a steady increase and then, a gradual decrease.

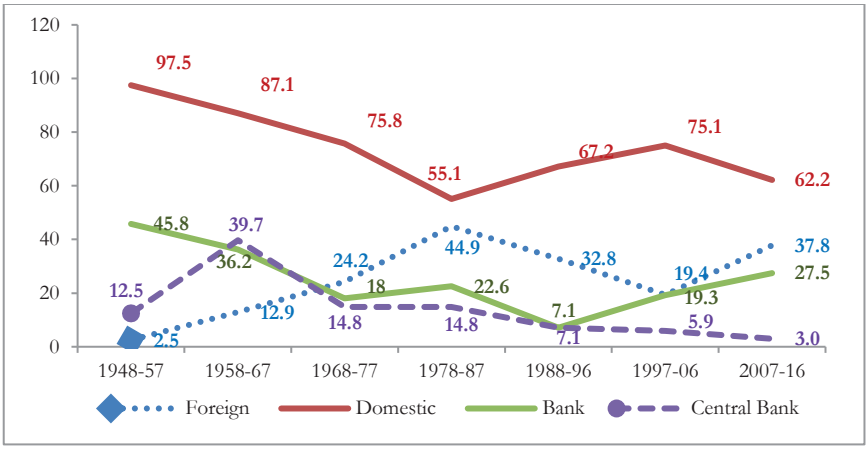
Table 1: Fiscal performance in Sri Lanka as a per cent of GDP

Category	1948-1957	1958-1967	1968-1977	1978-1987	1988-1996	1997-1906	2007-1916
Total Revenue and Grants	21.0	22.3	21.0	23.7	21.9	17.2	13.8
Total Expenditure	23.4	28.0	27.1	35.2	30.3	25.1	20.5
Current	15.7	21.0	19.9	19.4	21.9	19.6	14.9
Capital	7.7	7.0	7.2	15.8	8.4	4.9	5.3
Current AC (Surplus (+) /Deficit (-))	5.1	1.1	0.4	1.7	-1.9	-3.0	-1.6
Overall Deficit (after Grants)	-2.4	-5.8	-6.1	-11.5	-8.4	-8.5	-6.7

Source: Central Bank Annual Reports

In the wake of fiscal balances, during the period of 1978-87, overall budget deficits have shown a steady increase to a double-digit (-11.5 per cent) from around -2.5 per cent recorded in the 1950s. After 1987, the overall budget deficit has declined moderately to around -7 per cent of GDP.

Figure 1: Financing of budget deficits as a per cent of total financing



Source: Central Bank of Sri Lanka

In terms of the composition of financing sources, as given in Figure 1, during the period of 1978-87, the proportion of foreign financing has reached to around 45 per cent of total financing, from 2.5 per cent recorded in the 1950. During the period of 1987-2006, there has been a sharp drop of foreign financing to 19.3 per cent, and it has increased up to 40 per cent during the last decade. During the first three decades, domestic financing has become the major source of financing recording a proportion of over 75 per cent and it has been over 60 per cent of total financing during the last three decades. With respect to the composition of bank financing, it has initially been a high proportion of 40-46 per cent of total financing and during the period of 1968-87 it has reduced to 18-23 per cent. During the last twenty years, however, it has on average increased to about 20-30 per cent. Importantly, during the first three decades starting from 1948, central bank financing has been around 15 per cent of total financing, except the period during 1958-67 (40 per cent). In contrast, over the last three decades, central bank financing has dramatically changed, following a declining path.

With respect to inflation indicators, Consumer Price Index (CPI) and GDP Deflator (GDPD) are widely used. In Sri Lanka, there are three inflation indicators: Colombo Consumer Price Index (CCPI), Wholesale Price Index (WPI) and GDPD as far as historical data is concerned. As for updating, the base year of CCPI has been changed to 1950=100, 2002=100 and 2006/07=100. Further, as an alternative indicator to CCPI, National Consumer Price Index (NCPI) was introduced recently. Inflation rate measured by CCPI was a double-digit figure for two decades starting from 1978 and it relatively averaged to a higher value of 9.6 per cent and 7.8 per cent respectively during the next consecutive decades. Also, during earlier decades, CCPI inflation recorded a lower rate of about one per cent. Similarly, during the first three decades starting from 1968 GDPD recorded a double digits' inflation rate and during the next consecutive decades there was a slight decline to 9.0 per cent and 7.8 per cent, respectively. In contrast to historical data the budget deficit and inflation rate seem to follow a similar trend; during the period of first four decades starting from the 1950, budget deficit remained between 2.4 and 11.5 per cent while inflation rate remained between the range of 0.6-12.6 per cent. During the last three decades starting from 1988, the budget deficit changed from 8.4 to 6.7 per cent while CCPI inflation rate has changed from 12.8 to 7.8 per cent.

With respect to the patterns of other variables in this study, average historical data categorised by decades is shown in Table 2. Accordingly, in the 1950s, growth of narrow money supply (M1) stood at 2.5 per cent and then, it almost doubled decade by decade, to 12 per cent during the 1968-77 period. Over the period except the last decade, broad money supply (M2) followed a similar pattern of change. A higher volatility of annual growth rates has shown, however, in the growth rates of M1 in comparison to M2.

Table 2: Other macroeconomic indicators in Sri Lanka

Indicator	1951-1957	1958-1967	1968-1977	1978-1987	1988-1996	1997-2006	2007-2016
M_1	2.4	5.8	12.0	16.9	13.3	12.9	11.0
M_2	4.1	7.2	13.8	21.3	17.4	14.7	15.3
Exchange Rate US$	0.0	0.2	6.5	14.3	7.2	6.6	2.8
GDP Growth	3.4	3.8	3.8	5.2	4.8	5.2	6.0

Source: Central Bank Annual Reports

Regarding the change in the exchange rate of Sri Lankan Rupee (LKR) as against the United States dollars (USD) also amounted to 14.3 per cent during 1978-87 periods, doubling the growth rates in the previous decade. However, it has gradually decreased thereafter. Conversely, GDP growth rate stood at 3.4-3.8 per cent over three decades starting from 1951, and it increased to 4.8-6.0 per cent thereafter. The highest growth rate was recorded during the last decade. In addition, the growth of foreign reserves shows noticeable high volatility during the period concerned. In summary, the comparison of data suggests that many of the variables such as M1, M2 and exchange rate, importantly, seem to be following the similar pattern of changing; the variables have gradually increased until the period of 1978-87 and slightly fallen thereafter.

2. Theoretical overview of monetary policy and fiscal policy

There are some different views in economics on the interrelation of fiscal policy and monetary policy in an economy[2]. Establishing one of the milestones in economic history, the Keynesian

[2] In this study, fiscal policy and monetary policy are considered in the scope of only the budget deficit and inflation relationship.

approach focuses on aggregate demand as the source of output in an economy, assuming excess capacity and price rigidity. Thus, the expansionary fiscal policy influences the aggregate demand and output, thereby changing prices with a multiplier effect. Multiplier activates through the consumption related to current income, as assumed in this approach. According to the extensions of the Keynesian view, such a government intervention creates a crowding out effect: directly, through substituting economic goods and services; indirectly, through the interest rate and exchange rate.

From monetarists' point of view, quantity theory of money [3] explains that inflation is proportional to money supply. Thus, monetarists support the argument that there is no role of fiscal policy in price determination and merely, money supply determines price level. As Friedman, M. 1-21 famously mentioned, *"inflation is always and everywhere a monetary phenomenon"* and Friedman and Schwartz (1963) reiterated the same. New classical economists emphasise on the matter that inflation drives through money supply in the short run but, not in the long run. Contrary to the Keynesian approach, some economists argue on supply side influences of fiscal policy, considering concepts such as rational expectation. Even in the short-run, fiscal policy may impact long run households' decisions with rational expectation. In contrast to the Keynesian approach, consumption decisions explained in the rational expectation approach depends on the government's Intertemporal Budget Constraints (IBC) as explained below. Moreover, the Ricardian equivalence approach explains that if households are aware of IBC, a lump sum tax cut may not change their consumption, because a consumer does not consider a tax cut as a permanent increase in related revenue. The validity of Ricardian equivalence, however, is limited with households' liquidity constraints and violating with the other assumptions [4]. In addition, according to the Monetarist arithmetic argument, the fiscal-monetary policy combination is also based on IBC in explaining equilibrium in the economy. Therefore, IBC is recognised as one of the important policy tools in this study. In forming IBC, the general equilibrium model framework is used with respect to the household sector, the monetary and fiscal sector under several assumptions. Accordingly, a household's utility

[3] MV=PY where Money supply (M) determines the Price level (P) assuming the Velocity of money (V) and Output(Y) is given.

[4] Ricardian equivalence assumes imperfect foresight, imperfect capital market, short time horizons, and intergenerational fiscal burden.

maximisation that is subject to budget constraints is incorporated into consolidated government's budget constraints, that explains monitory and fiscal conditions in financing fiscal deficits. According to the idea of 'Unpleasant Monetarist Arithmetic' of Sargent and Wallace' (1981), the policy coordination would be the matter whether the monetary policy or fiscal policy which would be the dominating policy in concluding the equilibrium. Assuming the existence of the Ricardian equivalence, the unpleasant monetarist arithmetic argument explains IBC in terms of discounted value of current and future values. In other words, as shown in Eq. (1), the total sum of the present discounted value of current and future values of interest payments on outstanding debt is equal to the sum of all present and future discounted values of primary deficit, interest bearing debt and seigniorage.

$$I_{t-1}B_{t-1} = BS_t + B_t + [M_t - M_{t-1}] \quad (1)$$

and the primary surplus is given $BS_t = P_t(\mathcal{L} - g)$.

Where $I_{t-1}B_{t-1}$ is interest payments on government debt holdings in previous period, g is government constant expenditure, B_t denotes government borrowings from the household sector in current period and $M_t - M_{t-1}$ indicates the change in money supply between two periods. Thus, primary surplus denotes the difference between lump-sum taxes and fixed expenditure.

Alternatively, IBC can be demonstrated as in Eq. (2) in real terms.[5]

$$\left(\frac{1}{\beta}\right) b_{t-1} = s_t + b_t + [m_t - m_{t-1}(1 - \pi_t)] \quad (2)$$

Where $\frac{1}{\beta}$ is real interest rate, s_t and b_t are primary surplus and debt respectively, $\pi_t = \frac{P_t - P_{t-1}}{P_t}$ indicates inflation rate. Similarly, $[m_t - m_{t-1}(1 - \pi_t)]$ is considered as seigniorage. Further, Eq. (3) is defined: the present value of present and future government

[5] Real terms are denoted by lower cases.

debt(d_t) is to be financed by present value of present and future seigniorage revenue ($F_{cb,t}$) and present value of present and future government tax collection ($F_{gov,t}$).

$$d_t = F_{cb,t} + F_{gov,t} \tag{3}$$

In other words, the given endowed government bonds are assumed to be in real terms and financed through taxes and seigniorage. In the scope of IBC, as against the outstanding debt stock, the government needs to maintain a surplus, by changing expenditure or revenue.

Contrary to the theoretical views in the previous section, some economists argue that such an impact of seigniorage on inflation as explained in the monetarist arithmetic cannot be applicable for some counties, particularly developed countries (King 1995, Woodfold, 1996). Similarly, if fiscal policy influences price level through money supply, it is again supportive to the monetarist's argument that inflation is determined by monetary factors rather than fiscal factors (Carlstrom and Fuerst 2000). Among these arguments, the Fiscal Theory of Price Level (FTPL) explains the alternative approach of the behavior of monetary policy and fiscal policy in determining and controlling price. Introducing FTPL, Leeper (1991), Woodford (1998), Sims (1997) and Cochrane (2005) discuss that inflation would be determined by policy coordination, led by merely fiscal policy rather than monetary policy. As given in the following formula, FTPL describes that any change in real primary surpluses and discount rate is absorbed by a change in price level, owing to constant real debt stock with the assumption that IBC is satisfied. Therefore, the opponents argue price determination is directly linked with fiscal policy matters.

$$\frac{Nominal\ Debt_t}{Price\ level_l} = E_t \sum_{j=0}^{\infty} \frac{Real\ Primary\ Surpluses_{t+j}}{Discont\ Rate_{t+j}}$$

Explaining further with several theoretical aspects of FTPL, firstly, assuming that government's bond holdings and money supply in IBC are given in nominal terms, FTPL suggests that the value of the initial amount of assets and change in such assets will be determined through price changes over time. IBC, therefore, indicates the real value of government bond holdings and money supply with respect to time. Supposing that monetary

policy and fiscal policy are independent and similarly, even these policies do not consider the status of IBC, and the price level should change to satisfy IBC, in response to the nominal change of the variables in IBC.

3. Empirical literature review

A large and growing body of literature exists on the topic of the relationship between budget deficit and inflation. However, owing to the differences in usage of country-wise data, techniques and methodologies, and other country-specific factors there is no consensus among researchers about such a relationship as some researchers find positive long run relation while others evidence a negative or no relationship between variables concerned.

Using cross county data from 1960-2001. Catao and Terones (2003) developed a methodology to examine the relationship between budget deficit and inflation and found a strong positive link with high magnitudes in high inflationary developing countries. They found, conversely, no such relationship in developed countries. They investigated data for 107 countries, which were categorised in several ways: firstly, on the basis of the level of financial development, which included advanced, emerging markets and other developing countries; and secondly, on the basis of the level of inflation, which included the top 25 inflators, the middle 50 inflators and the bottom 25 inflators. Sri Lanka was also included into the middle 50 inflators' group and developing country group, respectively. In terms of the scope of the study, they considered budget deficit scaled by narrow money, instead of the conventional measure of budget deficit scaled by GDP, with the theoretical approach of consolidated budget constraint. For the methodology, using the Auto Regressive Distributed Lag Model (ARDL), they aimed to capture short term dynamics explicitly from long run effects on the aforesaid relationship. Importantly, the current study follows this special modification introduced by Catao and Terones (2003).

Nguyen (2014) found budget deficit, government expenditure and interest rate as determinants of inflation in the study, which examined the data from nine Asian countries, including Sri Lanka. The findings of the study supported the argument of Fiscal Theory of Price Level (FTPL); an active fiscal policy would cause inflation. In this study, several methodological approaches for the time period of 1985 to 2012 were used: Pooled Mean Group (PMG)

estimation-based Error Correction method, the panel differenced GMM Arellano-Bond estimation method, Wester Lund panel co-integration tests. Moreover, Ishaq and Mohsin (2015) conducted panel data analysis using time series data of 11 Asian countries, including Sri Lanka. They found that the relationship was stronger in an underdeveloped financial system and passive monetary policies with the lack of central bank independence. In terms of the data for the time period of 1981-2010 in this study, their methodology was the Generalised Method of Movements (GMM). Habibulah, Cheah and Bahaom (2011) analysed the data for the period from 1950 to 1999, from 13 developing countries including Sri Lanka and concluded the positive long run relationship between budget deficit, inflation and money supply. This study considered the Vector Error Correction Model (VECM) along with the two stage Engle-Granger causality test. With the data for the period of 1999-2011, Abu and Karim's (2015) research work examined a sample of 51 African countries, which were divided into two groups: low-income countries with high inflation, middle income countries with moderate inflation. They found a positive, non-linear deficit inflation nexus. In terms of the magnitude of the relationship, they concluded that a one per cent increase in budget deficit would lead to a 0.23 per cent increase in inflation. They captured the non-linearity of the relationship by adding the square of the budget deficit in their models, which were estimated using fixed effect and the GMM estimation methodology.

Turning to several country specific studies, Ndanshanu (2012) conducted a study in Tanzania with data for the period of 1967-2010, using the pair-wise Angle-Granger causality test with Error Correction (ECM) and concluded on a positive relationship between the budget deficit and inflation. In the case of Turkey, Koyuncu (2014) carried out a study with time series data from 1987 to 2013, to find the deficit-inflation nexus, considering variables: budget deficit and M2 both scaled by GDP and inflation measured by CPI. Results of the study revealed bidirectional causality between budget deficit and inflation directly and indirectly through money supply in the long run. The study used the Johansen Granger causality test and Vector Auto Regressive (VAR) approach. Bakera et al. (2014) did a study with the data for the period of 1975-2012 to find the budget deficit inflation relationship in Nigeria and revealed the budget deficit is positively related to inflation in the long run. Johansen cointegration analysis and VEC model were used in this study. For the data during the period of 1973-2003, Agha and

Khan (2006) identified a long run inflationary effect of fiscal imbalances and the government borrowings from the banking sector in Pakistan.

Turning to recent country specific studies done on Sri Lanka, using time series data for the period of 1959-2008, Ekanayake (2012) found a positive significant relationship between the budget deficit and inflation, with the magnitude that a one per cent increase in narrow money supply scaled budget deficit would cause an 11 per cent increase in inflation in the long run. In terms of methodology, the pair- wise Granger causality test, ARDL/Bound test model along with the VECM form was used in this study. Using time series data from 1950 to 2010 in the case of Sri Lanka, Devapriya and Ichihashi (2012) conducted a study considering a set of variables money supply, interest rates, exchange rate and CPI inflation and revealed a positive significant relationship between budget deficit and inflation using the Johansen Granger causality test with VAR analysis in their analysis.

Analysing Indonesian data for the period from 1971to 1999, Datta and Mukhopadhyay (2011) found a positive relationship between inflation and budget deficit with the causality coming from former to latter only in the short term. The study considered the Johansen Granger causality test, Impulse Response Functions (IRF) and Variance Decomposition (VD) in VAR analysis and VECM specification as its methodology. Using data of the period of 1980-2012 in South Africa, Khumalo (2013) investigated the budget deficit inflation nexus and revealed a long run positive causality running from budget deficit to inflation. The Granger causality test and VAR analysis were employed in this study. Using data from 1980 to 2000 in Turkey, Creel and Kamber (2004) investigated the application of FTPL to explain Turkish inflation and budget deficit and concluded such relationship would exist only in the short run. A study in Pakistan was carried out with time series quarterly data from 1960 to 2007 by Mukhtar and Zakaria (2010) to examine interaction between the variables budget deficit, board money supply (M2) and CPI inflation, and they found no direct relationship between the budget deficit and inflation. The methodology of the study included the Johansen cointegration analysis, Granger causality test with VECM specification. For monthly data from January 1995 to December 2012 in Vietnam, Van (2014) revealed a no inflationary impact of the budget deficit although money supply showed a positive relation. The study used the Structural VAR model along with IRF and VD approaches as its methodology and considered inflation,

real GDP, interest rate, and money growth in the set of variables. For the time period of 1980 -2010, Saysombath and Kyophilavong (2014) found no relationship between the budget deficit and inflation in the People's Democratic Republic of Laos. They applied the ARDL Bound test with the Structural VAR approach in their analysis. With the result of the Granger causality tests and impulse response in the SVAR, they further revealed inflation might cause budget deficit, although there was no causation from budget deficit to inflation.

The evidence presented in the literature review suggests mixed ideas on the interconnection between budget deficit and inflation. Many of the studies which were conducted using developing country data, however, suggest a strong positive relationship between budget deficit and inflation.

4. Research methodology

Different statistical methods were used in empirical studies to assess the relationship between budget deficit and inflation where each has its own advantages and disadvantages. In recent studies, the budget deficit-inflation relationship has been examined in different approaches namely causality analysis, linear regressions, cointegration analysis, other non-linear analysis, etc. Among them, the Granger causality test provides a statistical hypothesis in deciding whether one time series granger causes another. In other words, this approach exposes dependent-independent relationships among variables. The cointegration approach considers the predictability of two or more-time series. Thus, the time series are said to be cointegrated, if such series are non-stationary at levels, but stationary at the first differences. In other words, cointegration describes a long run relationship of time series. In the error correction approach, error correction models estimate the short-term and long-term effects of one time series to another provided that those time series are cointegrated. In other words, the speed of adjustment of a dependent variable to equilibrium is declared in response to a change in other variables. Some researchers, however, use a variety of statistical methods and tests with the mix of above alternative approaches. In terms of methods and tests, methods such as the Ordinary Least Square (OLS) model, Vector Auto Regressive (VAR) models and Vector Error Correction (VEC) models are also commonly used with the appropriate statistical tests. Researchers further consider a variety of variables that are appropriate for the model

specifications that represent all four sectors in the economy: fiscal sector, monetary sector, external sector, and real sector.

In this study, three approaches are used to explore the relationship between budget deficit and inflation, in terms of adopting the best suited methods for the investigation: Granger causality test method, which has been developed by Toda- Yamamoto (1995); Bound test procedure with Auto Regressive Distributed Lag (ARDL) approach, which has been developed by Pesaran and Shin (1999) and Pesaran et al. (2001); ARDL error correction model specifications, which is used to capture long-run relation with short term dynamics.

4.1. The model specification

In the model specification, budget deficit is considered as the independent variable in two different ways which include budget deficit scaled by GDP and budget deficit scaled by narrow money (BDM1). Accordingly, BDM1 considers the impact of change in money supply even with the constant budget deficit, in measuring the inflationary effects. Other explanatory variables, along with the two indicators of inflation, are also considered in this study, with respect to four separate multivariate models.

This study follows the model specification designed by Catao and Terrones (2003). The basic formulation in modeling BDM1 is based on the general equilibrium model developed by Liungqvist and Sargent (2000), which explains the relationship among money supply, inflation, and government sector variables. The variables are incorporated by means of the government budget constraint that explains fiscal-monetary relation in explaining inflation with a theoretical approach. In this specification, several assumptions are made: the representative household maximises its utility; the economy is a small open economy; money in the economy is as explained in the shopping time model. The shopping time model also entails several assumptions: constant amount of income per period (y), that is divided into private consumption (c_t) and government consumption (g_t); one unit of time, that is divided into leisure (l_t) and shopping (s_t). The subsequent equations are demonstrated as follows:

Given $c_t + g_t \leq y$ and $l_t + s_t = 1$ Where $t \geq 0$ and $y > 0$,

$$s_t = H\left(c_t, \frac{m_{t+1}}{p_t}\right) \tag{4}$$

Where, H_c, H_{cc}, $H_{m/p,m/p} \geq 0$ and $H_{c,m/p} \leq 0$, which denote that shopping time is a function of consumption and money holdings; the shopping time is negatively linked to real money balances of the household $\left(\frac{m_{t+1}}{p_t}\right)$ owing to transaction cost and m and p denote money supply and inflation respectively. According to the money demand function of the shopping time model, the return on risk-free bonds is higher than money holding with transaction costs. With the description of the shopping time model, equations related to the household sector and government sector are presented to signify the equilibrium positions in each sector.

As assumed earlier, representative household maximises its utility that is given by:

$$\max \sum_{t=0}^{\infty} \beta^t u(c_t, l_t) \tag{5}$$

subject to,

$$c_t + \frac{b_{t+1}}{R_t} + \frac{m_{t+1}}{p_t} = y - \tau_t + b_t + \frac{m_t}{p_t} \tag{6}$$

Where $c_t \geq 0$, $l_t \geq 0$, $u_{c,\, uz} > 0$, $u_{cc}, u_{zz} < 0$ and $u_{cz} \geq 0$ assumes an increasing and concave function. Furthermore, β in the equation (5) denotes the discount factor, where $0 < \beta < 1$. In Eq. (6), the components are defined: nominal money balances with household is m_{t+1} during the period between time t and t+1; τ_t denotes lump sum tax; b_t is the real value of one-period risk-free bond; p_t is the price level and R_t denotes the real gross rate of return.

Therefore, the necessary condition of above maximisation problem is:

$$1 - \frac{p_t}{p_{t-1}}\frac{1}{R_t} = 1 - \frac{R_{mt}}{R_t} = \frac{i_t}{1+i_t} \geq 0 \tag{7}$$

Eq. (7) can be rewritten as in Eq. (8), that is equivalent to the Fisher equation:

$$\frac{R_{mt}}{R_t} - 1 = R_t \frac{p_{t+1}}{p_t} - 1 \backsimeq r_t + \pi_t = i_t \tag{8}$$

Where r_t and π_t imply the real interest rate and inflation rate, respectively. In addition, $R_{mt}=\frac{p_t}{p_{t-1}}$ shows the inverse relation of inflation rate on real gross return on money holdings during the time t and t+1 and $1+i_t=\frac{R_{mt}}{R_t}$ indicates the gross nominal interest rate.

Accordingly, the relevant Lagrangian equation with respect to Eq. (4), (5) and (6) is:

$$\sum_{t=0}^{\infty}\beta^{t}\left\{u(c_t,l_t)+\lambda_t\left(y-\tau_t+b_t+\frac{m_t}{p_t}-c_t+\frac{b_{t+1}}{R_t}+\frac{m_{t+1}}{p_t}\right)+\mu_t\left[1-l_t-H\left(c_t,\frac{m_{t+1}}{p_t}\right)\right]\right\} \quad (9)$$

Related first order conditions are derived with respect to $c_t, l_t, b_{t+1}, m_{t+1}$ as given in following equations:

$$u_c(t)-\lambda_t-\mu_t H_c(t)=0 \quad (10)$$

$$u_l(t)-\mu_t=0 \quad (11)$$

$$-\lambda_t\frac{1}{R_t}+\beta\lambda_{t+1}=0 \quad (12)$$

$$-\lambda_t\frac{1}{p_t}-\mu_t H_{m/p}(t)\frac{1}{p_t}+\beta\lambda_{t+1}\frac{1}{p_{t+1}}=0 \quad (13)$$

In addition, the following expression for λ is obtained using Eq. (8) and Eq. (9).

$$\lambda_t=u_c(t)-u_\ell(t)H_c(t) \quad (14)$$

Similarly, by substituting Eq. (14) to Eq. (12), the real interest rate is expressed:

$$R_t=\frac{1}{\beta}\frac{u_c(t)-u_\ell(t)H_c(t)}{u_c(t+1)-u_\ell(t+1)H_c(t+1)_t} \quad (15)$$

Furthermore, Eq. (12) and Eq. (13) are rearranged to obtain Eq. (16) which equates cost and benefits of holding a marginal unit of real money. In other words, there may be a loss, because of money holdings instead of investing in interest bearing bonds whereas the consumer may

be benefited by having money in hand, owing to reduce shopping time. Accordingly, Eq. (16) is derived:

$$\frac{R_t - R_{mt}}{R_t}\lambda_t = -\mu_t \mathrm{H_{m/p}(t)} \tag{16}$$

To derive money demand function in this model, Eq. (17) forms as follows, using Eq. (11), Eq. (14) and Eq. (16) and equating $\mathrm{u_c(t)}$ and $\mathrm{u_\ell(t)}$ at $\ell_t = 1 - H\left(c_t, \frac{m_{t+1}}{p_t}\right)$.

$$\left(1 - \frac{R_{mt}}{R_t}\right)\left[\frac{\mathrm{u_c(t)}}{\mathrm{u_\ell(t)}} - \mathrm{H_c(t)}\right] + \mathrm{H_{m/p}(t)} = 0 \tag{17}$$

Finally, the money demand function is defined in the first part of Eq. (18):

$$\frac{m_{t+1}}{p_t} = F\left(c_t, \frac{R_{mt}}{R_t}\right) = \hat{F}\left(c_t, \frac{i_t}{1+i_t}\right) = M^d\left(c_t, \frac{1}{R^*(1+\pi_t)}\right) \tag{18}$$

Similarly, the first part of the equation is equal to the latter parts with respect to the expressions given in Eq.(7) and Eq.(8); the third part of the Eq. (18) demonstrates that c_t is positively related to money demand while negatively related to the interest rate $\frac{i_t}{1+i_t}$ as derived in Eq. (8). Furthermore, according to the explanation of Catao and Terrones (2003), since the model assumes interest rate parity of $(R^\star = R)$, the last part of the Eq. (18) shows that c_t is positively related to money demand and is negatively related to international interest rate $R^\star$ and domestic inflation rate $\pi_t = \frac{p_{t+1}}{p_t}$. With the completion of household sector equilibrium, the government sector is to be explained.

The government budget constraint as explained in the chapter on theoretical literature is:

$$\frac{B_{t+1}}{R_t} = \tau_t - g_t + B_t + \frac{M_{t+1} - M_t}{p_t} \tag{19}$$

Where B_t denotes the government borrowing from the private sector in terms of units of goods in time t and M_t denotes money stock. Further, M_0 and B_0 are assumed to be given in the model. Finally, the long run equilibrium is formed to obtain an estimated form of this study, incorporating equations related to the household sector and government sector.

In forming the long run equilibrium, the additional assumptions with respect to prices and taxes are given; demand for money equals the supply of money ($m_t = M_t$); bond holding is ($b_t = B_t$) at the point that household maximises its utility and entity holds that $y = c_t + g_t$.

Therefore, economy-wide budget constraint is,

$$\frac{b_{t-1}}{R_t} = y_t - c_t - g_t + b_t \tag{20}$$

Furthermore, in the long run stationary equilibrium, the following conditions are assumed:

$\frac{p_t}{p_{t+1}} = R_m$, $R_t = R$, $c_t = c$, $s_t = s$ where t ≥ 0

As shown in Eq.21, the stationary equilibrium is obtained using Eq. (15) and Eq. (18).

$$R = \beta^{-1} \text{ and } \pi = \frac{M}{p} = M^d\left(c_t, \frac{1}{R^*(1+\pi_t)}\right) = \varphi(\pi) \tag{21}$$

In order to form the estimated formula, Eq. (21) is substituted to Eq. (19) resulting in the following equation.

$$\frac{\pi}{1+\pi} = \frac{p[g-\tau+B\frac{(R-1)}{R}]}{M} \tag{22}$$

Hence, the estimated form, $\pi = \varphi \frac{G-T}{M}$ is derived considering the approximation:

$$\pi \approx \frac{\pi}{(1-\pi)} \text{ and } G - T \approx p[g - \tau + B\frac{(R-1)}{R}$$, where BDM1 is $\frac{G-T}{M}$.

Having defined BDM1, the ARDL model specification is formed along with the other variables.

4.2. ARDL model

The synthesis of budget deficit and inflation is formed according to the procedure proposed by Pesaran and Shin (1999) and Pesaran et al. (2001), in terms of cointegration and error correction models in this study, which provides an appropriate framework to find the long run relationship with short-run dynamics. One advantage of the ARDL methodology is that

it avoids the prerequisite of the existence of the same order of integration in time series data as other methodologies. In addition, the ARDL model/Bound testing methodology estimates and interprets a simple model with a single equation form. Furthermore, the different lag levels may be included into the model, with respect to dependent and independent variables.

Before proceeding to the cointegration process with the ARDL model equations, it will be necessary to describe properties of ARDL. The ARDL model is autoregressive since the lag values of the dependent variable are included in the model as regressors. Similarly, the model has explanatory variables with lag values as regressors that are called distributed lag. Therefore, the model illustrated in Eq. (23) is explained as ARDL (p,q_1…..q_k) model, where 'p' symbolizes the number of lag for regressors of dependent variables and 'q_1…q_k' refer to the number of lags of explanatory variables from the first variable to k^{th} number of variables. Thus, the system entails (k+1) variables including k^{th} number of other variables and the dependent variable in the single equation system. In addition, in a certain model, some of the explanatory variables may be incorporated without lags and some of the other variables may have several lags.

Setting the equation form, there are three versions of ARDL model specifications: simple ARDL model, long- run version of ARDL model and the Bound tests formulation of ARDL model. The first form of equation estimates ARDL (p, q_1….q_k), that denotes dependent variable with its own lags and lags of other explanatory variables:

$$y_t = \alpha_0 + a_1 t + \sum_{i=1}^{\mathcal{P}} \Psi_i \; y_{t-i} + \sum_{j=1}^{k} \sum_{l_j=0}^{q_j} \beta_{j,l_j} x_{j,t-l_j} + \varepsilon_t \qquad (23)$$

Where y is the dependent variable; α_0 is the constant term and a_1 is the coefficient of linear trend, Ψ is the coefficient of lag variables of dependent variables used as repressors; β is the coefficient of other explanatory variables; ε_t is the random disturbance term.

Secondly, in the long run ARDL model, the long run coefficients are presented in Eq.24.

$$\hat{\alpha}_1 = \frac{\hat{a}_1}{1-\sum_{i=1}^{\mathcal{P}} \hat{b}_0} \text{ and } \hat{\theta}_j(1) = \frac{\hat{b}_j}{1-\sum_{i=1}^{\mathcal{P}} \hat{b}_{0,i}} \qquad (24)$$

Accordingly, ARDL cointegrating regression relationship EC_t and the bound test null hypothesis form is derived considering the differences of Eq.23 and substituting Eq.24:

$$\triangle y_t = b_0 y_{t-1} + \sum_{j=1}^{k} b_j x_{j,t-1} + \sum_{i=1}^{p-1} c_{0,j} \Delta y_{t-1} + \sum_{j=1}^{k} \sum_{l_j=1}^{q_j-1} c_{j,l_j} \Delta x_{j,t-l_j} + \varepsilon_t \quad (25)$$

Where, $EC_t = y_t - \sum_{j=1}^{k} \frac{b_j}{b_0} x_{j,t}$ and $H_0: b_0 = b_j = 0, \forall j$

Bound test procedure provides bounds on the critical values of F statistics, where the critical values of lower bound and upper bound are given for the different number of variables, depending on the order of cointegration. The assumptions for bounds are: all the variables are I(0) for lower bound; all the variables are I(1) for upper bound. Moreover, F statistics generated by a certain model are tested against the given bound values. In terms of decision rule, if the calculated value falls below the lower bound, the assumption for lower bound must be accepted, concluding that there is no long run relationship between two variables. Conversely, if the calculated F-statistics fall above the upper bound, the upper bound assumption is accepted, with the meaning that there is a long run relationship between dependent and independent variables. If the computed value falls between the lower and upper bounds, however, the result tends to be inconclusive.

It is also worth to note that the ARDL model assumes no serial correlation issue in the system owing to the fact that the formation includes lag variables of dependent variables as regressors. Serial autocorrelation is known as the situation where the residuals of a series that is known as the unexplained part of a regression, are correlated with its own lag values. Simply, ε_t of the above model is said to be serially correlated, if ε_t is correlated with $\varepsilon_{t-1}, \varepsilon_{t-2}$ and so on. If the model is suffered from a serial correlation issue, however, the coefficient of the regression is considered to be biased and respective standard errors may be incorrect. Thus, it is important to identify the serial correlation issue of a certain model before proceeding with the model.

4.3. Toda-Yamamoto granger causality procedure

The Granger causality between the dependent variable and independent variables is very important in modeling ARDL single equation formation that finds the causality between two or more series of stationary data that are cointegrated. As an example, with two time series data 'x' and 'y', x is said to Granger-cause y if y can be explained/forecasted more strongly after taking x and y together, rather than taking only y. In testing Granger causality, a null hypothesis is tested against an alternative hypothesis at the appropriate significance level, based on the model specification as demonstrated below, assuming the VAR model.

$$y_t = \alpha_0 + \alpha_1 y_{t-1} + \cdots + \alpha_p y_{t-p} + \beta_1 x_{1-1} + \cdots + \beta_p x_{t-p} + u_t \qquad (26)$$

$$x_t = \gamma_0 + \gamma_1 x_{t-1} + \cdots + \gamma_p x_{t-p} + \delta_1 y_{1-t} + \cdots + \delta_p y_{t-p} + v_t \qquad (27)$$

Where α and β symbolise coefficients for the variables x and y. Regarding Eq.26, the relevant null hypothesis is set to be: H_0: $\beta_1 = \beta_2 = \cdots = \beta_p = 0$ that implies that x does not Granger cause y, as against H_1 that assumes, H_0 is not true. Similarly, the set of hypotheses is also formed with respect to Eq. 27, $H_o: \delta_1 = \delta_2 = \cdots \ldots \ldots \ldots = \delta_p = 0$, that assumes y does not Granger cause x. Accordingly, the existence of Granger causality is concluded by rejecting H_0 with a suitable confidence level.

Engle and Granger (1987), however, point out that if the data is stationary at the different orders, even though they are cointegrated, the testing procedure explained above may be erroneous. The Engle-Granger causality test, therefore, may not provide a strong decision rule for the data in the current study. Therefore, the Granger causality procedure developed by Toda and Yamamoto (1995) is used in this study, as that is the most appropriate testing procedure for the data in the study that are integrated in different order. Toda and Yamamoto (1995) provide very comprehensive information about the procedure with the abstract of their paper as given in the following quotation:

> ……...*We can apply a usual lag selection procedure to a possibly integrated or cointegrated VAR since the standard asymptotic theory is valid (as far as the order of integration of the process does not exceed the true lag length of the model). Having determined a lag length k, we then*

> *estimate a ($k + d_{max}$)th-order VAR where d_{max} is the maximal order of integration that we suspect might occur in the process.* (Hiro Y.Toda, , Taka, Yamamoto. (1995) Statistical Inference in Vector Auto regressions with possibly integrated processes. Journal of Econometrics, 66 (1995): pp.225-250.)

The Toda and Yamamoto procedure, thus, provide the testing method, which is free from the problems of the order of integration or cointegration.

The testing process has several steps. The first step includes determining the maximum order of integration (d_{max}) using the unit root tests: the Augmented Dickey-Fuller (ADF) test, Kwiatkowski-Phillips-Schmidt-Shin test etc. Secondly, the VAR model specification, like a model as illustrated in Eq.26/Eq.27, is to be used in deciding the maximum lag length (k^{th} lag), considering the selections of lag length criteria: Akaike Criteria (AIC), Bayesian Information Criteria (BIC), Schwarz Information Criteria (SIC) etc. The third step is to check the VAR model for serial independence, stability etc. applying the standard tests: Auto Regressive unit root graph, VAR residual serial correlation Lagrange Multiplier (LM) test, VAR residual normality test etc. The fourth step is to include $k+d_{max}$ lags as exogenous variables and re-estimate the VAR model. Finally, depending on relevant results of the Wald test, the null hypothesis is rejected at an appropriate significance level to decide Granger causality. As explained above, this decision provides statistical evidence of the existence of a causal relationship between variables concerned. Relevant to the current study, the Wald test results are used to examine the causality coming from budget deficit to inflation while rejecting the opposite direction.

5. Empirical analysis

This study examines the relationship between budget deficit and inflation in Sri Lanka in terms of causality, long run cointegration and magnitude of long run coefficients using time series data from the period 1957-2016. As explained previously, the variables and models are appropriately applied with statistical tests,[6] to assess this relationship. In summarising the variables in the study, firstly, two measures of budget deficit are used: budget deficit scaled

[6] This study uses e-views 9.5 version to carry out aforementioned tests.

narrow money supply (BD/M1), budget deficit scaled by Gross Domestic Product (BDGDP). Secondly, two alternative indicators of inflation are also considered in this study: Colombo Consumer Price Index (CCPI) and GDP deflator. Additionally, the study considers several explanatory variables in the selected models: the exchange rate of Sri Lankan Rupees vs. US$ (US$), Broad money supply (M2), GDP growth, three months Treasury Bill Yield (TBR). The data in this study are taken from the latest Annual Reports of the Central Bank of Sri Lanka.

Graphical representation reveals the hypothesis of this study demonstrating a long run trend with random cycles. LNBDM1 shows an upward trend with a curvature. In addition, the variables namely, LNFR, LNUSD and LNM2 and LNTBR demonstrate an upward trend. In common, the variables appear to be a mix of stationary and non-stationary.

5.1. The analysis of unit root

Although testing for the unit root is not a necessary condition or pre-test requirement in the ARDL system, owing to the ability to deal with variables in the different order of integration, it is advisable to test for the presence of unit root to clarify that the data series are not I (2). This is because the system of ARDL tends to be erroneous, when dealing with integrated stochastic trends of I (2) variables. Thus, with understanding of the nature and the behavior, the variables are tested for prevalence of unit root. To test for the unit root, Augmented Dikey-Fuller (ADF) test has been applied in this study with Akaike Information Criteria (AIC). Accordingly, t-statistics of the ADF test statistics are compared with the test critical values at different significance levels. Consequently, the null hypothesis of non-stationarity is rejected considering related probabilities to determine order of integration. The t-statistics and related probabilities demonstrate the variables are integrated at different levels: integrated at levels I (0) or integrated at the first difference I (1).

The results show that the stationarity of variables is varied owing to the presence of different probabilities with different options. The statistical tests, however, reveal that none of the variables are I (2). This data series, thus, are well fitted for the ARDL model specification, which are designed particularly for the data in this nature.

5.2. Estimated models

There are four functional forms modeled in this study: VAR models in the Toda-Yamamoto Ganger causality analysis and the ARDL model specifications in cointegration analysis. Thus, the functional forms are designed based on the nature of the variables and the order of integration. Accordingly, this study considers four separate models, which are divided into two, depending on separate alternative indicators for inflation: CCPI and GDPD. Furthermore, the two categories are again classified into two forms, considering different budget deficit indicators: BDM1 and BDGDP. In other words, this study investigates the two budget deficit indicators scaled by different denominators (M1 and GDP), in terms of two alternative inflation indicators (CCPI and GDPD). The denominator of the conventional budget deficit indicator (BDGDP) is considered as an indicator, which may capture all the changes in budgetary components: revenue, expenditure, deficit financing etc. On the other hand, BDM1 has been derived, concerning the government budget constraints and BDM1 is believed to capture the effects of inflationary financing of the budget deficit, considering narrow money supply as its base. Applying these two measures, thus, provides sufficient theoretical and practical background for a better comparison, while ensuring strong evidence in revealing the interaction between budget deficit and inflation. Regarding indicators of inflation, CCPI calculates with selected samples of consumer items, including imported items and selected population groups. GDPD covers all the items domestically produced with respect to all the population. CCPI is, however, widely utilised in measuring inflation. Both the indicators, thus, are very important in explaining inflationary impacts, particularly, in the long run. Considering these differences, both measures are alternatively used in this study, to ascertain a comprehensive analysis with a better comparison and statistical evidence. With regard to the other variables, this study includes several explanatory variables, namely, US$, FR, M2, GDP, TBR, considering their impact on the main variables.

5.3. Causality analysis

In performing the causality test, this study examines the nature of the causal relationship between budget deficit and inflation. In other words, the causality test is carried out to determine the relationship, which was established in the hypothesis of this study; the causality may come from budget deficit to inflation. As mentioned in the methodology, this study

applies the Toda-Yamamoto procedure to test Granger causality followed by the pre-tests for serial independence and stability. In line with pre-testing steps, maximum lag length (d_{max}) is determined based on the Akaike Information Criteria (AIC) and maximum order of integration (k) is concluded in line with the unit root analysis. Subsequently, this study has applied the VAR residual serial correlation LM test with the null hypothesis of no serial correlation at the lag order, of which acceptance is based on higher chi-square probabilities. In addition, the pre-testing procedure has observed the AR root graph to ensure the stability of the VAR model, which must proceed with the Wald test at the next step.

Regarding all the models, the maximum order of integration (k) equals one that indicates all the variables are I (0) or I (1). Also, the maximum lag length (d_{max}) selected on the basis of AIC is higher than the value of k. With the acceptance of the null hypothesis at 5 per cent significance levels, the result of the serial correlation LM test concludes the serial independence of all four models. Further the result of the stability test also conclude that the selected VAR models are dynamically stable.

With the success of pre-tests as described above, the selected VAR models have been rematerialised imposing $(k+d_{max})th$ lags as exogenous variables. Subsequently, with the result of the Granger causality/Block Exogeneity test, Granger causality has been determined by rejecting the null hypothesis of no dependent- independent relation between the selected two variables with lower probabilities. Using the same logic, higher probabilities conclude acceptance of null hypothesis.

The results, as shown in Table 3, indicate that all four models reject the null hypothesis at the one per cent significance level, confirming causality coming from budget deficit to inflation. Similarly, all four models reject the opposite causality by accepting relevant null hypotheses. This concludes that a unidirectional relationship exists between representative variables namely BDM1 and BDGDP (indicative variables of the budget deficit) and CCPI and GDPD (two indicators of inflation) at acceptable significance levels: model 1 at 10 per cent, model 2 at 5 per cent, model 3 and model 4 at one per cent. On the other hand, all null hypotheses of no opposite direction cannot be rejected with a very high significance level. In other words, the unidirectional relationship of the deficit–inflation relationship has been revealed with the

evidence given in Table 3 below. Importantly, irrespective of the difference in the indicators of both budget deficit and inflation, the results are confirmed with strong statistical evidence. This study, thus, concludes strong statistical evidence for the existence of unidirectional causality, coming from budget deficit to inflation in Sri Lanka.

In completion of testing procedure for Granger causality, cointegration testing process can be proceeded to explore budget deficit-inflation interaction. Regarding the cointegration analysis, the ARDL model specification designs a single equation system where the dependent-independent causality is considered to be very important.

Table 3: Result of Block Exogeneity Wald test

Model	Null hypothesis	Result	Probability
1	1.no causality from LNBDM1 to LNCCPI	H_0 rejected	0.0570
	2.no causality from LNCCPI to LNBDM1	H_0 accepted	0.3431
2	1.no causality from LNBDGDP to LNCCPI	H_0 rejected	0.0425
	2.no causality from LNCCPI to LNBDGDP	H_0 accepted	0.9582
3	1.no causality from LNBDM1 to LNGDPD	H_0 rejected	0.0000
	2.no causality from LNGDPD to LNBDM1	H_0 accepted	0.6402
4	1.no causality from LNBDGDP to LNGDPD	H_0 rejected	0.0039
	2.no causality from LNGDPD to LNBDGDP	H_0 accepted	0.2463

In addition, the results provide strong evidence to proceed with the estimated models for further investigation of possible long-run cointegration.

5.4. ARDL regression and bound test procedure

To assess the cointegration between budget deficit and inflation, the ARDL model specifications associated with ARDL/Bound test procedure need to be formed. To form the relevant ARDL model specifications, this study follows the similar model formulation that tested for Granger causality in the previous section. The illustrative long run ARDL model formulation is as follows:-

Model-1

$$\triangle \mathrm{CCPI}_t = \alpha_0 + \sum^{q1}_{\ell=1} \delta_m \triangle \mathrm{CCPI}_{t-\ell} + \sum^{q2}_{m=0} \delta_m \triangle \mathrm{BDM1}_{t-m} + \sum^{q3}_{m=0} \theta_m \triangle \mathrm{M2}_{t-m} + \sum^{q4}_{m=0} \sigma_m \triangle \mathrm{US\$}_{t-m} + \sum^{q5}_{m=0} \gamma_m \triangle \mathrm{TBR}_{t-m} + \sum^{q6}_{m=0} \zeta_m \triangle \mathrm{RGDP}_{t-m} + \omega_0 \mathrm{CCPI}_{t-1} + \omega_1 \mathrm{BDM1}_{t-1} + \omega_2 \mathrm{M2}_{t-1} + \omega_3 \mathrm{US\$}_{t-1} + \omega_4 \mathrm{TBR}_{t-1} + \omega_5 \mathrm{RGDP}_{t-1} + \varepsilon_t$$

The graphical representation suggests a mix of possible stationarity and non-stationarity time series data. Moreover, the test result of the order of integration of the variables reveals that all the variables are a mix of I(0) and I(1) variables. In determining the lag length as to select information criteria for model specifications presented above, this study applies automatic model selection feature incorporated with E-views, where the model selection process is based on the lowest value of selection criteria that is AIC. Model selection is based on the process where the best fitted model specifications are selected pooling a considerable number of models, by means of respective maximum lag lengths provided with the VAR specifications.

The tests performed for the serial autocorrelation using the Breush-Godfrey Serial Correlation LM test concludes that no serial correlation exist in selected models, by rejecting the null hypothesis that the residuals of the series are serially correlated. The null hypothesis has been rejected at higher probabilities of F statistics and Chi-Squares in model 1 and model 2. However, model 3 and model 4 probabilities of F statistics have exceeded only a 5 per cent significance level. Furthermore, the graphical representations of autocorrelation, partial autocorrelation and Q-stat with related probabilities confirm the statistical evidence of non-presence of serial autocorrelation. The results, therefore, verify the selection of the best models at a strong significance level, thereby providing sufficient statistical evidence for applying the single equation ARDL model which incorporated lag values of dependent variables as repressors.

In investigating cointegration, the selected ARDL models are to be appropriately arranged to perform the bound test, where F values and related bounded critical values are obtained for lower bound I(0) and upper bound I(1). Accordingly, the decision rule is made by comparing calculated F-statistics with related bounds critical values with respect to different significance levels. Decision rule measures the existence of cointegration of series, depending on the region, where the calculated F values fall. Accordingly, if F-statistics exceeds upper bound critical values, a decision is to be taken in favor of the presence of cointegration. Conversely, if F-statistics falls below the lower bound, non-existence of cointegration is determined. Nevertheless, the results are inconclusive if F-statistics falls in between the bounds.

Table 4: ARDL/Bound test results

Significance Level	Bounds	Model 1	Model 2	Model 3	Model 4
		F Statistics			
		2.991	3.218	5.745	4.49
		Bounds Critical Values			
10.0%	I(0)	1.99	1.99	1.99	2.08
	I(1)	2.94	2.94	2.94	3.00
5.0%	I(0)	2.27	2.27	2.27	2.39
	I(1)	3.28	3.28	3.28	3.38
2.5%	I(0)	2.88	2.88	2.55	2.70
	I(1)	3.61	3.61	3.61	3.73
1.0%	I(0)	2.88	2.88	2.88	3.06
	I(1)	3.99	3.99	3.99	4.15

The results obtained from the bound test presented in Table 4 that shows the related F-statistics of all four models exceed upper bounds, at acceptable significance level, revealing statistical evidence to accept the cointegration relationship as formed in the models. Accordingly, F stat of Model 1 exceeds bound at a 10% significance level and Model 2 passes the test with a 2.5% significance level. Model 3 and 4, however, exceed the upper bound at 1% significance level.

The results reveal the long-run relationship between the budget deficit and inflation in Sri Lanka. In other words, the overall findings of cointegration confirm further that the existence of cointegration in both the deficit indicators (BDM1 and BDGDP) irrespective of the scales and the results are commonly applied to the two different inflation measures (CCPI and GDPD) as well. Thus, these results are in line with the results obtained in causality tests. Furthermore, it is provided with the statistical evidence to proceed with investigating long run coefficients using the ARDL error correction version to ascertain the magnitudes of the existing relationship.

Table 5: Results of the long-run form of ARDL model

Independent Variables	Dependent Variable			
	LNCCPI		LNGDPD	
	Model 1	Model 2	Model 3	Model 4
LNBDM1	1.62**	-	1.46*	-
LNBDGDP	-	1.69*	-	2.34*
LNGDPD	-	-	-	-
LNM2	-0.60	-0.06	0.71	2.25
LNRGDP	-0.44	-0.46	-0.57	0.70
LNUS$	1.91	1.67	-0.70	-0.56
LNTBR	0.29	-0.19	0.94*	0.06
LNF	-0.61	-0.86**	-0.80	-2.88**
C	-0.52	-0.13	-6.43*	-10.31
Cointeg. Term	-0.69***	-0.67***	-0.80***	-0.64***

*,** and *** denote significant levels of 10%, 5% and 1% respectively

5.5. ARDL regression and long run analysis

In obtaining long-run coefficients of the ARDL model, which was suggested by the bound test procedure, this study applies error correction versions of the ARDL model. Accordingly, similar model specifications of ARDL/Bound test procedure are rearranged to the ARDL cointegration and long run form in E-views to obtain relevant coefficients. With the successive application of the tests, the results are demonstrated in Table 5: the respective cointegration terms indicate a desired minus sign and value of each is less than one; the coefficients of budget deficit indicators are positive and significant; other variables show mixed results and

many of them are insignificant. Regarding model 1: the cointegration term is -0.59, which means more than half of the disequilibrium will correct within one year; the coefficient of BDM1 is positive and significant at 10 per cent. Moreover, the coefficient predicts that a one per cent increase in LNBDM1 will lead to a 1.26 per cent increase in inflation rate measured by LNCCPI. Other variables in model 1, however, are insignificant (except RGDP), although some of the variables entail a correct sign. Regarding model 2, the cointegration term (-0.67) and coefficient of LNBDGDP (2.13) are both highly significant, p=0.01. Similarly, model 3 records that 80 per cent of deviations will be corrected within one year while coefficient of LNBDM1 is significant at 10 per cent level. Model 4 results confirm that the cointegration term is highly significant and the coefficient of LNBDGDP is significant at 10 per cent level.

The results shown in the above table reveal, in common, about half of the equilibrium adjustment will be corrected within one period as evidenced with one per cent significance level. Alternative indicators of the budget deficit (BDM1 and BDGDP), are both significant with respect to both indicators of inflation, concluding a strong positive relationship between budget deficit and inflation. With respect to the magnitudes, the relationship establishes that a one per cent increase in LNBDM1 and LNBDGDP may cause a 1-2 per cent increase in inflation irrespective of measurement of inflation. In summary, the overall results, therefore, reveal a long run positive relationship with the causality coming from the budget deficit to inflation with the magnitudes of 1-2 per cent, as proved by the different statistical tests under acceptable significance levels. The result further confirms the budget deficit inflation relationship in terms of both the budget deficit indicators and inflation indicators irrespective of their differences.

6. Conclusion and recommendations

6.1. Conclusion

The purpose of this study is to examine the relationship between the budget deficit and inflation in Sri Lanka. Accordingly, the relationship is assessed using three alternative statistical approaches: the Toda-Yamamoto Granger causality procedure, which examines the causal relationship between the variables; the ARDL/Bound test cointegration approach, which investigates the long-run relationship with short-term dynamics; the ARDL error correction

form, which examines the cointegration term and long-term coefficients. Using these statistical approaches, this study models budget deficit in two different scaling. Firstly, budget deficit is scaled by narrow money (BDM1), based on the theoretical approach of Intertemporal Budget Constraint (IBC) and secondly, budget deficit is scaled by GDP used as a conventional indicator. Moreover, separate inflation indicators (CCPI and GDPD) are also used in this study, in order to capture different aspects of inflation within the scope of the two inflation measures.

With respect to the estimated models, four separate model specifications are designed to estimate the aforementioned relations, which are categorised according to the separate indicators for budget deficits and inflation. Additionally, several explanatory variables are also included in all the models, representing macroeconomic sectors directly associated with budget deficit and inflation. As discussed previously in this study, background information and empirical research designs are considered in forming the above models. Furthermore, empirical analysis of the current study works out with time series annual data during the period of 1957-2016.

Turning to the findings, this study concludes firstly, unidirectional Granger causality with respect to all the estimated models. In other words, the results reveal that the budget deficits Granger caused inflation, but not vice versa in Sri Lanka. This causal relationship was commonly evidence in all four models irrespective of the difference in the indicators used in the models. Furthermore, the conclusion of the Granger causality tests proves a strong statistical significance of acceptable level.

Secondly, in line with the result of Granger causality tests, this study reveals a long run cointegration relationship between budget deficit and inflation in Sri Lanka. Moreover, the results of the cointegration tests also prove that the cointegration results are seemingly common to all the estimated models. In addition, the cointegration test results are proved with acceptable statistical evidence of significance levels ($p=0.10$, $p=0.5$, and $p=0.01$).

Thirdly, this study concludes the positive long-run correlation with considerable magnitudes between budget deficit and inflation in Sri Lanka. The long-run cointegration coefficients of

estimated models are less than one with negative sign and are significant at one per cent level. The magnitudes of long-run cointegration terms in all the four models are between -0.6 and -0.8 per cent, commonly indicating 60 per cent to 80 per cent of disequilibrium between principal variables would be corrected within a one-year period; the speed of adjustments was comparably high. Regarding the magnitudes of long run cointegration coefficients, the long run coefficients of the ARDL error correction models reveal that one per cent change in budget deficits as measured by LNBDM1 and LNBDGDP will result in a 1.5-2.5 per cent change in inflation as measured by LNCCPI and LNGDPD in Sri Lanka at acceptable significance levels (10%, 5%, and 1%). Moreover, four separate models formed in this study conclude nearly similar results suggesting strong evidence of the positive relationship between variables interested in this study. The results of all three approaches: Granger causality test results, ARDL/Bound test results and the ARDL long run coefficients collectively confirm the hypothesis in this study that the existence of considerable magnitude of the positive relationship between the budget deficit and inflation in Sri Lanka are proved with strong statistical evidence.

Referring to the theoretical literature, Unpleasant Monetarist Arithmetic (Sargent and Wallace, 1981) that is considered as one of the milestones in uncovering the budget deficit-inflation nexus, emphasises the importance of fiscal policy in price determination, particularly under fiscal dominance. In recent economic history, theoretical arguments have emerged in favor of a considerable role of fiscal policy in determining price level, with approaches such as fiscal theory of price level. The findings of the current study are supported by these theoretical explanations.

According to the findings of the empirical studies, some researchers conclude the strong positive relationship between budget deficit and inflation, particularly, in developing countries. Thus, the findings of this study contribute to filling the gap in the literature, enhancing the understanding of the budget deficit-inflation relationship. In line with that, this study broadly confirms similar type of findings: findings of Catao and Terrones (2003), Ishaq and Mohsin (2015), Habibulah, Cheah and Bahaom (2011), which consider a developing country group including Sri Lanka; findings of Abu and Karim (2015) which did not include Sri Lanka in the sample of the study; findings of country-specific studies, such as the studies of Solomon and Wet (2004), Helmy (2008), Ndanshanu (2012), and Ekanayake (2012), which was conducted

using similar country data. Similarly, Devapriya and Ichihashi (2012) also found a similar positive long-run relationship with bi-directional causality using country data for Sri Lanka.

6.2. Policy recommendations

The findings of this study entail several important implications for policy makers and future researchers. Firstly, the findings explore fiscal policy influence into the inflation in Sri Lanka. According to the concept of intertemporal budget constraints in Economics, the impact of budget deficit on inflation may emerge sooner or later with a higher cost. Similarly, Sargent and Wollece (1981) explain the unpleasant monetarist arithmetic, where the fiscal dominance situation may limit a central bank's ability to control inflation in an economy. The findings of this study suggest that a similar theoretical approach is applicable to Sri Lanka to some extent. Thus, policy makers may consider the policy interaction revealed in this study in formulating and implementing the fiscal policy and monetary policy in Sri Lanka. In this regard, the fiscal policy may be rule-based, to keep budget deficits at a lower level to minimise the adverse impact on inflation. This may be realized through rationalising expenditure, improving revenue performance, and assuring maximum efficiency of government resource utilisation. These measures, in addition, may be helpful to reduce the pressure on monetary policy which is responsible for price stability. However, fiscal policy management is always a challenge for policy-makers in terms of several key factors: higher expenditure in expediting economic growth in the country, unavoidable expenditures such as interest payments and amortisation, lower revenue performance and limited accessibility of non-inflationary financing, underdeveloped market structures etc. Monetary policy, on the other hand, is also challenging with poor fiscal management including inflationary deficit financing.

Secondly, the findings of this study are important, in the wake of the improvements of the monetary policy framework in Sri Lanka as the Central Bank of Sri Lanka is in the process of adopting IT framework as its monetary policy framework. Well managed fiscal-monetary coordination is a prerequisite of an IT framework, and the findings of this study provide insightful understanding about the fiscal-monetary policy relationship and some other key areas to be considered. Therefore, as a policy recommendation, fiscal sector pressure on monetary policy needs to be minimised with strong fiscal management strategies.

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Appendices

Figure A1: Graphical representations of data

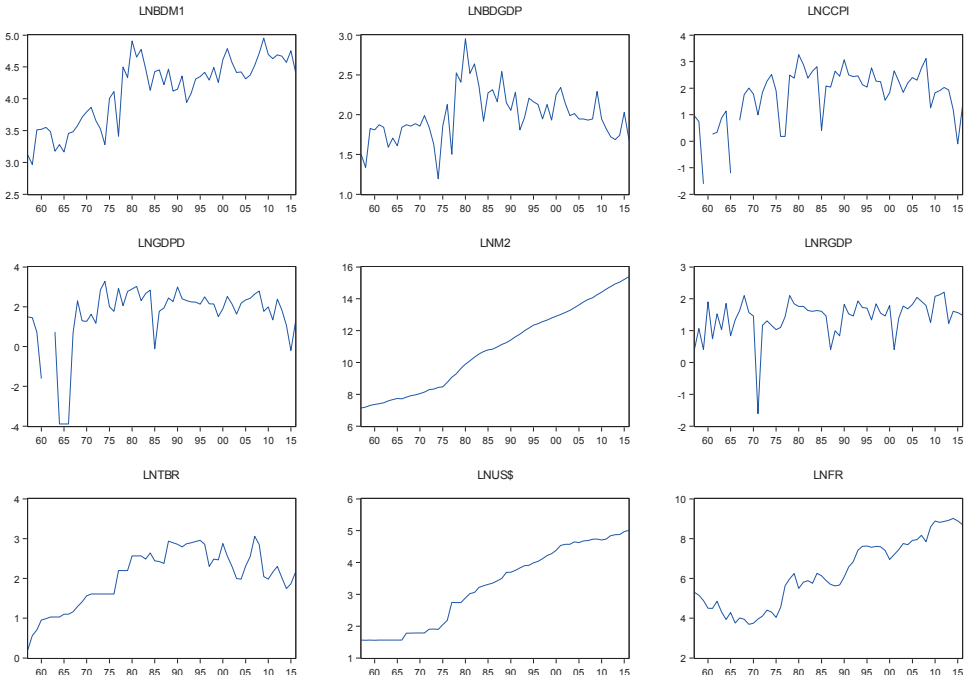


Table A1: Test results of unit root

Variables	Include in Test Equation	Augmented Dicky-Fuller							
		Akaike Info. Criterion				Schwarz Inf. Criterion			
		Levels		1st difference		Levels		1st difference	
		t-Stat.	Prob.	t-Stat.	Prob.	t-Stat.	Prob.	t-Stat.	Prob.
LNCCPI	**Tre.and Int.**	-2.96	0.15	-4.53	0.00	-2.96	0.15	-7.40	0.00
	None	-0.52	0.48	-4.31	0.00	-1.27	0.19	-7.68	0.00
LNGDPD	**Tre.and Int.**	-3.10	0.12	-7.81	0.00	-3.10	0.12	-5.94	0.00
	None	-0.52	0.48	-6.76	0.00	-1.86	0.06	-5.92	0.00
LNBDM1	**Tre.and Int.**	-2.94	0.16	-11.42	0.00	-4.04	0.01	-11.42	0.00
	None	0.76	0.87	-11.36	0.00	0.76	0.87	-11.36	0.00
LNBDGDP	**Tre.and Int.**	-2.92	0.16	-11.68	0.00	-3.99	0.01	-11.68	0.00
	None	-0.13	0.64	-11.74	0.00	-0.13	0.64	-11.74	0.00
LNRGDP	**Tre.and Int.**	-5.13	0.00	-4.52	0.00	-7.16	0.00	-13.14	0.00
	None	-0.30	0.57	-4.59	0.00	-0.94	0.31	-13.36	0.00
LNM2	**Tre.and Int.**	-3.23	0.09	-3.68	0.03	-2.73	0.23	-3.68	0.03
	None	3.21	1.00	-0.81	0.36	3.21	1.00	-1.20	0.21
LNTBR	**Tre.and Int.**	-0.82	0.96	-7.18	0.00	-2.11	0.53	-7.18	0.00
	None	0.46	0.81	-6.43	0.00	0.16	0.73	-6.43	0.00
LNUS$	**Tre.and Int.**	-1.72	0.73	-7.05	0.00	-1.72	0.73	-7.05	0.00
	None	4.55	1.00	-1.33	0.17	4.55	1.00	-5.25	0.00

Tre. and Int.=Trend and Intercept, t-stat=t-statistics, prob.=probabilities

Table A2: Functional forms of the estimated models

Model	Functional Form
Model-1	LNCCPI=f(LNBDM1, LNM2, LNRGDP, LNTBR, LNUS$, LNFR)
Model-2	LNCCPI=f(LNBDGDP, LNFR, LNUS$, LNTBR, LNM2, LNRGDP)
Model-3	LNGDPD=f(LNBDM1, LNM2, LNTBR, LNUS$, LNRGDP, LNFR)
Model-4	LNGDPD=f(LNBDGDP LNM2, LNRGDP, LNFR, LNUS$)

Table A3: Tests results of serial independence

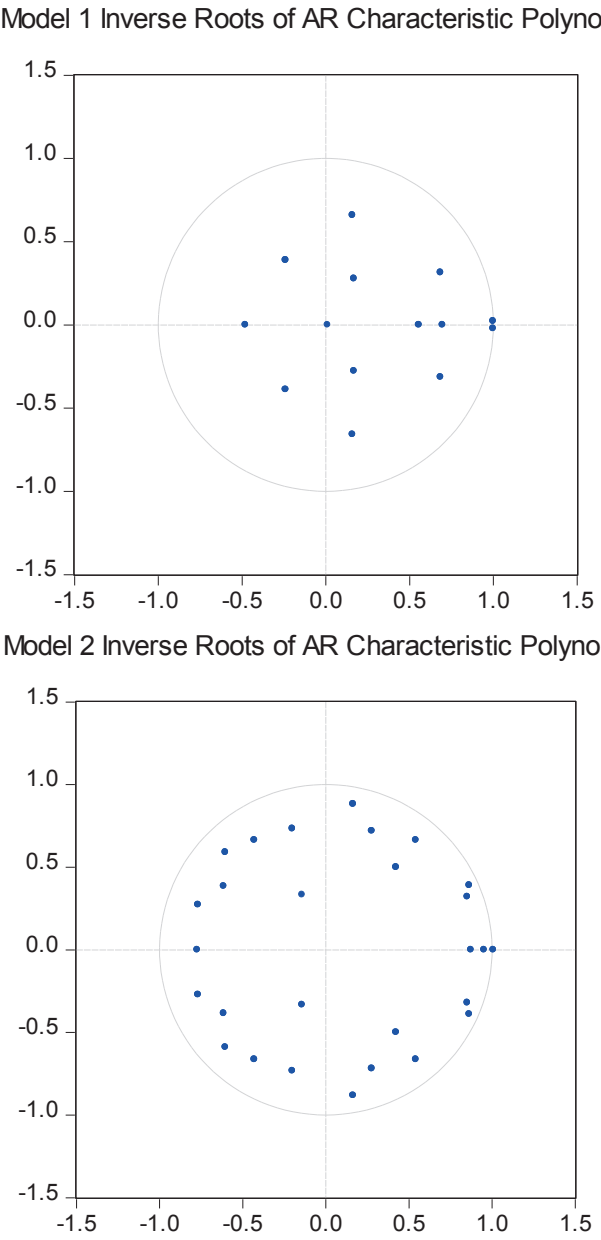
Model	Lag Order (k)	Information Criteria	d_{max}	Serial Correlation LM test	Inverse Root of AR Characteristic Pyramid[7]
1	1	AIC	2	H_0 accepted	Dynamically stable
2	1	AIC	3	H_0 accepted	Dynamically stable
3	1	AIC	5	H_0 accepted	Dynamically stable
4	1	AIC	5	H_0 accepted	Dynamically stable

Table A4: Test result of Breush-Godfrey serial correlation LM test

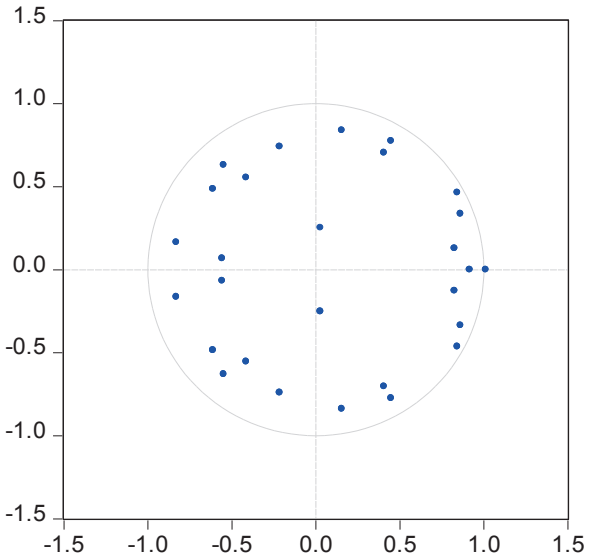
Model	Prob. F Statistic	Prob. Chi-Square
1	F(4,24), 0.9949	C(4), 0.9787
2	F(2,24), 0.6512	C(2) 0.3943
3	F(3,26), 0.1345	C(2), 0.0198
4	F(4,23), 0.0935	C(4), 0.0370

[7] The results are based on Inverse Root of AR Characteristic Pyramids as given in Figure A2.

Figure A2: Inverse roots AR characteristic polynomial (for causality tests)



Model 3 Inverse Roots of AR Characteristic Polynomial



Model 4 Inverse Roots of AR Characteristic Polynomial

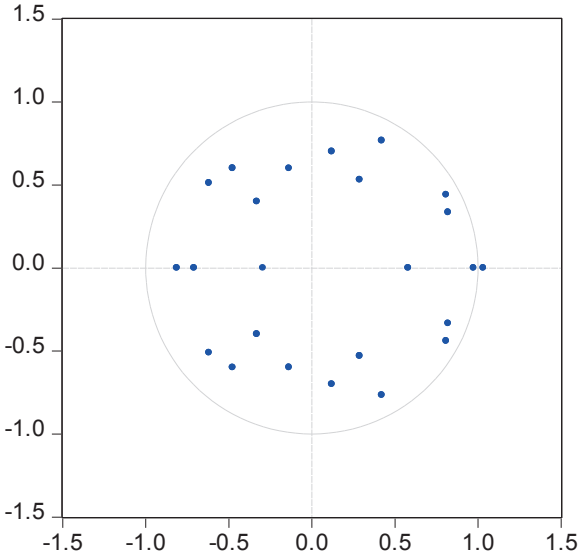
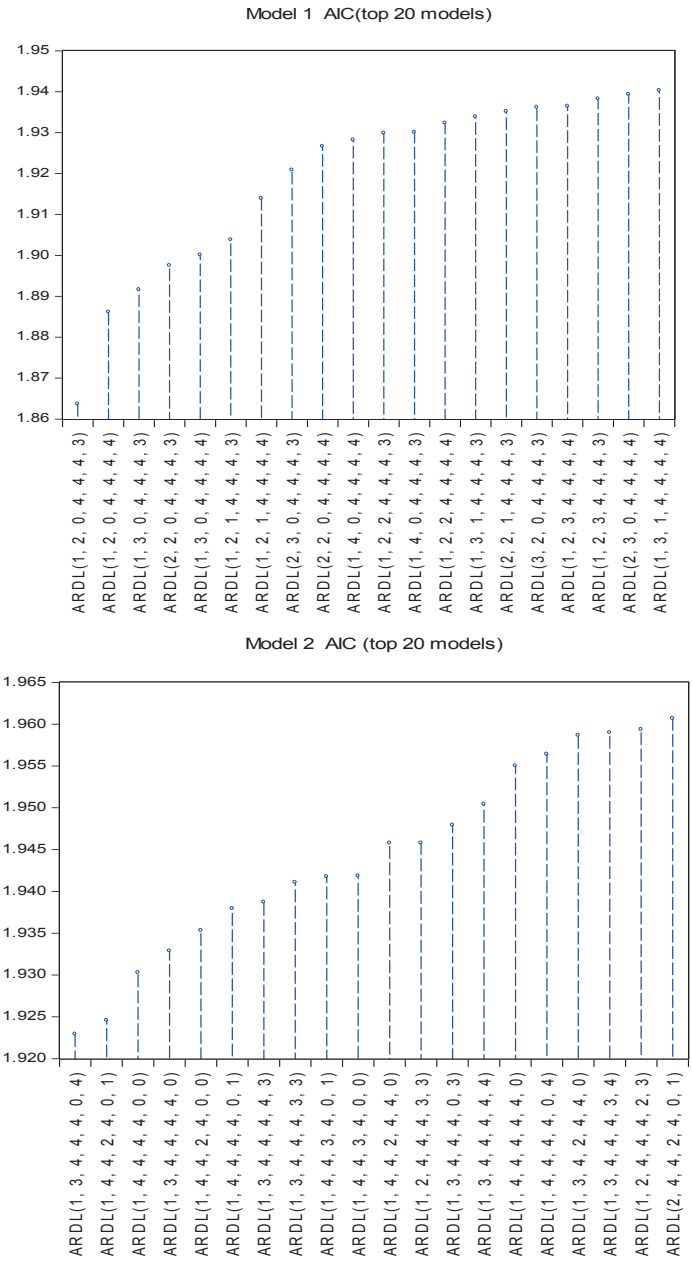
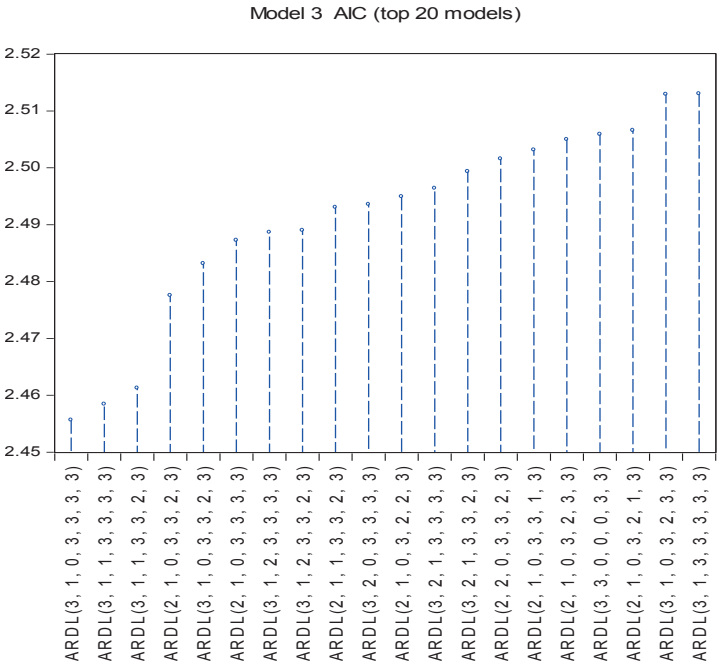


Figure A3: Top 20 ARDL models selected through AIC




Model 3 AIC (top 20 models)
2.52
2.51
2.50
2.49
2.48
2.47
2.46
2.45
ARDL(3, 1, 0, 3, 3, 3)
ARDL(3, 1, 1, 3, 3, 3)
ARDL(3, 1, 1, 3, 2, 3)
ARDL(2, 1, 0, 3, 2, 3)
ARDL(3, 1, 0, 3, 2, 3)
ARDL(2, 1, 0, 3, 3, 3)
ARDL(3, 1, 2, 3, 3, 3)
ARDL(3, 1, 2, 3, 2, 3)
ARDL(2, 1, 1, 3, 2, 3)
ARDL(3, 2, 0, 3, 3, 3)
ARDL(2, 1, 0, 3, 2, 3)
ARDL(3, 2, 1, 3, 3, 3)
ARDL(3, 2, 1, 3, 2, 3)
ARDL(2, 2, 0, 3, 2, 3)
ARDL(2, 1, 0, 3, 1, 3)
ARDL(2, 1, 0, 3, 2, 3)
ARDL(3, 3, 0, 0, 0, 3)
ARDL(2, 1, 0, 3, 2, 1)
ARDL(3, 1, 0, 3, 2, 3)
ARDL(3, 1, 3, 3, 3, 3)

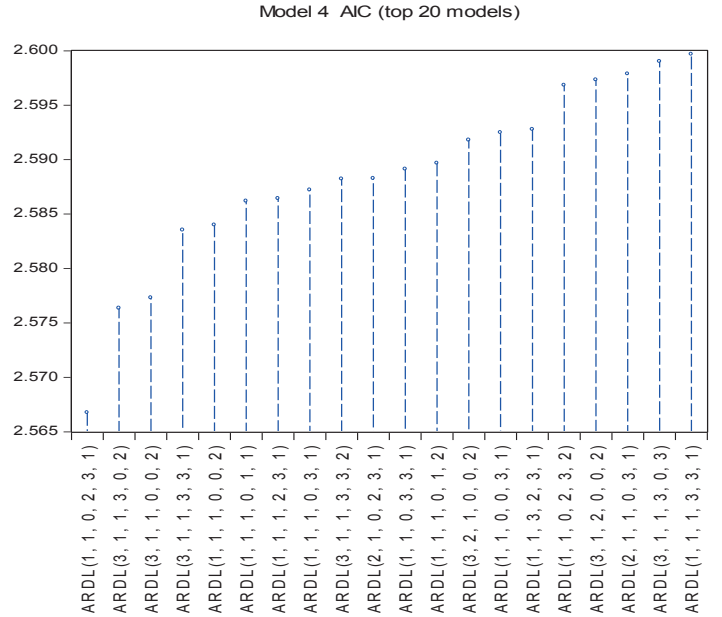
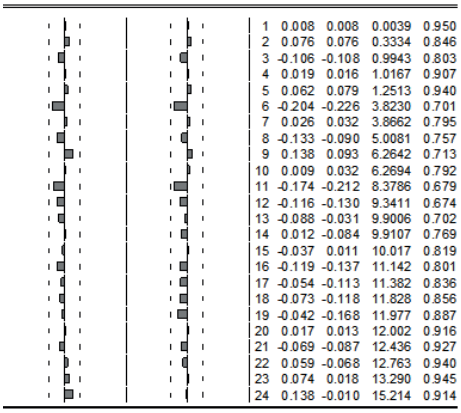

Model 4 AIC (top 20 models)
2.600
2.595
2.590
2.585
2.580
2.575
2.570
2.565
ARDL(1, 1, 0, 2, 3, 1)
ARDL(3, 1, 1, 3, 0, 2)
ARDL(3, 1, 1, 0, 0, 2)
ARDL(3, 1, 1, 3, 3, 1)
ARDL(1, 1, 1, 0, 0, 2)
ARDL(1, 1, 1, 0, 1, 1)
ARDL(1, 1, 1, 2, 3, 1)
ARDL(1, 1, 1, 0, 3, 1)
ARDL(3, 1, 1, 3, 3, 2)
ARDL(2, 1, 0, 2, 3, 1)
ARDL(1, 1, 0, 3, 3, 1)
ARDL(1, 1, 1, 0, 1, 2)
ARDL(3, 2, 1, 0, 0, 2)
ARDL(1, 1, 0, 0, 3, 1)
ARDL(1, 1, 3, 2, 3, 1)
ARDL(1, 1, 0, 2, 3, 2)
ARDL(3, 1, 2, 0, 0, 2)
ARDL(2, 1, 1, 0, 3, 1)
ARDL(3, 1, 1, 3, 0, 3)
ARDL(1, 1, 1, 3, 3, 1)

Table A5: Auto correlation and partial auto correlation (for ARDL)

Model 1

Date: 05/24/17 Time: 09:30
Sample: 1957 2016
Included observations: 53
Q-statistic probabilities adjusted for 1 dynamic regressor

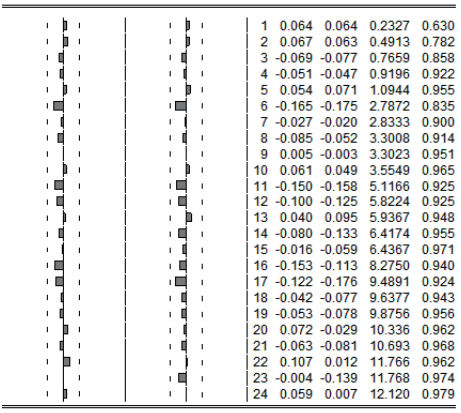


	AC	PAC	Q-Stat	Prob*
1	0.008	0.008	0.0039	0.950
2	0.076	0.076	0.3334	0.846
3	-0.106	-0.108	0.9943	0.803
4	0.019	0.016	1.0167	0.907
5	0.062	0.079	1.2513	0.940
6	-0.204	-0.226	3.8230	0.701
7	0.026	0.032	3.8662	0.795
8	-0.133	-0.090	5.0081	0.757
9	0.138	0.093	6.2642	0.713
10	0.009	0.032	6.2694	0.792
11	-0.174	-0.212	8.3786	0.679
12	-0.116	-0.130	9.3411	0.674
13	-0.088	-0.031	9.9006	0.702
14	0.012	-0.084	9.9107	0.769
15	-0.037	0.011	10.017	0.819
16	-0.119	-0.137	11.142	0.801
17	-0.054	-0.113	11.382	0.836
18	-0.073	-0.118	11.828	0.856
19	-0.042	-0.168	11.977	0.887
20	0.017	0.013	12.002	0.916
21	-0.069	-0.087	12.436	0.927
22	0.059	-0.068	12.763	0.940
23	0.074	0.018	13.290	0.945
24	0.138	-0.010	15.214	0.914

*Probabilities may not be valid for this equation specification.

Model 2

Date: 05/24/17 Time: 09:43
Sample: 1957 2016
Included observations: 53
Q-statistic probabilities adjusted for 1 dynamic regressor

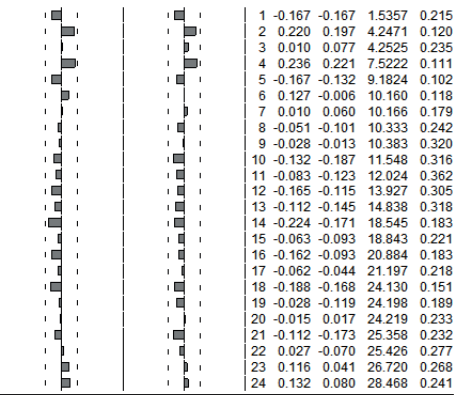


	AC	PAC	Q-Stat	Prob*
1	0.064	0.064	0.2327	0.630
2	0.067	0.063	0.4913	0.782
3	-0.069	-0.077	0.7659	0.858
4	-0.051	-0.047	0.9196	0.922
5	0.054	0.071	1.0944	0.955
6	-0.165	-0.175	2.7872	0.835
7	-0.027	-0.020	2.8333	0.900
8	-0.085	-0.052	3.3008	0.914
9	0.005	-0.003	3.3023	0.951
10	0.061	0.049	3.5549	0.965
11	-0.150	-0.158	5.1166	0.925
12	-0.100	-0.125	5.8224	0.925
13	0.040	0.095	5.9367	0.948
14	-0.080	-0.133	6.4174	0.955
15	-0.016	-0.059	6.4367	0.971
16	-0.153	-0.113	8.2750	0.940
17	-0.122	-0.176	9.4891	0.924
18	-0.042	-0.077	9.6377	0.943
19	-0.053	-0.078	9.8756	0.956
20	0.072	-0.029	10.336	0.962
21	-0.063	-0.081	10.693	0.968
22	0.107	0.012	11.766	0.962
23	-0.004	-0.139	11.768	0.974
24	0.059	0.007	12.120	0.979

*Probabilities may not be valid for this equation specification.

Model 3

Date: 05/24/17 Time: 09:50
Sample: 1957 2016
Included observations: 52
Q-statistic probabilities adjusted for 3 dynamic regressors

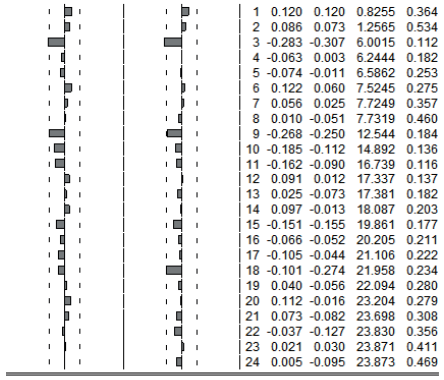


	AC	PAC	Q-Stat	Prob*
1	-0.167	-0.167	1.5357	0.215
2	0.220	0.197	4.2471	0.120
3	0.010	0.077	4.2525	0.235
4	0.236	0.221	7.5222	0.111
5	-0.167	-0.132	9.1824	0.102
6	0.127	-0.006	10.160	0.118
7	0.010	0.060	10.166	0.179
8	-0.051	-0.101	10.333	0.242
9	-0.028	-0.013	10.383	0.320
10	-0.132	-0.187	11.548	0.316
11	-0.083	-0.123	12.024	0.362
12	-0.165	-0.115	13.927	0.305
13	-0.112	-0.145	14.838	0.318
14	-0.224	-0.171	18.545	0.183
15	-0.063	-0.093	18.843	0.221
16	-0.162	-0.093	20.884	0.183
17	-0.062	-0.044	21.197	0.218
18	-0.188	-0.168	24.130	0.151
19	-0.028	-0.119	24.198	0.189
20	-0.015	0.017	24.219	0.233
21	-0.112	-0.173	25.358	0.232
22	0.027	-0.070	25.426	0.277
23	0.116	0.041	26.720	0.268
24	0.132	0.080	28.468	0.241

*Probabilities may not be valid for this equation specification.

Model 4

Date: 05/24/17 Time: 10:09
Sample: 1957 2016
Included observations: 54
Q-statistic probabilities adjusted for 1 dynamic regressor



	AC	PAC	Q-Stat	Prob*
1	0.120	0.120	0.8255	0.364
2	0.086	0.073	1.2565	0.534
3	-0.283	-0.307	6.0015	0.112
4	-0.063	0.003	6.2444	0.182
5	-0.074	-0.011	6.5862	0.253
6	0.122	0.060	7.5245	0.275
7	0.056	0.025	7.7249	0.357
8	0.010	-0.051	7.7319	0.460
9	-0.268	-0.250	12.544	0.184
10	-0.185	-0.112	14.892	0.136
11	-0.162	-0.090	16.739	0.116
12	0.091	0.012	17.337	0.137
13	0.025	-0.073	17.381	0.182
14	0.097	-0.013	18.087	0.203
15	-0.151	-0.155	19.861	0.177
16	-0.066	-0.052	20.205	0.211
17	-0.105	-0.044	21.106	0.222
18	-0.101	-0.274	21.958	0.234
19	0.040	-0.056	22.094	0.280
20	0.112	-0.016	23.204	0.279
21	0.073	-0.082	23.698	0.308
22	-0.037	-0.127	23.830	0.356
23	0.021	0.030	23.871	0.411
24	0.005	-0.095	23.873	0.469

*Probabilities may not be valid for this equation specification.

Table A6: ARDL Model Selection

Model	Selected model	Max. lags	Lowest value of the criteria
1	ARDL(1,2,0,4,4,4,3)	4	1.864
2	ARDL(1,3,4,4,4,0,4)	4	1.923
3	ARDL(3,1,0,3,3,3,3)	3	2.456
4	ARDL(1,1,0,2,3,1)	3	2.567

Revisiting the Export-led Growth Hypothesis for Liberalised Sri Lanka

Ranpati Dewage Thilini Sumudu Kumari[1]

Abstract

The export-led growth (ELG) hypothesis postulates the existence of a strong positive linear relationship between exports and output growth in the long run for a given economy. The empirical nexus between exports and economic growth so far is mixed. Thus, this paper aims to empirically shed more light on the causal relationship between exports and economic growth in the context of a small open economy by re-investigating the validity of the ELG hypothesis for Sri Lanka. Using time series data on Gross Domestic Product (GDP), exports, imports and remittances over four decades from 1980 to 2019 during which Sri Lanka had a liberalised economy regime in place, Johansen cointegration test results provide evidence of a long run association among the variables. However, vector error correction model (VECM) results fail to confirm the long run relationship between exports and GDP. Consequently, this paper finds no evidence to support the validity of the ELG growth hypothesis for Sri Lanka. Hence, the findings raise the question of the efficacy of the trade policies that Sri Lanka has adopted since the early 1980s.

Key Words: *Economic growth, Export, Export-led growth hypothesis, Sri Lanka*

JEL Classification: *F14; F43; N15*

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1. Introduction

Sri Lanka opened its economy in late 1977 embarking on a series of liberalisation reforms, becoming the first South Asian country to do so (Kelegama, 2000). Opening up helped Sri Lanka to attract more Foreign Direct Investment (FDI) inflows, establish a sound institutional framework and adopt a flexible exchange rate system (Dias, 1991). Specifically, it facilitated the economy to get integrated to the world economy creating new trade opportunities. This was followed by moves to simplify foreign trade procedures and a gradual reduction in tariffs and non-tariff barriers. As a part of this, industrial and trade policies were directed at promoting exports. Of them, the important policies were the establishment of export processing zones and providing financial incentives such as tax exemptions, tax holidays and tax reductions to export oriented industries. Following the liberalisation, Sri Lanka reported the notable annual average growth of Gross Domestic Product (GDP), imports, exports and remittances at 4.9 per cent, 7.7 per cent, 7 per cent and 14.2 per cent, respectively, during the four decades ending in 2019 (Central Bank of Sri Lanka, 1980-2019).[2]

However, during the post-liberalisation period, Sri Lanka has oscillated between protectionist and liberalisation strategies such as state controls and import substitutions (IMF, 2018; Athukorala and Rajapatirana, 2000). During this period, trade as a percentage of GDP has gradually been slowing down (Central Bank of Sri Lanka, 1978-2019).[3] Also, Sri Lanka's exports as a share of GDP was lower than some of its regional peers. For instance, in 2019 exports of goods and services as a share of GDP was 107 per cent in Vietnam, 65 per cent in Malaysia, 61 per cent in Cambodia, and 58 per cent in Thailand, in contrast to 23 per cent in Sri Lanka (World Bank, 2020). In addition to exports, remittances have also been a significant source of foreign exchange inflows for Sri Lanka since liberalisation. These remittances are usually used for either investment in capital goods or consumption, particularly for the consumption of imported goods. However, remittances may contribute to economic growth when they are mostly used for capital investments.

[2] Please see Table A1 in Appendices, for details.

[3] Please see Figure A1 in Appendices, for a detailed exposition.

Even though exports as a percentage of GDP have been declining, the impressive output growth in Sri Lanka during the four decades under review poses the question whether trade liberalisation, specifically, exports, exert a significant impact on output growth. It is also of interest to examine whether the ELG hypothesis holds for Sri Lanka. Theoretically, the ELG hypothesis suggests that there is a strong positive linear relationship between exports and output in the long run for a given country.

Empirically, the validity of the ELG hypothesis has been investigated by several researchers in respect of a number of economies by using different methodologies and variables. However, only a few published studies tested the validity of the ELG hypothesis for Sri Lanka. Previous studies have employed a wide range of explanatory variables including exports, imports, investments, trade openness, capital formation, and employment among others. Also, those studies cover different sample periods. Thus, the findings of these studies are mixed and inconclusive. Against this backdrop, revisiting the validity of the ELG hypothesis for Sri Lanka by including new explanatory variables for different sample periods is of interest to policymakers. Hence, adopting Ahmed and Uddin (2009)[4] for Bangladesh, this paper contributes to the literature by reinvestigating the validity of the ELG hypothesis for Sri Lanka including remittances as an explanatory variable in the model for the first time. Similarly, this study covers the whole post-liberalisation period spanning over four decades from 1980 to 2019.[5]

Using annual data on GDP, imports, exports and remittances, Johansen cointegration test results provide evidence for long run cointegration among the variables. However, vector error correction model (VECM) does not suggest the existence of any long run or short run relationship between exports and output. Hence, this study fails to support the validity of the ELG hypothesis for Sri Lanka. However, Granger causality test results show a unidirectional causality running from imports to GDP, and remittances to imports. The findings of this study

[4] Ahmed and Uddin (2009) investigated the causal nexus between exports, imports, remittances and GDP growth for Bangladesh and found limited evidence to support the ELG hypothesis as exports cause GDP growth only in the short run.

[5] After liberalisation, both exports and imports reported exponential growth in 1978 and 1979 reflecting immediate positive response to policy change in the former case and release of the pent-up demand in the latter. The economy started to stabilise from 1980. Also, the government significantly intervened in foreign trade in 2020. Therefore, this study considers only the period from 1980 to 2019 that had a liberalised economy regime.

facilitate Sri Lanka to revisit its policies and reorganise the institutions that facilitate trade. Specifically, findings will help policymakers in reformulating tariff, export diversification and resource reallocation policies.

The paper is organised as follows: Section 2 discusses the related theoretical and empirical literature. Section 3 presents the data, model specification, and the empirical investigation procedure. The empirical results and discussions are presented in Section 4. Section 5 concludes with policy recommendations.

2. Literature Review

2.1 Theoretical Foundation

The theoretical foundation for the relationship between trade openness and economic growth can be traced far back to 1700s. The founders of classical theory have extensively discussed the importance of trade openness for economic growth and the advantages that can be drawn by countries through liberalised trade. Among them, Smith (1776), argued that all nations would gain simultaneously, if they practised free trade and specialised in accordance with their absolute advantage. Alternatively, discussing the comparative advantage, Ricardo (1817) showed that counties can reallocate their scarce resources to more productive sectors to improve the wellbeing, if they were open to trade. Even in the subsequent periods, the success of the free market, outward oriented policies and trade liberalization for generating export oriented growth has widely been accepted by academics (Feder, 1983; Krueger, 1978; Krueger, 1990; Krueger, 1998). The positive causality running from exports to output growth takes many forms such as increasing economies of scale (Helpman and Krugman, 1985), enhancing technological improvements or fast technology diffusion (Grossman and Helpman, 1991), relaxing the foreign exchange constraints by increasing a country's capacity to import capital goods and raw materials (McKinnon, 1964; Habiyaremye, 2013), and enhancing economic efficiencies through increased competition (Krueger, 1980). However, refuting the validity of the ELG hypothesis, Pack (1988) suggests that both economic growth and trade are the outcomes of structural changes, economic development and technological changes mainly due to globalisation.

2.2 Empirical Literature

A growing body of literature examines the validity of the ELG hypothesis for various countries by using both cross country and single country time series data. Those studies have employed different econometric techniques ranging from simple ordinary least squares to multivariate cointegration tests. They cover different time periods and selected different variables in different forms. Those studies have produced mixed and inconclusive results.

In the global context, some empirical studies documented a strong and positive relationship between exports and economic growth supporting the validity of the ELG hypothesis for various countries. For instance, Abual-Foul (2004) finds evidence to support the ELG hypothesis for Jordan; Thurayia (2004) for Saudi Arabia and Sudan; Kalaitzi (2013) for the United Arab Emirates; Muse et al. (2013) for Nigeria; Medina-Smith (2001) for Costa Rica; Bashir et al. (2015), Love and Chandra (2004) for Pakistan; Al Mamun and Nath (2005) and Paul (2014) for Bangladesh; Dash (2009), Sahni and Atri (2012) and Venkatraja (2015) for India, and Kim et al. (2020) for Myanmar. Furthermore, another set of literature finds the bidirectional causality or the causality running from exports to output and vice versa. This view was established by Mah (2005) for China; Elbeydi et al. (2010) for Libya, and (Kumari and Malhotra, 2014) for India. Meanwhile, some other studies provide evidence to support reduced form that is the unidirectional causation from output growth to exports. For instance, Oxley (1993); Dhawan and Biswal (1999) and Panas and Vamvoukas (2002) find evidence in favour of growth led hypothesis for Portugal, India and Greece, respectively. However, several other studies find no evidence to support the ELG hypothesis. For example, findings of Shan and Sun (1998) for Hong Kong, Korea, and Taiwan; Panas and Vamvoukas (2002) for Greece; Afzal and Hussain (2010) for Pakistan, and Mishra (2011) for India do not support the ELG hypothesis.

Although the literature is growing, there are limited studies that test the validity of the ELG hypothesis for Sri Lanka. Particularly, Sri Lanka was included in country comparison studies, and hence, standalone studies on Sri Lanka are rare. Also, the literature uses different explanatory variables and covers different sample periods. Hence, it delivers mixed and conflicting results.

For instance, using annual data on GDP and exports for 1960-1997 from eight Asian developing countries and employing cointegration and error correction model, Ekanayake (1999) found evidence for ELG in Sri Lanka. By conducting a country specific study to cover a longer time period from 1960 to 2010 Balamurali and Sivarajasingam (2012) provided strong evidence to support the ELG hypothesis in Sri Lanka. They also employed annual data on GDP and exports and cointegration and error correction model for the imperial investigation. Confirming Ekanayake (1999) and Balamurali and Sivarajasingam (2012), in a recent study, Francis and Vijayakumar (2019) using annual data on GDP, exports, gross fixed capital formation, employment, and inflation for 1977-2018 and VEC methodology established the validity of the ELG hypothesis for Sri Lanka. Alternatively, Priyankara (2018) by using data on GDP, exports of top services, good exports and terms of trade index for 1984-2013 found that the ELG hypothesis holds for services exports of Sri Lanka. This study adopted the vector autoregressive model to identify the causality.

In contrast, by examining the relationship between exports and economic growth, Abhayaratne (1996) found no evidence to support the ELG hypothesis in Sri Lanka during 1960-1992. GDP, exports and imports are used in this paper to calibrate the model in cointegration analysis. Similarly, the findings of Dilrukshini (2008) failed to support the validity of ELG hypothesis for Sri Lanka. She employed annual data on GDP, exports, imports, investment and labour for 1960-2015, and adopted VARs for the empirical estimation. Confirming both Abhayaratne (1996) and Dilrukshini (2008), Tahir et al. (2015) also found no evidence in support of the ELG hypothesis for Sri Lanka.

In this setting, this study would contribute to the literature by reinvestigating the ELG hypothesis for Sri Lanka including remittances as an explanatory variable in the model. To the best of this researcher's knowledge, there is no study in the literature that uses remittances to test the ELG hypothesis for Sri Lanka.

3. Data and Methodology

3.1 Variables and Data

This analysis tests the validity of ELG hypothesis for Sri Lanka covering four decades from 1980 to 2019 during which the country had a liberalised economy regime in place. For the empirical analysis, annual time series data on GDP, imports, exports, private remittances and GDP deflator are sourced from different issues of the Annual Reports of the Central Bank of Sri Lanka published from 1980 to 2019 (Central Bank of Sri Lanka, 1980-2019). All the nominal variables are deflated by the GDP deflator with 1996 as the base year to make them real and expressed in logarithmic transformation to avoid the problems associated with the annual time series data (Gujarati, 2021). The summary statistics of the variables are in Table 1.

Table 1: Summary Statistics[1]

Variable[2]	Mean	Std.Dev	Min	P1[3]	P50[3]	P99[3]	Max
LGDP	9.63	0.19	9.24	9.97	9.24	9.60	9.97
LEXP	8.09	0.23	7.72	8.64	7.72	8.10	8.64
LIMP	8.52	0.22	8.08	9.29	8.08	8.49	9.29
LREM	11.08	0.85	9.50	12.36	9.50	11.06	12.36

Source: Author's calculations using the data from the Central Bank of Sri Lanka.

Notes: 1. Summary statistics are for the natural log of real variables. Number of observations are 40.
2. LGDP, LEXP, LIMP and LREM represent real GDP, real exports, real imports and real remittances in log terms, respectively.
3. P1, P50 and P99 are 1st, 50th (median) and 99th per centiles, respectively.

Figure 1 depicts the time series behaviour of real variables in their log forms. The log of real GDP, exports and imports are in the declining trends, while remittances were increasing during 1980 to 2019.

Figure 1: Log of Real GDP, Real Exports, Real Imports and Real Remittances

Source: Author's calculations using the data from the Central Bank of Sri Lanka.

3.2 Model Specification

To empirically examine the validity of the ELG hypothesis for Sri Lanka, this study uses two alternative model specifications. Model-1 includes GDP as the dependent variable and, exports and imports as explanatory variables, while Model-2 adds remittances as the third explanatory variable. Particularly, this study uses remittances as an explanatory variable to test the validity of the ELG hypothesis for Sri Lanka for the first time by following Ahmed and Uddin (2009) who did the same for Bangladesh. Accordingly, two model specifications are given in equation (1) and (2).

Model-1

$$LGDP_t = \alpha_0 + \alpha_1 LEXP_t + \alpha_2 LIMP_t + \varepsilon_t, \quad (1)$$

Model-2

$$LGDP_t = \beta_0 + \beta_1 LEXP_t + \beta_2 LIMP_t + \beta_3 LREM_t + \varepsilon_t \quad (2)$$

where $LGDP_t$, $LEXP_t$, $LIMP_t$ and $LREM_t$ represent real *GDP*, real exports, real imports and real remittances in log terms, respectively, at time t. ε_t is the error term.

3.3 Testing Procedure

This study uses VECM to test the ELG hypothesis for Sri Lanka. The first step of the testing procedure is to determine the order of integration of the series by using an appropriate test.[6] The stationarity of the variables is tested by using a widely recognised unit root test, the Augmented Dickey-Fuller (ADF) test (Dickey and Fuller, 1979). The ADF test is applied on both at *level* and *first* difference series. A time series is said to be integrated of order zero, i.e., I(0), if it is stationary at the level form. A differenced series is called integrated of order *d*, i.e., I(*d*), if it is stationary at a differentiated form. If the individual variable is y_t, the general form of ADF test with intercept (α_0) and with both intercept and trend ($\alpha_t t$) can be written as in equations (3) and (4), respectively.

$$\Delta y_t = \alpha_0 + \gamma y_{t-1} + \sum_{i=0}^{k} \beta_i \Delta y_{t-i} + \varepsilon_t \quad \textit{(with intercept)} \quad (3)$$

$$\Delta y_t = \alpha_0 + \alpha_1 t + \gamma y_{t-1} + \sum_{i=0}^{k} \beta_i \Delta y_{t-i} + \varepsilon_t \quad \textit{(with intercept and trend)} \quad (4)$$

[6] If time series data do not have the characteristic of stationarity, the resultant regressions produce spurious results (Dougherty, 2011)

where $\Delta y_t = y_t - y_{t-1}$ is the first difference of series y_t, k is the optimum number of lags, α, γ *and* β are the parameters and ε_t is the stochastic disturbance term. If all the variables are stationary and integrated of the same order, then it is permitted to move to the second step to check the existence of a long term relationship among variables.

Even if the variables, GDP, exports, imports and remittances, individually are non-stationary, it may be possible that a linear combination of the variables may be stationary. Thus, the second step investigates whether the series are cointegrated and have a long run equilibrium relationship. This study uses vector autoregression (VAR) based Johansen's cointegration test developed by Johansen (1988) and Johansen and Juselius (1990) to estimate the cointegration[7] as adopted by Dilrukshini (2008) and Francis and Vijayakumar (2019) for Sri Lanka. This test uses two statistics named trace statistics and maximum eigenvalue to determine the number of cointegrating vectors. Trace statistics and maximum eigenvalue statistics estimate two VARs as in equation (5) and (6), respectively.

$$\Delta y_t = r_1 \Delta y_{t-1} + r_2 \Delta y_{t-2} + \ldots\ldots\ldots\ldots + r_p \Delta y_{t-p+1} \quad (5)$$

$$y_t = r_1 \Delta y_{t-1} + r_2 \Delta y_{t-2} + \ldots\ldots\ldots\ldots + r_p \Delta y_{t-p+1} \quad (6)$$

where, y_t is the vector of the variables involved in the model and p is the order of autoregression. In those tests the null hypothesis is that there is no cointegrating vector against the alternative hypothesis that indicates one or more cointegrating vectors. Since the test results of this paper suggest the long run cointegration between variables, in the third step, VECM is carried out to investigate both long run and short run causality between variables.[8]

[7] Before performing the cointegration test, to ensure an appropriate model specification, optimal lag length which removes the autocorrelation can be determined using several criteria: the sequential modified LR test, the Final prediction error (FPE), the Akaike (1974) information criterion (AIC), the Schwarz (1978) information criterion (SC), and the Hannan-Quinn information criterion (HQ).

[8] The selection of the appropriate test, i.e., VAR or VECM in the third step depends on the results of the cointegration test in the second step. If cointegration results show long run relationship between variables, VECM is conducted to investigate both long run and short run relationships between variables. Alternatively, if there is no cointegration between variables, the VAR is implemented.

The causality may occur from lagged difference and error correction term. Hence, to understand the causal relationship among the variables, the following specifications are tested.

Model-1

$$\Delta LDGP_t = \alpha_1 + \alpha_{LGDP} ECM_{t-1} + \sum_{i=1}^{p} \alpha_{11} \Delta LEXP_{t-1} + \sum_{i=1}^{p} \alpha_{12} \Delta LIPM_{t-1} + \varepsilon_{LGDP_t} \quad (7)$$

$$\Delta LEXP_t = \alpha_2 + \alpha_{LEXP} ECM_{t-1} + \sum_{i=1}^{p} \alpha_{21} \Delta GDP_{t-1} + \sum_{i=1}^{p} \alpha_{22} \Delta LIMP_{t-1} + \varepsilon_{LEXP_t} \quad (8)$$

$$\Delta LIMP = \alpha_3 + \alpha_{LIMP} ECM_{t-1} + \sum_{i=1}^{p} \alpha_{31} \Delta LGDP_{t-1} + \sum_{i=1}^{p} \alpha_{32} \Delta LEXP_{t-1} + \varepsilon_{LIMP_t} \quad (9)$$

Model-2

$$\Delta LDGP_t = \beta_1 + \beta_{LGDP} ECM_{t-1} + \sum_{i=1}^{q} \beta_{11} \Delta LEXP_{t-1} + \sum_{i=1}^{q} \beta_{12} \Delta LIPM_{t-1} + \sum_{i=1}^{q} \beta_{13} \Delta LREM_{t-1} + \mu_{LGDP_t} \quad (10)$$

$$\Delta LEXP_t = \beta_2 + \beta_{LEXP} ECM_{t-1} + \sum_{i=1}^{q} \beta_{21} \Delta LGDP_{t-1} + \sum_{i=1}^{q} \beta_{22} \Delta LIPM_{t-1} + \sum_{i=1}^{q} \beta_{23} \Delta LREM_{t-1} + \mu_{LEXP_t} \quad (11)$$

$$\Delta LIMP_t = \beta_3 + \beta_{LIMP} ECM_{t-1} + \sum_{i=1}^{q} \beta_{31} \Delta LGDP_{t-1} + \sum_{i=1}^{q} \beta_{32} \Delta LEXP_{t-1} + \sum_{i=1}^{q} \beta_{33} \Delta LREM_{t-1} + \mu_{LIMP_t} \quad (12)$$

$$\Delta LREM_t = \beta_4 + \beta_{LREM} ECM_{t-1} + \sum_{i=1}^{q} \beta_{41} \Delta LGDP_{t-1} + \sum_{i=1}^{q} \beta_{42} \Delta LEXP_{t-1} + \sum_{i=1}^{q} \beta_{43} \Delta LIMP_{t-1} + \mu_{LREM_t} \quad (13)$$

where, α_i, α_{ij} and β_i, β_{ij} are parameters; ECM_{t-1} is the error correction term lagged one period and ε_t and μ_t are the error correction terms. Finally, the VECM Granger causality test is employed to determine the direction of causality between variables. If two variables have a common trend, causality exists at least in one direction: unidirectional or bidirectional. This test estimates the Granger causality between X and Y variables using the following equations:

$$X_t = \sum_{i=0}^{n} \alpha_i X_{t-i} + \sum_{i=0}^{n} \beta_j Y_{t-i} + u_{1t} \quad (14)$$

$$X_t = \sum_{i=0}^{m} \lambda_i X_{t-i} + \sum_{i=0}^{n} \delta_j Y_{t-i} + u_{2t} \quad (15)$$

where u_{1t} and u_{2t} are serially uncorrelated random distributions with zero mean. Equation (14) tests the following hypothesis on the basis of F-statistics at chosen level of significance where null hypothesis, $H_0 : X_t$ does not Granger cause Y_t, against the alternative hypothesis, H_1: X_t Granger causes Y_t. Similarly, Equation (15) tests the hypothesis where null hypothesis, *H0*: Y_t does not Granger cause X_t against the alternative hypothesis, *H1:* Y_t Granger causes X_t. This study tests four time series simultaneously.

4. Empirical Results

This section discusses the main findings of the study. Following the procedure to test the ELG hypothesis stated in section 3.3, two different models are separately estimated, i.e., Model-1 without remittances and Model-2 with remittances as an independent variable, to obtain the results presented below.

4.1 Unit Root Tests

The estimation of the VAR/VECM test begins with the testing of the variables for unit roots. As the first step, all the variables in this study are tested for stationarity by using the ADF test and the results are presented in Table 2. The null hypothesis in ADF is that the series contains the unit root against the alternative that the series is stationary. The unit root test results revealed that all variables under consideration are non-stationary at their levels. However, all variables are stationary at their first difference forms, and hence they are integrated in the same order, i.e., order 1, or I (1). The Johansen cointegration test then can be applied as data series are integrated in the same order.

Table 2: Results of Augmented Dickey-Fuller Unit Root Test

Variable	Level		First Difference		Results
	Intercept	Trend and Intercept	Intercept	Trend and Intercept	
LGDP	-1.631	-1.539	-3.386 **	-3.494 *	**I (1)**
LEXPO	-1.485	-2.692	-6.647 ***	-6.524 ***	**I (1)**
LIMP	-2.565	-3.193	-6.020***	-6.152 ***	**I (1)**
LREM	-0.083	-2.578	-5.454 ***	-5.380 ***	**I (1)**

Source: Author's calculations using the data from the Central Bank of Sri Lanka.

Notes: ***, ** and * show the rejection of null hypothesis at 1 per cent 5 per cent and 10 per cent levels of significance, respectively. I (1) represents stationary after first difference.

4.2 Testing Cointegration

Before performing the cointegration test, optimal lag lengths are determined for the VAR systems, i.e., by using the LR, FPE and AIC criteria for Model-1 and FPE, AIC and HQIC criteria for Model-2[9]. The selected optimal lag length for both models is 3. Detailed lag length selection results are in Table A2 in Appendices.

In the second step, the Johansen cointegration test is performed on the stationary series with three lags and the results are in Table 3. The results revealed the presence of at least two cointegrating relationships between variables at 5 per cent significance level in both models, failing to reject the null hypothesis that specifies no cointegrating equations in the model. The prevalence of the long run association requires the VECM to test the long run and short run relationships between variables and their causal effects.

[9] Following the literature, majority of criteria that also includes AIC is considered for optimal lag selection.

Table 3: Results of Johansen Cointegration Test

Number of Cointegrating vectors	Trace Statistics	Critical Value at 5%	Max-Eigen Statistics	Critical Value at 5%
Model-1				
None	39.269	29.68	21.983	20.97
At most 1	17.286	15.41	17.107	14.07
At most 2	0.179*	3.76	0.179	3.76
Model-2				
None	74.726	47.21	41.420	27.07
At most 1	33.305	29.68	25.428	20.97
At most 2	7.877*	15.41	4.616	14.07
At most 3	3.261	47.21	3.261	3.76

Source: Author's calculations using the data from the Central Bank of Sri Lanka.

Notes: * denotes rejection of the hypothesis at the 5 per cent level.

4.3 VECM Test Results

In the third step, the VECM is carried out and the test results are reported in Table 4. The estimated VECM results are reliable as both models pass the diagnostic tests at 5 per cent level of significance as in Tables A3 and A4. There is no serial residual correlation and residuals are normally distributed in the estimated VECM models. Similarly, VECM results have been found to be stable. The long run causality is prevalent if the coefficient of the lag error correction term (ECM_{t-1}) is negative and statistically significant. The coefficients attached to the error correction terms, i.e., ECM_{t-1} of Model-1 and Model-2 are non-negative. Hence, the results of both VECM models do not support the presence of a long run causality running from explanatory variables to economic growth. Consequently, the results fail to support the validity of the ELG hypothesis for Sri Lanka.

Then, to examine the short run causality between variables, the individual lag coefficients and p value for each independent variable are considered. To establish a short run relationship, the p value should be significant. Accordingly, a few short run elasticities are observed in Table 4. The short run elasticity of GDP with respect to import is negative and statistically significant in both models. Therefore, imports contribute negatively to economic growth in Sri Lanka. In contrast, the short run elasticities of GDP with respective remittances are positive and

statistically significant in Model-2. Similarly, results show strong evidence of causality to suggest that remittances lead to increase imports in the short run. Hence, remittances contribute positively to both economic growth and imports. Contrastingly, exports lower the remittances in the short run. However, there is no short run casual effects between exports and GDP as the coefficients are not statistically significant in both models. Hence, the VECM test results of this study fail to establish any causal relationship between exports and GDP either in the long run or in the short run for Sri Lanka. To complete the analysis, it is important to determine the direction of causality between variables.

Table 4: VECM Test Results

	Model-1			**Model-2**			
	Δ(LGDP)	**Δ(LEXP)**	**Δ(LIMP)**	**Δ(LGDP)**	**Δ(LEXP)**	**Δ(LIMP)**	**Δ(LREM)**
ECM_{t-1}	0.080	0.134	0.538***	0.0879	0.172	0.491***	0.154***
	(0.076)	(0.137)	(0.149)	(0.061)	(0.119)	(0.110)	(0.061)
$\Delta(LGDP_{t-1})$	0.643***	0.507	0.762*	0.618***	0.393	0.573	0.188
	(0.226)	(0.425)	(0.441)	(0.219)	(0.428)	(0.396)	(0.220)
$\Delta(LGDP_{t-2})$	0.302	-0.262	0.090	0.266	-0.200	0.163	0.168
	(0.228)	(0.411)	(0.46)	(0.219)	(0.427)	(0.396)	(0.219)
$\Delta(LEXP_{t-1})$	-0.194	-0.264	-0.232	-0.141	-0.225	0.672	-0.228*
	(0.152)	(0.273)	(0.296)	(0.130)	(0.254)	(0.235)	(0.130)
$\Delta(LEXP_{t-2})$	0.004	-0.331	-0.137	0.074	-0.268	0.175	0.154
	(0.145)	(0.261)	(0.283)	(0.135)	(0.264)	(0.245)	(0.136)
$\Delta(LIMP_{t-1})$	-0.280*	-0.098	-0.081	-0.297**	-0.046	-0.156	0.236*
	(0.151)	(0.272)	(0.296)	(0.143)	(0.280)	(0.259)	(0.144)
$\Delta(LIMP_{t-2})$	-0.100	0.233	-0.021	-0.134	0.210	-0.179	-0.051
	(0.126)	(0.226)	(0.246)	(0.115)	(0.225)	(0.209)	(0.116)
$\Delta(REM_{t-1})$				0.292*	0.054	0.492*	0.161
				(0.159)	(0.311)	(0.288)	(0.160)
$\Delta(REM_{t-2})$				-0.019	0.252	0.477*	0.108
				(0.160)	(0.313)	(0.290)	(0.160)
C	-0.007	-0.016	0.005	-0.015	-0.017	-0.013	0.069
	(0.010)	(0.018)	(0.020)	(0.014)	(0.027)	(0.254)	(0.141)***

Source: Author's calculations using the data from the Central Bank of Sri Lanka.

Notes: ***, ** and * statistically significant at 1 per cent, 5 per cent and 10 per cent level, respectively. Δ(..) indicates the first difference of the logged variable: $\Delta(Y_t) = Y_t - Y_{t-1}$. Standard errors are in parentheses.

4.4 Granger Causality Test

As the last step, the VECM Granger causality test is carried out to determine the direction of causality. The results of the causality tests are presented in Table 5. This test shows the short run causality running from explanatory variable to dependent variable, in which the null hypothesis, namely, the lagged value of coefficients in each equation are zero. If the p value is less than 5 per cent, then the null hypothesis is rejected. The Model-1 results does not suggest any directional causality between variables. However, Model-2 suggests a unidirectional causality running from exports to remittances, a unidirectional causality running from imports to GDP and a very strong unidirectional causality running form remittances to imports. Granger causality results are largely in line with the VECM results.

Table 5: Granger Causality Test Results – Chi Statistics

	Δ(LGDP)	**Δ(LEXP)**	**Δ(LIMP)**	**Δ(LREM)**
Model-1				
Δ(LGDP)		1.56	4.20	
Δ(LEXP)	1.93		0.65	
Δ(LIMP)	3.45	1.60		
Model-2				
Δ(LGDP)		0.85	3.73	2.57
Δ(LEXP)	2.10		0.52	6.30**
Δ(LIMP)	4.65*	1.08		3.58
Δ(LREM)	3.83	0.96	9.56***	

Source: Author's calculations using the data from the Central Bank of Sri Lanka.

Notes: ***, ** and * denote significance at 1 per cent, 5 per cent and 10 per cent, respectively.

In conclusion, by using two different model specifications, one with remittances and another without remittances, the results do not find any causal relationship between exports and output either in the long run or in the short run. Hence, this study finds no evidence to support the validity of the ELG hypothesis for Sri Lanka. The finding of this study is consistent with Abhayaratne (1996); Dilrukshini (2008) and Tahir et al. (2015) for Sri Lanka.

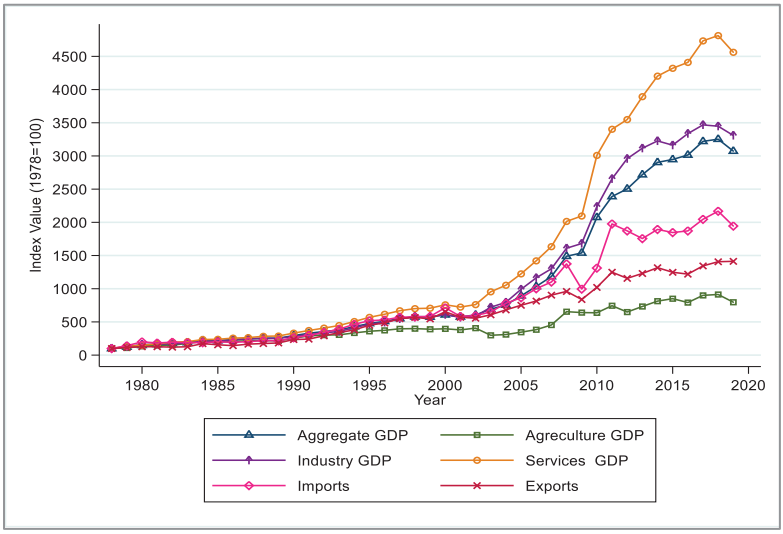
4.5 Discussion of Results

The results show that the economic policy strategies adopted in the past and the institutions built to promote exports have so far not been effective in generating sustainable long run economic growth in Sri Lanka. Specifically, Sri Lanka has been concentrating on simple technology-based exports of which the value addition has been insufficient to record a high economic growth. For instance, Sri Lanka has been promoting labour intensive and low value adding apparel and garment industry as the main thrust of exports. In 2019, this single sector accounted for nearly 47 per cent of the total export revenue but had only a share of 5 per cent in GDP (Central Bank of Sri Lanka, 2019). Thus, the growth of the apparel and garment industry did not make a significant contribution to GDP. Furthermore, around 80 per cent of garments are exported to EU, UK and USA making its growth principally dependent on the economic performance of those export destinations. The performance of the apparel and garment sector and its contribution to GDP growth are constrained by the competition coming from the low wage economies like Bangladesh, Myanmar and Cambodia. Similarly, Sri Lanka's exports are mostly buyer-driven products relative to the products that are producer-driven (Athukorala, 2016).

Additionally, the very strong positive causality running from remittances to import shows that like in many other developing countries, the remittances inflows to Sri Lanka are mostly used for the consumption of imported goods instead of being invested in capital goods. It may have hindered the potential capital accumulation and economic growth that would have been realised through optimal allocation of remittances.

Moving a further step ahead to see what would have been the sources of output growth, stylised facts in Figure 2 suggest that Sri Lanka's past growth may have come from the growth of services and manufacturing that has not been directed towards exports. However, further research is needed to establish this perspective, a potential area of research for the future.

Figure 2: GDP, Sectoral GDP, Imports and Exports Indices



Source: Central Bank of Sri Lanka.

5. Conclusions and Recommendations

In empirical literature, the nexus between exports and economic growth is mixed. The heterogeneity in these results may be due to the selection of different sample periods, different explanatory variables and diverse data sources, and different methodological procedures. In this backdrop, this study aimed to shed more light on causal relationship between exports and economic growth by re-testing the validity of the ELG hypothesis for Sri Lanka. This study differs from the other similar studies as it uses remittances as an independent variable and covers four decades of post-liberalisation from 1980 to 2019. Using annual data on GDP, exports, imports and remittances, VECM results do not support the presence of long run causality running from exports to GDP. Hence, the findings of the study fail to support the validity of the ELG hypothesis for Sri Lanka confirming the findings of Abhayaratne (1996); Dilrukshini (2008) and Tahir et al. (2015).

The results show that the economic policy strategies adopted in the past and the institutions built to promote exports have so far not been effective in generating sustainable long run economic growth in Sri Lanka. Hence, the findings of this study facilitate Sri Lanka to revisit

its policies and reorganise the institutions that facilitate trade. Broadly, findings will help policymakers in reformulating tariffs, export diversification and resource reallocation policies. Particularly, the future export strategy should facilitate the country to move away from the single sector-based exports to a diversified export structure that uses complex technology. This is important because it would help Sri Lanka to be competitive in trade on one hand and allow the country to join the global supply chain to produce inputs for the globalised manufacturing sector, on the other (Athukorala, 2016b). Also improving Sri Lanka's ranking in the ease of doing business and corruption perception indices is of paramount importance in this regard to ensures a favourable business climate.

Although it is widely used, adopting a conventional methodology to estimate the cointegration relationships may be a potential caveat of this study. Furthermore, Sri Lanka's past growth may have come from the growth of services and manufacturing that may has not been directed for exports. However, further investigation of this perspective and the estimation of cointegration using relatively new techniques with structural breaks are left for future research.

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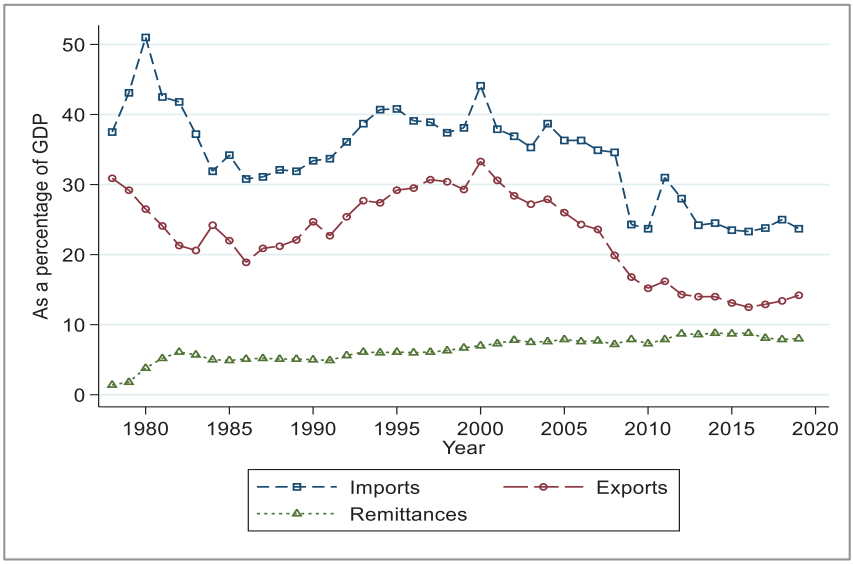
Appendices

Table A1: Growth of GDP, Imports, Exports and Remittances (%) in Sri Lanka

Period	GDP	Imports	Exports	Remittances
1980-1989	4.3	5.1	5.4	25.2
1990-1999	5.2	10.6	11.9	11.6
2000-2009	5.0	6.9	4.9	12.3
2010-2019	5.3	8.3	5.8	7.7
1980-2019	4.9	7.7	7.0	14.2

Source: Central Bank of Sri Lanka.

Figure A.1. Imports, Exports and Remittances as a Percentage of GDP



Source: Central Bank of Sri Lanka.

Table A2: Results of Optimal Lag Order Selection

Model-1

Endogenous Variables: LGDP, LEXP, LIMP

Lags	LL	LR	FPE	AIC	HQIC	SBIC
0	72.381	N/A	4.30E-06	-3.854	-3.808	-3.723
1	147.063	149.36	1.10E-07	-7.503	-7.319	-6.976
2	164.384	34.64	7.10E-08	-7.966	-7.643*	-7.042*
3	175.511	22.256*	6.5e-08*	-8.084*	-7.623	-6.764
4	181.417	11.812	8.10E-08	-7.912	-7.313	-6.196

Model-2

Endogenous Variables: LGDP, LEXP, LIMP, LREM

Lags	LL	LR	FPE	AIC	HQIC	SBIC
0	51.916	N/A	8.20E-07	-2.662	-2.601	-2.486
1	205.463	307.090	4.00E-10	-10.304	-9.996	-9.424*
2	233.18	55.436	2.10E-10	-10.955	-10.402	-9.371
3	257.838	49.316	1.5e-10*	-11.436*	-10.637*	-9.148
4	272.086	28.495*	1.90E-10	-11.338	-10.294	-8.347

Source: Author's calculations using the data from the Central Bank of Sri Lanka.

Note: * indicates lag order selected by the criterion at 5 per cent level.

Table A3: Test Results for Serial Correlation

Lag	Chi Statistics	
	Model-1	Model-2
1	15.367*	14.571
2	18.058**	13.401

Source: Author's calculations using the data from the Central Bank of Sri Lanka.

Note: ** and * statistically significant at 5 per cent and 10 per cent level, respectively. If probability is less than 5 per cent, the null hypothesis (H0: no autocorrelation at lag order) is rejected. In Model-1 at lag 1 and in Model-2, at lag 1 and 2, the probability more than 5 per cent, hence null is not rejected. Hence, (except for lag 2 in Model-1) there is no autocorrelation in VECM models.

Table A4: Test Results for Residual Normality

Equation	Chi Statistics	
	Model-1	Model-2
Δ(LGDP)	3.118	1.650
	(0.210)	(0.438)
Δ(LEXP)	0.302	0.654
	(0.860)	(0.721)
Δ(LIMP)	1.140	2.103
	(0.566)	(0.349)
Δ(LREM)		0.682
		(0.711)
ALL	4.560	5.088
	(0.601)	(0.748)

Source: Author's calculations using the data from the Central Bank of Sri Lanka.

Note: Probabilities are in parantheses. If probability is less than 5 per cent, the null hypothesis (H0: residuals are normally distributed) is rejected. Since, the probabilities are more than 5 per cent both models, both Model-1 and Model-2 are desirable.

Foreign Direct Investment and Economic Growth Evidence from Sri Lanka

W Nilesha Sandani Fernando[1]

Abstract

This paper discusses the link between Foreign Direct Investment (FDI) and the economic growth of Sri Lanka together with, national investment, labour, trade openness, and university graduation in Sri Lanka from 1980 to 2016. The study confirms that there is a significant long-run association between real variables such as, Gross Domestic Product (GDP), national investment, employment, and trade with FDI and the short run co-efficient of FDI has also reported a level of significance. The model also indicates that, FDI can positively affect national investment, and employment but negatively affect trade. The reported model forecasts that the historical trend of low level of growth for FDI is expected to stay unchanged over the next few years. FDI may act as an important element to accelerate the economic development of Sri Lanka. Policy formulation should aim at improvements to the infrastructure, wider scope for gaining FDI spill-overs to domestic production, domestic labour market and encourage import substitute for FDI.

***Key Words**: FDI, Economic growth, Vector Error Correction, Sri Lanka*

***JEL Classification:** C2; E2; F4*

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1. Introduction

Capital is the most important factor of production in any economy. Capital accumulation can be through domestic sources as well as through foreign sources. FDI and foreign loans can create capital, which are foreign sources. However, FDI has manifold features which make it more preferable to other sources of capital such as foreign debt. These favourable features include, bundled benefits such as the ability of accessing international markets, production enhancement, technological expertise, creation of employment opportunities with superior managerial skills, support on gap filling of the country's savings-investment, and easing foreign exchange limitations. These in turn stimulate the economic growth in host countries.

FDI can be defined as "the net inflows of investment to acquire a lasting management interest (10 per cent or more of voting stock) in an enterprise operating in an economy other than that of the investor. It is the sum of equity capital, reinvestment of earnings, other long-term capital, and short-term capital as shown in the balances of payments."[2]

Apart from the favourable effects of FDI, there are negative impacts as well. FDI can adversely affect the balance of payment. If imports rise with the FDI inflow (import goods as project material, etc), that may lead to loss of domestic productivity advantage. Foreign firms are specialised in technology and it is possible that they capture the opportunities faster than local investors, especially in developing countries. Such opportunities lost will in the long term have adverse effects for local investments and development of a country, as imperfect competition might even force the local investors to exit the market (Ghazali, 2010).

A steady state represents the long run equilibrium of the economy (Mankiw, 2010). Countries below the level of steady state have high growth potential. Developing countries usually possess a level of capital below the steady state. Countries near or at the steady state, therefore, have no motivation to invest in their own country but seek investment opportunities in

[2] World Bank (2017, TCdata360)
http://tcdata360.worldbank.org/indicators/BX.KLT.DINV.WD.GD.ZS?country=GBR&indicator=1541&viz=line_chart&years=1970,2016

developing countries who are below the steady state level. Therefore, investing in countries like Sri Lanka could be attractive to foreign investors and such capital accumulation can lead the country towards growth and reach the long run equilibrium. This concept is analysed in the study done by Blomsrtom, Lipsey and Zejan, (1992). They claim that when compared to the United States if the initial per capita income is lower for a developing nation, they can have faster growth subsequently. They further state that the inflow of FDI has a significant positive impact on the income growth of developing countries and faster growth can be achieved, by countries which are already at a somewhat high level of development but not the very poor countries.

Sri Lanka is a middle-income country with a per capita GDP of USD 3,886 (2016) and a literacy rate of average 92.4 per cent (2016). Therefore, theoretically, Sri Lanka should have the potential of attracting FDI and using FDI as a source of economic growth.

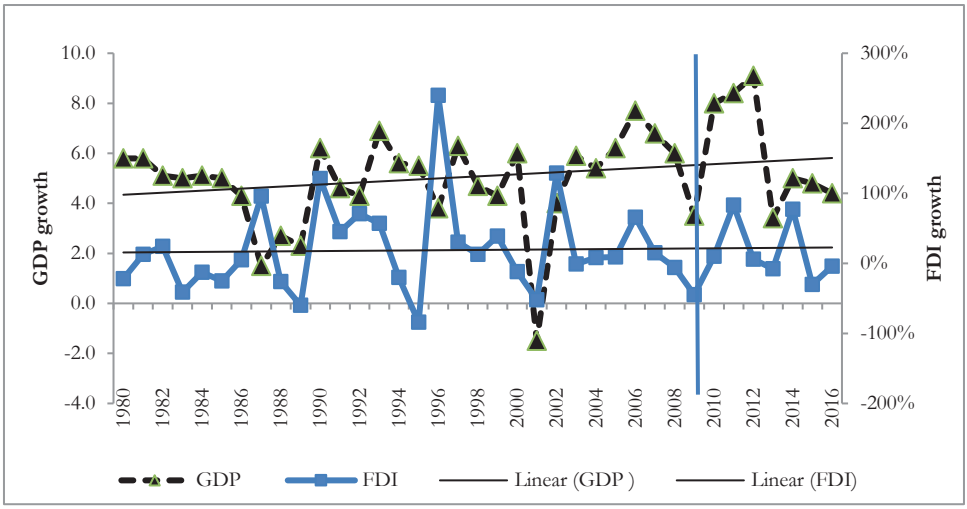
In 2016, 35 per cent of government recurrent expenditure was debt interest payment, which is the biggest portion of recurrent expenditure. Increasing public debt has adverse economic impacts such as high interest rates, collapsing of the domestic currency, tax burdens on the public and finally may threaten the sustainability of the economy. For Sri Lanka, therefore, there is an extreme need of an alternative way of attracting capital to the country, other than debt. FDI is the best alternative, given the government can reap the benefits of it by correctly articulating policies.

In the Sri Lankan context, during the period of post-independence and pre-economic liberalization, that is from 1948 to 1977 there were some attempts to implement policies to attract FDI to the country. With the identification of market oriented economic policies as the most beneficial for the growth, economists and politicians made it their policy priorities to create an FDI friendly economic environment in the late 1970s. Accordingly, with the regime change in 1977, the Foreign Investment Act 1978 was established in order to provide policy guidance in attracting more FDI to the country. Since then almost all successive governments and policy makers have supported market liberalisation and continued to relax trade and foreign exchange policies (Athukorala, 2003 as cited in Board of Investment Report 2002). There was a marked increase in FDI following the policy turn-around in 1977, followed by a

sharp collapse immediately after the escalation of the ethnic conflict in 1983. Nearly three decades of violence ended in 2009, which resulted in a remarkable increase in the GDP growth and the inflow of FDI.

It is evident that with the post war impact, GDP growth and FDI growth began moving towards a gradual divergence to trending association (Figure 1) and this association between FDI and GDP growth is also evident in the correlation estimation between FDI growth and GDP growth which has improved from 0.1000 correlations in the period of 1980 to 2008 to 0.4516 correlations in the period 2009 to 2016 which is the post war time. The reported correlations for both periods are significant.

Figure 1: The relationship of real GDP growth and the FDI growth



Source: The Central Bank of Sri Lanka and author's calculations

There are only a limited number of studies that analyse the effect of FDI on economic growth in the context of Sri Lanka in the recent past, especially in relation to post war impact. Lack of comprehensive studies to guide policy decisions on FDI may also contributed to the fact that Sri Lanka is attracting lesser amounts of FDI compared to its neighbouring Asian countries.

In this study, the focus will be on the time between 1980 to 2016 which also includes the post war era, and the research attempts to identify whether there is a significant relationship between FDI and economic growth in Sri Lanka. It will stress on the importance of promoting FDI for rapid growth of the economy of Sri Lanka.

The study confirms that there is a significant and long-run association between GDP, national investment, employment, and trade with FDI, and the short run co-efficient of FDI also reports a level of significance. The findings of this study would be useful for policy makers in general, for better calibration of macroeconomic policies, in attracting FDI to Sri Lanka and steering such investments towards development of the country.

The remainder of this paper is structured as follows: Part 2 contains a discussion of the theoretical outline of FDI related growth including justifications for using the production function in the study and a review of prior academic literature. Part 3 provides the model analysis and the related discussions are in Part 4, followed by the conclusion.

2. Literature Review

2.1. The Theoretical Foundation of FDI Led Growth

The Harrod-Domer model suggests that the economic growth depends on the level of savings and productivity of capital investment. Raising the level of saving may be difficult, especially for developing countries. Therefore, such nations are required to borrow 'savings' by ways of loans, grants and FDI.

The neoclassical model of growth and endogenous models of growth also provide theoretical support for FDI and its impact on economic growth. Endogenous growth theory holds that technological advancement and human capital are the key contributors to economic growth. As such, the main way in which FDI can affect growth is by increasing returns to production via externalities and output efficiency spillovers (De Mello, 1997). The main feature of the neoclassical model is the convergence property. That is, the lower the real per capita GDP the higher the forecastable growth level (Barro, 1996). That explanation theoretically supports developing countries utilising FDI flows originating from advanced countries.

FDI brings a bundle of advantages as capital, technology and expertise which can have an impact on the capital stock of the host country and it can enhance labour productivity by way of knowledge transfer and managerial practice (Hoang et al., 2010). That is, FDI can supplement the element of 'capital' in the production function and can influence the output or the GDP level.

2.2. Modelling Economic Growth Using Production Function and Determinants of Growth

Mankiw (2010) argues that the large increase in the factors of production, i.e. labour force participation, capital stock, and education, is attributable to exceptional growth levels in four East Asian countries. From 1966 to 1990, the real income per person grew about 2 per cent in the USA whilst in these countries it grew by 7 per cent per annum. Therefore, modelling growth in terms of capital, labour and qualitative human capital is suitable for testing the long run growth effects, and a model can be constructed in the form of the production function.

Barro (1996) argues that the growth rate tends to be much higher if the country initiates with a lower level of real per capita GDP. His findings further show that the highest standard in political democracy is not essential for the growth of GDP. Barro's findings are positive observations in relation to Sri Lanka as it is a country with a middle level of per capita GDP and has established democracy to a satisfactory level.

Romer (2011) explains, if L represents 'labour' and A represents 'effectiveness of labour' i.e. education, skill of the labour and attitude towards employment or quality of infrastructure, AL represents as 'effective labour', the progress of the technology included in this manner is known as 'labour augmented' or 'Harrod-neutral'. The Solow model[3] focuses on the properties of the production function and how the L, K (capital) and A link in the production function to produce the output (Y). Sahoo (2006) explains that the most significant and influential determinants of FDI in South Asia are labour force growth and market size. Coe, Helpman, Hoffmaister (1995) discuss that a properly educated workforce can increase productivity by

[3] Robert Solow and Swan (1956)

directly and indirectly attracting FDI and enabling the country to get advantage of advanced technology with its investing partners.

Mankiw, Romer and Weil (1992) tested a model by augmenting the Solow model and incorporated human capital as a supplementary explanatory variable in their cross-country regression. Knowing the importance of the labour and the effectiveness of the labour in estimating the production function, this study incorporates labour as an explanatory variable. Further, given the importance of the quality of education regarding productivity and attracting foreign capital, university education was also added as a variable in this model to capture such qualitative nature of the labour force of the country. Vacaflores (2011) found the positive effect of FDI on labour in Latin America. Vacaflores states that this effect is mostly important for less developed countries, with less inflow of FDI and larger informal sector workers.

However, a different result was observed by Raleva (2014) in the case of Bulgaria from 1992 to 2013. The study found the impact of labour to GDP was very negative after 2009 and 1998-2000 and a correlation was found between the negative effects of labour on GDP in the recession period except in 1996.

Many studies have shown that countries with externally oriented trade policies can benefit more from FDI than inwardly oriented trade policies in relation to growth of economy. Agrawal (2000) included 'trade' taking log of export to the model. Tiwari and Mutascu (2011) also expanded the production function by adding export to the model. Balasubramanyam, Salisu and Sapsford (1996) studied the role of FDI in growth process in the context of developing nations with different trade policy regimes. They measure trade by 'exports' and argue that exports lead to higher factor productivity, lessen foreign exchange constraints and result in a higher rate of technological advancements (as cited by Salvatore & Hatcher, 1991). Trade openness measures an economy's trade intensity (Pritchett, 1996). Trade openness can be said as 'free trade' in an economy where trade distortions are exterminated. Basu, Chakraborty, and Reagle (2003) claim that FDI and GDP can mutually reinforce each other in open economies. The study measured the trade openness using the index of trade.[4]

[4] (Import + export)/GDP

Kohpaiboon's (2003) results show that the growth impact from FDI is more when the country has an export promoting trade regime. This research used trade openness[5] for the tested model. Athukorala (2003), and Balamurali and Bogahawatte (2011), in the context of Sri Lanka, extended their models by including 'trade liberalisation' in the form of trade openness.

Ghazali (2010) found a positive correlation between FDI, GDP and national investment. Inflow of FDI enhances local investment via connected benefits like market access, technology and skills and domestic investment is one of the indications of the status of the economy for foreign investors. Agrawal (2000) explains the difficulty of measuring the accurate capital stock in developing countries and approximates capital stock by the ratio of domestic fixed investment to GDP. Athukorala (2003) also estimates the model taking domestic investment to GDP as a proxy for capital. Baharumshah, Slesman, and Devadason (2015) examine how the three types of foreign capital namely, FDI, portfolio equity and debt inflow affect growth, and claim that different type of capital effect the growth in different levels.

The inclusion of FDI as a variable in the production function can be validated as it represents an alternative source of capital to the model.

The capital stock is a fundamental factor of the economy's ability to produce and it causes growth of GDP. A contrasting result to such opinion is expressed by Choe (2003). The study found that domestic investment does not cause growth and concludes that domestic investment does not necessarily support economic growth.

Theoretically and empirically, capital is known as the central factor of production and the base of growth. However, the unavailability of reliable information on such may result in conflicting observations.

[5] (Import + export)/GDP

2.3. Arguments For and Against the Impact of FDI on the Growth of Economy

Agrawal (2000) claims that the increase in FDI in Asian countries is associated with increase in national investment. The findings are in line with implementation of free trade policies in many Asian countries in the 1980s, and the analysis shows that the influence of FDI on growth is negative prior to 1980 and increasingly positive in late 1980s. His study proves that the countries without trade distortions could have increased benefits from foreign capital. Agrawal's (2000) study also found a positive impact of net foreign borrowing as a share of GDP on growth, but the coefficient is smaller relative to the coefficient of FDI, and claims that FDI is more preferred for the economy compared to foreign borrowing.

Tiwari and Mutascu (2011) found that FDI and export have a positive impact on growth of Asian countries, and capital and labour support such development. Yao (2006) reveals that FDI and export can make a positive and strong effect on China's growth. Yao goes on to explain that the openness in the exchange market and allowing FDI are the reasons for the economic success in China. Chen, Chang, and Zhang (1995) also found a positive impact on growth by FDI. However, they go on to explain some of the negative social and political effects of FDI led growth such as uneven economic development in coastal and inland provinces causing unequal income distribution.

The positive impact of FDI on economic growth is theoretically expected and has been proven by many empirical studies; however, there is evidence of disagreement, too. For example, Herzer (2012) studied the effect of FDI on growth of 44 developing countries and states that FDI has on average, a negative effect. But there were large differences across countries. Further he suggests, the impact of growth from FDI can mainly be explained by country wise differences in independence on trade, less government intervention and business freedom.

Duasa (2007) found that there is no strong impact of FDI on growth of an economy. However, he says that FDI does contribute to the stability of growth. Pradhan (2009) studied the connection between FDI and the growth of five ASEAN[6] countries. He concluded that the relationship co-integrated at the panel level; however, at the individual level a significant

[6] Association of South East Asian Nations

effect on growth was shown only by Singapore and Thailand. Lensink, and Morrissey (2006) found some positive effects of FDI on GDP. However, the results were weaker for developing countries where volatility of FDI existed. Therefore, they concluded that FDI volatilities can negatively affect the growth of a country.

2.4. Factors Affecting FDI Inflows

There are several factors which affect the inflow of FDI to a country. Policy adoption should aim not only to attract FDI but also to drive foreign investment to yield expected growth targets. Therefore, it is important to identify such factors and focus on how FDI can be utilised to achieve growth objectives. Many studies identify factors influencing the inflow of FDI. Among those, there are some significant factors for Sri Lanka.

The existence of a strong domestic financial market is a positive factor when attracting FDI. Alfaro, Chanda, Kalemli-Ozcan, and Sayek (2004) found that benefits gain from FDI are more for countries with well-developed financial markets. Durham (2004) found a similar result. His regression also included business regulations and property right indexes and concluded that the more superlative the corruption index rating, higher the effect of FDI on such countries. Zhang (2007) discusses that a liberalised trade regime, improved education and human capital conditions, macroeconomic stability, and export oriented FDI promote economic growth.

Infrastructure is a necessary feature for economic development. It is also a key requirement in attracting FDI. Yol and Tang (2009) found that there is a long run relationship between the real exchange rate, GDP growth and infrastructure. Thilakaweera (2012) also found that infrastructure has a greater influence on attracting FDI in the context of Sri Lanka.

A study by Kimino, Saal and Driffield (2007) suggests that political and economic stability, fair borrowing, labour costs and investor perception towards risk in the source country are determinants of inward FDI. Baharumshah et al. (2015, as cited in Prasad, Rajan and Subramanian, 2007) say that developing countries with underdeveloped financial markets should be careful in attracting forms of foreign capital. Balamurali and Bogahawatte (2011) in

their study state that Sri Lanka's protectionist trade policies and regulatory barriers have caused high cost of capital for foreign firms and loss of profits.

2.5. Studies in the Context of Sri Lanka

There are some studies done in order to identify the association between FDI and growth in Sri Lanka. These studies show mixed results on how FDI impacts the growth of the Sri Lankan economy, which lead to an inconclusive opinion on whether FDI has a positive impact on GDP. Athukorala (2003) found that FDI does not have a significant impact on economic growth and the causation is from GDP growth to FDI, not from FDI to GDP. The model has not captured the importance of labour. Ravinthirakumar et al. (2019), studied the causal relationship between tourism, FDI, political instability and other variables in the context of Sri Lanka and claim that there is a long run relationship among these variables. Balamurali and Bogahawatte (2011) suggest that there is a long run equilibrium association present and the direction of causality is towards FDI to GDP growth and GDP growth to FDI. Therefore, study concluded observing bidirectional causality between FDI and economic growth in Sri Lanka. Velnampy et al. (2014) found that there is a long run equilibrium relationship,however, there is no significant impact of FDI on growth. Deyshappriya (2012) claims that although the FDI shows a positive effect on GDP the degree of the effect is insignificant. The causality observed from FDI to GDP is reported as a one-way causality. The study claims that the insignificance of the impact of FDI is due to the lack of economic and political stability and poor infrastructure.

Conducting more studies on this aspect in the context of Sri Lanka has been discouraged due to the economic and political instability that has prevailed in the country for decades, which has caused less FDI flowing to the country. The importance of FDI for an emerging economy like Sri Lanka is enormous. Especially FDI can play a vital part in rebuilding the economy and society after conflict. It can provide non-debt capital, which is important to a country with a high debt level. Evidence of very limited analysis on this important aspect for Sri Lanka, especially with post war impact, creates motivation for further studies. This study also incorporates the educated labour force to the model, to the extent of available information, which was lacking in previous literature. The next section details the model construction and the sources of data.

3. Data, Model and the Methodology

This study was carried out using the data gathered mainly from the publications of the Central Bank of Sri Lanka and publications of other relevant institutions such as the Department of Census and Statistics, Sri Lanka. Time series data from 1980 to 2016 were extracted from the relevant sources for the analysis, which gives 37 observations.

The methodology of this study includes estimating an econometric model based on the production function framework. The level of output of an economy, in a given time is decided by the factors of production and the production technology. This study therefore considers five explanatory variables including FDI to structure the econometric model.

In growth related studies, research traditionally follows the Solow model (Romer, 2011). The Solow model considers capital, labour and effectiveness of labour as variables. At any given time an economy has some level of capital and labour which are combined to produce the output. The origin of the reported model is $Y = f(K, L)$, where Y denotes the output level or GDP measured in real growth rate terms.

Ghazali (2010) and Mankiw (2010) discuss the role of capital in producing output and the growth. Further, Ghazali highlights the positive correlation between national investment and FDI. Considering the difficulty of obtaining reliable data series on capital stock in developing countries, investment as a ratio of GDP is used to denote the capital stock (IN) in the reported model. This approach is similar to those of Agrawal (2000) and Athukorala (2003).

Mankiw (2010) stresses that openness to international trade can have a positive effect on economic growth. In this study 'TRAD' represents trade openness capturing the effect of openness of the trade policy regime. Athukorala (2003) and Balamurali and Bogahawatte (2011) followed the same approach of using trade openness to represent 'trade' as opposed to the use of 'export' by Agrawal (2000) and Tiwari and Mutascu (2011).

According to the Cobb-Douglas production function, if constant technology is assumed, labour and /or capital can increase the production level of a country. Hence, human capital can be considered as a key component of economic growth. Tiwari and Mutascu (2011)

suggests that FDI and exports support economic growth of Asian countries with the help of labour and capital. Considering the importance of human capital, the reported model uses 'employed persons as a ratio of mid-year population' denoted as 'EMP', as opposed to Athukorala (2003) 's model where labour was dropped from the estimation.

Coe et al. (1995) and Mankiw et al. (1992) explain the power of educated population on attracting FDI and promoting growth. 'University graduation as a percentage of mid-year population' (UNI) is used in this study to represent the quality of the labour force.

Inflow of FDI is represented by 'FDI', which is the ratio of FDI inflow to GDP.

By considering the explained variables, the augmented production function is constructed as follows:

RGDPG = (NI, TRAD, LEMP, FDI, UNI)

Where;

1. **RGDPG** denotes the *real GDP in growth rate terms;*
2. **NI** represents the domestic capital stock (*National Investment/GDP*);
3. **TRAD** represents the trade openness calculated by (*import + export) / GDP;*
4. *Log of employed persons per mid-year population* is denoted by **LEMP**;
5. **FDI** represents the inflation adjusted *FDI inflow to real GDP;*
   An additional estimation was carried out using *FDI growth rate*, denoted by **FDIG,** to check whether the level of statistical significance in long and short run adjustments could be improved.
6. *Log of* u*niversity graduation as a percentage of mid-year population* given by **LUNI;**
7. e_t is used as the error term to absorb the effect of all other factors affecting economic growth.

Given the above explanatory variables the regression equation can be as follows:
RGDPG = ($\mathbf{b_0}$ + $\mathbf{b_1}$ NI+ $\mathbf{b_2}$ TRAD+ $\mathbf{b_3}$ FDI+ $\mathbf{b_4}$ LEMP+ $\mathbf{b_5}$ LUNI + e_t)

The next section explains the method by which the model was tested and the rational of selecting the suitable methodology.

The stationarity property of the selected variable was tested using the Augmented Dickey-Fuller (ADF) test and the Phillips-Perron (PP) test. Selection Order Criteria is used to specify the appropriate lag length which is based on Final Prediction Error (FPE), Schwarz's Bayesian information criterion (SBIC), the Akaike's information criterion (AIC), Likelihood Ratio (LR), and the Hannan and Quinn information criterion (HQIC).

The model was built with the Vector Error Correction (VEC). The stability and white noise were tested by conducting VEC stationary, residual autocorrelation and the test for normality.

4. Results and Discussion

4.1. Descriptive Statistics

The total number of observations is 37 in the sample from 1980 to 2016. All the variables have reasonable standard deviations. (descriptive statistics are in Table A1 of the Appendices).

4.2. Unit Root Test

Testing for stationarity is the initial step of building the correct model. As suggested by Becketti (2013) the unit root test was conducted in two lag levels, lag length 3 and 4[7]. With lag length 4 ADF test confirms the stationarity at first difference in 5 per cent level for all variables, except for TRAD and LEMP. The results were further confirmed by the PP test. The PP test was carried out for TRAD and LEMP and it confirmed stationarity at first difference. For RGDPG none zero drift term was added which represents the long run growth rate of GDP (Becketti, 2013). The stationarity assumption was not changed even with the drift term.

[7] Test results can be provided on demand

Similar results were evident with lag length 3. Stationarity at first difference was confirmed for TRAD by PP test, consequent to the ADF test. All other variables confirmed the first difference stationarity by both ADF and PP tests. It was observed that RGDPG is stationary even with the drift term.

The unit root test results for both lag length 3 and 4 confirms the variables are integrated at first difference. Further, uniformity of test results between two lag lengths strengthens the result and reduces the possibility of variation in outcome due to changes in the lag length. Having confirmed that variables will not lead to spurious regression, the study proceeded to test for appropriate lag length and co-integration.

4.3. Appropriate Lag Length Selection

Lag length selection results were conducted with FDI/GDP and with FDIG, with and without the maximum lag, which allows for identifying whether the variables are sensitives to the lag length. It was observed that with the maximum lag 8, the lag selection test is sensitive to the maximum lag specified.

Liew (2004) found that AIC and FPE give better predictions than other criteria if the number of observations is less than 60. He further explains that AIC and FPE lessen the possibility of underestimations and improve the chances of arriving at a true lag length. Balamurali and Bogahawatte (2011) in the context of Sri Lanka, used AIC to select the lag length. Lag 4 was selected as the appropriate lag length for testing co-integration and fixing the error correction model. This lag selection is also similar to Thilakaweera (2012) in studying the relationship among GDP, FDI and infrastructure in the context of Sri Lanka.

4.4. Testing for Co-integration

Johansen's multiple-trace statistic for co-integration was tested in this study. Two alternative test models were tested.[8] If the model includes FDI/GDP, there is a possibility of having one co-integration equation at a five per cent critical level, and if the model is constructed with FDIG

[8] Test results can be provided on demand

there can be one co-integration equation at ten and five per cent critical levels. The possibility of having a co-integrating vector can be interpreted as the presence of a long term equilibrium.

Having confirmed that the variables are stationary at first difference and the existence of a co-integration relationship lead to specification of a VECM. Athukorala (2003) also found a co-integration relationship at 5 per cent confidence level in a similar study on Sri Lanka.

4.5. Fitting the VECM

When there is a shock to the system the adjustment process works in the opposite direction. Therefore, a long run coefficient can be said to be stable if the value is negative and less than 1 (i.e. -1 < Coeff. < 0) (Athukorala, 2003 and Becketti, 2013).

The reported model estimated one co-integration relationship as suggested by the co-integration test. Table A2 of the Appendices shows the fitted VECM with the FDI/GDP. The model reports the long term coefficient of -1.9574. This is significant at the 5 per cent significance level, with the p value of 0.0000. Although the sign of the coefficient is negative and significant, it is greater than 1. This shows an oscillatory adjustment which is not usually interpreted as a long term adjustment.

Short run adjustments were measured by the coefficients of lagged individual variables. Similar to the long run coefficient, short run coefficients of FDI also display an oscillatory nature. However, coefficients are highly significant in LD, L2D and L3D. National Investment (NI) reported to be significant in lag 2 and 3, with a coefficient less than 1 in all lags. However, the correct sign was observed only in lag 1 and 3. Trade openness (TRAD) shows the correct sign with coefficient less than 1 in all levels. Significance is, however, observed only in lag 1. Labour (EMP) shows significance in lag 1 and 3. Although it is observed with less than 1 coefficient, none of them has the negative sign. Log of UNI reports significance in lag 1 and a coefficient of less than 1 in all three lags. The correct sign can be observed in lag 2 and 3.

The reported model was then tested with the FDIG instead of FDI/GDP, in order to test whether the results could be improved. Overall, the output shows the model fits well. VECM

reported similar results with both the trend terms 'Constant' and 'Restricted Constant'. This implies that co-integration equations are stationary around a constant mean (Becketti, 2013). The test results for the model with FDIG are reported in Table A3 of the Appendices. The error correction term was reported as -0.9692 with a very high significance level by reporting a p value of 0.002. Accordingly, the speed of adjustment can be interpreted as 97 per cent, which is close to one period. The findings show relative improvements compared to the studies done by Athukorala (2003) and Deyshappriya (2012) in the Sri Lankan context. As studying the relationship of FDI to GDP is the main objective of this research, the short run coefficient of FDIG is an important indication of this model. FDIG reports the correct sign and the value is less than one for all the lag levels. Statistical significance is observed for the L2D and L3D. Therefore, it is evident that FDIG has a short run effect on the error correction process. Therefore, the model reports both long run and short run significance.

NI although the reported coefficients are realistic, none of them shows a statistical significance in short run. Therefore, national investment can said to be 'weakly exogenous'. Engle, Hendry and Richard (1983) proposed a definition of weak exogeneity. A series of variables can be weakly exogenous if there is no loss of information of the parameters when the model condition on them. Further, Jacobs and Wallis (2010) explains that in VECM estimation, treating some variables as weakly exogenous permits efficient inference on the co-integration coefficient. TRAD also reports the correct coefficient but the significance can only be observed in lag 1. The variable EMP, however, only has a correct short term co-efficient in lag 2 and all the co-efficient are insignificant leading to weak exogeneity. Log of UNI shows the significance in Lag 2 and 3 levels with the correct coefficient. The short run effect of UNI on the error correction is therefore significant and efficient.

With the improved result on the long run adjustment term and the short run coefficient of the FDIG, the following co-integration relationship was established. The statistical significance is very high with all the variables and reported p values of 0.0000. The standard deviations also appear reasonable for all the coefficients. Table 1 reports the statistics related to the co-integration equation.

Table 1: Co-integration equation

Beta	Coef.	Std. Err.	z	P>|z|	95% Conf.	Interval
Rgdpg	1					
Ni	0.2067	0.0490	4.2200	0.0000	0.1106	0.3028
Trad	0.1137	0.0115	9.9300	0.0000	0.0913	0.1362
Fdig	-0.0344	0.0034	-9.9900	0.0000	-0.0412	-0.0277
LEMP	0.3339	0.0266	12.5400	0.0000	0.2817	0.3861
LUNI	-0.0353	0.0028	-12.8300	0.0000	-0.0407	-0.0299
_cons	0.0594					

The co-integration relationship is built as follows.

RGDPG = -0.0594 -0.2067NI -0.1137TRAD +0.0344FDIG –0.3339LEMP + 0.0353LUNI

The reported equation clearly indicates the expected sign, which is the positive effect of FDI on GDP growth. Such positive effect is in line with the findings of Agrawal (2000) and Tiwari and Mutascu (2011). For a 1 unit increase in the FDI, GDP will increase by .0344. The 3.44 effect in percentage terms is moderate, but this result is explainable considering the low FDI inflow to the country. The positive and significant impact FDI has on GDP growth is a promising sign of the economy.

The variable LUNI, which represents the qualitative nature of the labour force, also reports the expected sign. The positive impact of quality of labour on GDP is also confirmed by other research. In Coe et al. (1995) it was proven that developing countries with a higher enrolment rate for secondary education have a better productivity rate. The reported results in this study further prove the said claim. For 1 unit change in UNI the impact on GDP will be .0353. As per Dundar et al.(2017) the largest skill gaps which question the quality of the university education in Sri Lanka are communication, desire and ability to learn and ability to work as a team. Eliminating such skill gaps in university education will increase the impact the qualitative labour could have on the growth of the economy.

The effect of trade could not be determined before the estimation as it may have been affected by the status of the current account, exchange rate policy stance, etc. The reported result for TRAD shows a negative impact on GDP. The Central Bank of Sri Lanka (2016) states that the trade account deficit as a percentage of GDP increased to 11.2 in 2016. The current account balance was continuously in deficit from 1980 to 2016. Balamurali and Bogahawatte (2011), in the context of Sri Lanka, found the same negative relationship and go on to state that the growth of imports compared to exports is the reason for the negative impact of trade openness on GDP of Sri Lanka.

FDI generally plays an important role in the process of export oriented industries of a country. It is widely accepted that export oriented FDI (EOFDI) is an integral element of policy reforms towards growth. During 1967-77 out of total 82 foreign companies established, only 12 were export oriented companies. During 1978-92 out of 397 who signed for export oriented foreign firms, only 211 were in operations by end 1992 (Athukorala, 2007). Sectoral analysis of FDI inflow to Sri Lanka shows that, inflow of FDI to the infrastructure sector grew by 291 per cent by 2018, compared to 2015, whilst manufacturing and service sectors attracted only 13 per cent and 18 per cent growth, respectively in the same period (Central Bank of Sri Lanka, 2019). Further, sectoral distribution of export oriented manufacturing firms (in Export Processing Zone) shows that, compared to 1982, in 1991 the share of export of resourced based products[9] increased only to 11.5 per cent from 3.3 per cent regardless of the number of firms increasing from 4 to 29. Similarly, the export share of standardised consumer products[10] declined from 94.9 per cent to 79.6 per cent although the number of firms grew from 27 to 81, in the same period (Athukorala, 2007). According to data related to the Greater Colombo Economic Commission, considering the foreign exchange leakages, the share of imported inputs in gross export value is as high as 70 per cent, thus the net foreign exchange component represented in gross export earning is as low as 15 per cent (Athukorala, 2007). It is evident that the net impact of exports on balance of payments is not satisfactory to make a significant impact on growth. The negative impact of trade openness in the reported model can be attributed to such macro-economic factors.

[9] Process food, tobacco, rubber products, ceramic, gem

[10] Hand-looms, garments, knitting mills, leather and plastic goods, footwear, sport goods and jewelry

The study expected a positive impact of EMP; however, the model reports a negative impact of EMP on GDP. Similar results were observed by Raleva (2014) during the economic down turn in Bulgaria. Several factors affect economic growth; demand side factors and supply side factors. Real wage affects aggregate demand and if the real wage falls, it causes a decline in real income and spending. Central Bank of Sri Lanka (2016) states that the real wages of both the government and private employment categories decreased in 2016. This implies a decrease in spending. On the other hand, supply side growth impact comes from factors such as productivity of workers, training, motivation and flexibility in the labour market. Although this study has not conducted an extensive analysis on labour market of Sri Lanka, the effect of real wages, low productivity, unskilled nature of labour and lack of motivation can be identified as possible reasons for the negative impact of labour on GDP reported in the model. Further, three decades of civil conflicts have also caused brain drain in Sri Lanka, and providing skills to labour has become less of a priority. Central Bank of Sri Lanka (2016)[11] states that, high unemployment levels in youth and educationally qualified persons continue to be severe concerns in the Sri Lankan labour market. There has been a considerable increase in the number of employment opportunities created by EOFDI. However, the majority of jobs offered required no major skills and/or female workers with lower skills (Athukorala, 2007). Such unskilled/ semi-skilled labour certainly requires lower pay and hence the real wage effect of employment boost of EOFDI may not be significant on GDP. Skill gaps of employees also severely harm the potential for production. Substantial shortages in skills produce 43 per cent less than the usual capacity (Dundar et al., 2014). Therefore, the lack of sufficient skill levels prevents 'labour' functioning effectively and reaching the expected production potential. The youth unemployment[12] rate rose from 17.2 in 2011 to 21.6 in 2016, and the youth unemployment rate in 2016 indicates that one out of every five economically active youths is unemployed (Department of Census and Statistics, Sri Lanka Labour Force Survey,2016). These factors may be attributed to the negative impact of labour on GDP growth.

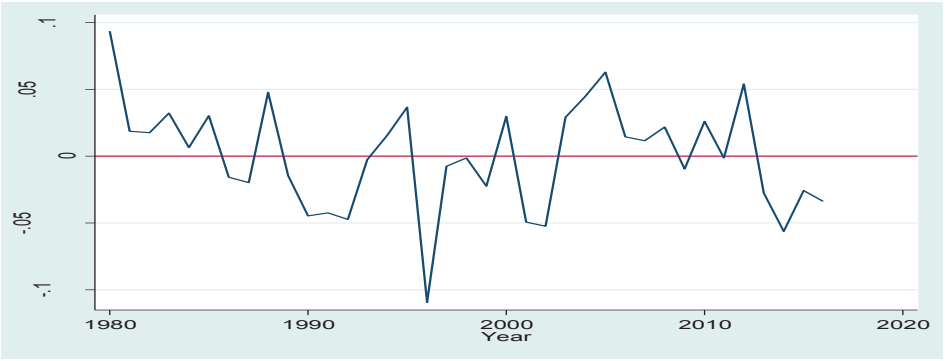
[11] Annual Report Chapter 4, p139

[12] Age between 15-24 years

The impact of NI on GDP was reported as negative. This contradicts the expected sign for national investment in this study. Choe, (2003) also found similar results in his study of 80 countries from 1971 to 1995. Being an agricultural and service oriented economy, Sri Lanka invests in plantations and agricultural projects. Dishaka and Ikemoto (2013) analyse the labour productivity in tea plantation sector of Sri Lanka. They claim that low social development, an aging workforce and the limited use of capital incentive methods create less productivity on investment in the plantation sector of Sri Lanka. Further, large scale investment in infrastructure projects such as harbours, airports and road developments took place in the last 10-12 years. The time taken to realise the return on investment for very large scale infrastructure projects is comparatively long. That may also be the reason the growth impact of national investment is not reflected in GDP numbers. Becketti (2013) explains that 'regime change' over the sample period may create problems. He further says that differences in monetary policy and regulations may change the dynamic relationship which the model tries to estimate.

Figure 2 shows the estimated co-integration relationship. There is a wide oscillation observed in the mid-1990s and early 2000s. However, after 2008 wide fluctuations started to settle down until 2015, when a regime change. Sri Lankan political history had regime changes in 1977, 1994, 2002, 2005 and 2015. It is clearly visible that the co-integration relationship has swings in those respective times. Therefore, it can be viewed that political stability, investor confidence and a 'development friendly' political stance affect growth potentials and stability of the economy.

Figure 2: Estimated Co-integration Relationship



Source: Author's calculations

4.6. Tests for Stability and White Noise

It is important to confirm that the model has correctly specified the number of co-integrating equations. Eigenvalues are strictly less than one if it has been correctly processed. In the tested model, all the eigenvalues are located inside the unit circle. However, there are two values plotted very close to the circled limit, specifying that some shocks will not die out in the short run. These test results confirm that the model is stable and hence, it is correctly specified.
The absence of autocorrelation in error term, indicate the consistence property of a time series. The Langrange-multiplier test results clearly accept the null hypothesis of no autocorrelation in lag order. The maximum order of autocorrelation to be tested is specified as 4. It is confirmed that from order 1 to 4 there is no autocorrelation; hence the model was further confirmed for correct specification.

The Jarque-Bera test result shows strong acceptance of the null hypothesis of normally distributed error terms. Considering each equation, except FDIG, all other variables report a probability of more than 0.05. According to the test interpretation the error of FDIG can be interpreted as skewed and kurtotic. The econometric assumptions of errors are iid (independently, identically distributed) and normally distributed, making the estimated model consistent and efficient. The reported model, therefore, is further confirmed for lack of non-normality.

4.7. Impulse Response Function and Forecasts

Orthogonalized IRF (IRF) results from the VECM shows (Figure A1 of Appendices: IRF Charts) that FDI has a permanent effect on GDP, which is positive. However, the faster positive impact of the impulse on period 2-3 will slow down after periods 7-8. National Investment shows a negative effect on GDP. National investment has an immediate negative impact and increases sharply. Trade openness has a declining effect from the impulse at the beginning and by period 4 it has a positive effect, and shows a permanent effect. However, the effect is negative overall. The impact of labour declines initially and then increases fast. However, the impact tends to decay over time. LUNI has a rapid positive impact of an impulse and tends to decay slowly.

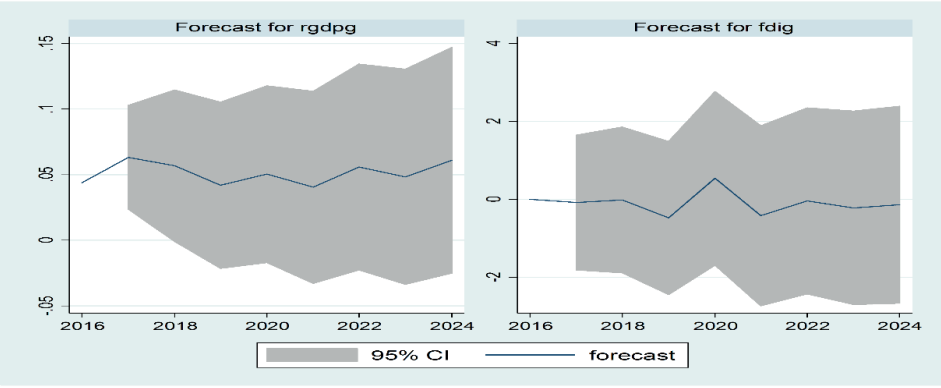
Secondly, the IRF was conducted to test how an impulse on FDI affects national investment, labour and trade. According to the result, an impulse on FDI will have a permanent and positive effect on national investment. The effect is immediate on national investment and slows down by period 5, then increases fast. The positive effect FDI can have on national investment has been confirmed in many previous studies. Agrawal (2000) found that 1 per cent increase in FDI is associated with 4-5 per cent increase in national investment. Athukorala (2003) also discusses the link between FDI and domestic investment of Sri Lanka. He observed a crowding in effect. The IRF of the reported model too can observes the positive effect of FDI on national investment.

Impulse on FDI has an immediate and permanent impact to labour. The sharp positive impact declines by period 2-3 and again starts improving by period 5-6. This proves the traditional view on FDI that it comes with a bundle of benefits including employment, skills and technology. This observation is in line with the claim of Vacaflores (2011). Vacaflores state that, FDI induces business operations in such a way that it converts informal sector to formalise employment activities. This finding can be true in the Sri Lankan context, too. Similar results were observed in the case of university education (LUNI) also, where the impact is positively increasing and permanent. This effect is also explainable as an inflow of FDI and related development activities have the ability to increase employment opportunities for well educated workers. Miningou and Tapsoba (2017) suggest that non resource rich countries can attract FDI by establishing quality in their education system which specially addresses the requirements of the economy.

The impact of impulse declines for trade and is negative. This effect is possible if the FDI inflow tends to increase imports, by way of material, machinery and other inputs, which certainly have an adverse impact on the trade account. Yousaf, Hussain and Ahmad (2008) shows FDI increases the real demand for import in the short and long run, whilst exports will decrease in the short run with an increase of FDI and increases in the long run. This suggests Sri Lanka to consider an import substitute policy for FDI, which will improve the trade account balance and create a demand for local inputs.

Figure 3 displays a forecast for the period from 2016 to 2024 at 95 per cent confidence interval. According to the reported model, the growth of GDP tends to be between 4 per cent to 6 per cent. The growth of FDI, however, shows a negative value in 2019 and positive in 2020. The historical trend of low level of growth for FDI is expected to remain unchanged. Therefore, policymakers must have a clear vision about the future of FDI in Sri Lanka.

Figure 3: Projected Growth of FDI and GDP



Source: Author's calculations

5. Conclusion and Policy Implications

The objective of this study was to identify the possible long run relationship between GDP growth and FDI in Sri Lanka. The reported model was constructed based on the production function, using capital, trade openness, labour and university graduation, with FDI growth to study the relationship such variables may have on GDP growth. The study examined data from 1980 to 2016.

The variables of the model were confirmed to be stationary at first difference. The appropriate lag length for the co-integration test and VECM was decided as 4. The Johansen test for co-integration confirmed the presence of a long run relationship by reporting one co-integrating equation. The stationarity at first difference and the presence of a co-integration relationship satisfy the necessary conditions to specify a VECM. The results were significant in the long and short run when tested with the FDI growth rate. The study found that there is a positive

and significant relationship between FDI and growth of GDP. The error correction term is highly significant and the co-efficient was correctly signed, with the model testing for lag 4. The short run coefficients of FDIG were also significant at lag 2 and 3 levels. This satisfies the fundamental objective of the study.

The positive impact of quality labour has been proved by many previous studies and it was further confirmed by the reported model. The findings assert the importance of a highly educated work force and the importance of investing in qualitative aspects of labour. The co-integration equation reports a negative effect of national investment on GDP, although the expectation was a positive impact. A close view of the equation shows that the long run effect has a sensitivity to regime change in Sri Lanka. The impact of national investment being negative can be explained as policy uncertainties of such transitional periods to some extent. The negative impact of trade openness can be attributed to the prolonged deficit in the trade account of Sri Lanka. The effect of labour on GDP also reported to be negative.

Tests for model stability and white noise reported that the model is correctly specified and there was no autocorrelation at lag order. Evidences of normally distributed errors are also satisfactory. According to the IRF, FDI has a permanent effect on GDP, which is positive. However, the faster positive impact of the impulse on period 2-3 will slow down after periods 7-8. The co-integration equation shows that for 1 unit increase in the FDI, GDP growth will increase by 0.0344. This positive and significant effect of FDI on GDP is an affirmative signal. The immediate, positive and permanent effect of impulse of FDI on NI, EMP and LUNI gives positive indications regarding FDI inflows. The TRAD, however, shows a negative effect and continues to decline.

Another important finding of the study is that the historical trend of low level of growth for FDI is expected to be unchanged in the next few years. The importance of formulating necessary policies to improve the level of FDI inflow is a crucial topic to be discussed by policy makers.

For any economy, FDI can provide an alternative source of capital. In the study by Agrawal (2000), he claims that FDI is preferable compared to foreign borrowing. For an economy like Sri Lanka where foreign and domestic borrowing are at the higher end, FDI can be the more

suitable form of foreign capital, which also comes bundled with other benefits like technology, market access and skills.

As observed by Alfaro et al. (2004) and Durham (2004) Sri Lanka should attempt to strengthen the domestic financial markets and improve their position in the Doing Business and Risk Indicator ranking which is a valuable indication to foreign investors about the security of properties and ease of operation in the country they intend to invest. Based on the observations and suggestions of Baharumshah et al. (2015), Sri Lanka too should have specific taxing and capital inflow/outflow policies. Based on Yol and Tang's (2009) findings on how infrastructure helps in attracting FDI, one of the initial and continuing tasks for Sri Lanka is to build necessary infrastructure. The study by Kimino et al. (2007) stresses the importance of political and economic stability to attract FDI to a country. The establishment of a stable political vision should be the foundation to any long term policy formulation.

Backward linkage to domestic inputs should be promoted rather than relying on imported inputs by export oriented foreign firms. Further, attention should be given to transferring skills and technologies from FDI, as most production functions come through foreign firms are assemble type activities which require low skilled labour.

Despite the high educational level in Sri Lanka, levels of technical skills and non-cognitive skills are low among university graduates. Therefore, strategic priorities and policy reforms should focus on technical and vocational education and training.

Trade policies should aim at reducing the anti-export bias. Introduction of para-tariffs leads to distorted input prices, which in turn leads to distortions in production patterns. High tariffs on final products rather than on material for productions, creates anti-export bias, as domestic producers may prefer to sell goods domestically. Trade barriers created by tariffs also make difficulties for local firms to access world-class material at competitive prices and integrate into Global Value Chains. Such an inward oriented nature of the economy may also affect the lower volumes of FDI in the long term.

Balamurali and Bogahawatte (2011) highlight the importance of liberalised policies in boosting foreign investment. However, it should be noted that, excessive concessions like long tax holidays, access to economically crucial sectors and unnecessary relaxation of labour laws can have adverse effects and hinder growth in the long term.

Although the impact of the reported model is statistically significant, the low level of FDI inflow has diminished the effect of FDI on growth. FDI is highly sensitive to fundamental macroeconomic factors. Therefore, ongoing policy directions are expected, which will provide the required drives to attract FDI and reap the full benefit of it.

Reliable data for FDI is available only from the 1980s; therefore, the study is limited to only 37 observations. A longer set of samples would have enabled a more predictable and conclusive outcome.

Future research may contribute more to these findings on the Sri Lankan context, by studying the postwar impact of FDI on growth. That will further strengthen the opinion on FDI and will help to articulate strong policies to drive the country towards rapid growth aided by FDI.

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Appendices

Table A1: Descriptive Statistics

Name	Variable	Obs.	Mean	Std. Dev.	Min	Max
RGDPG	Real GDP growth	37	0.0508	0.0195	- 0.0150	0.0910
NI	National Investment/GDP	37	0.2683	0.0408	0.2120	0.3910
TRAD	(Import + Export)/GDP	37	0.5773	0.1150	0.3700	0.7700
FDI	FDI/GDP	37	0.0128	0.0053	0.0025	0.0254
FDIG	FDI growth	37	0.3229	0.7062	- 0.8299	2.9421
LEMP	Log Employ./Midyear Population	37	- 1.0034	0.0636	- 1.0987	- 0.8800
LUNI	Log Uni.Grad./Mid-year Population	37	- 3.2589	0.7458	- 5.5994	- 1.9283

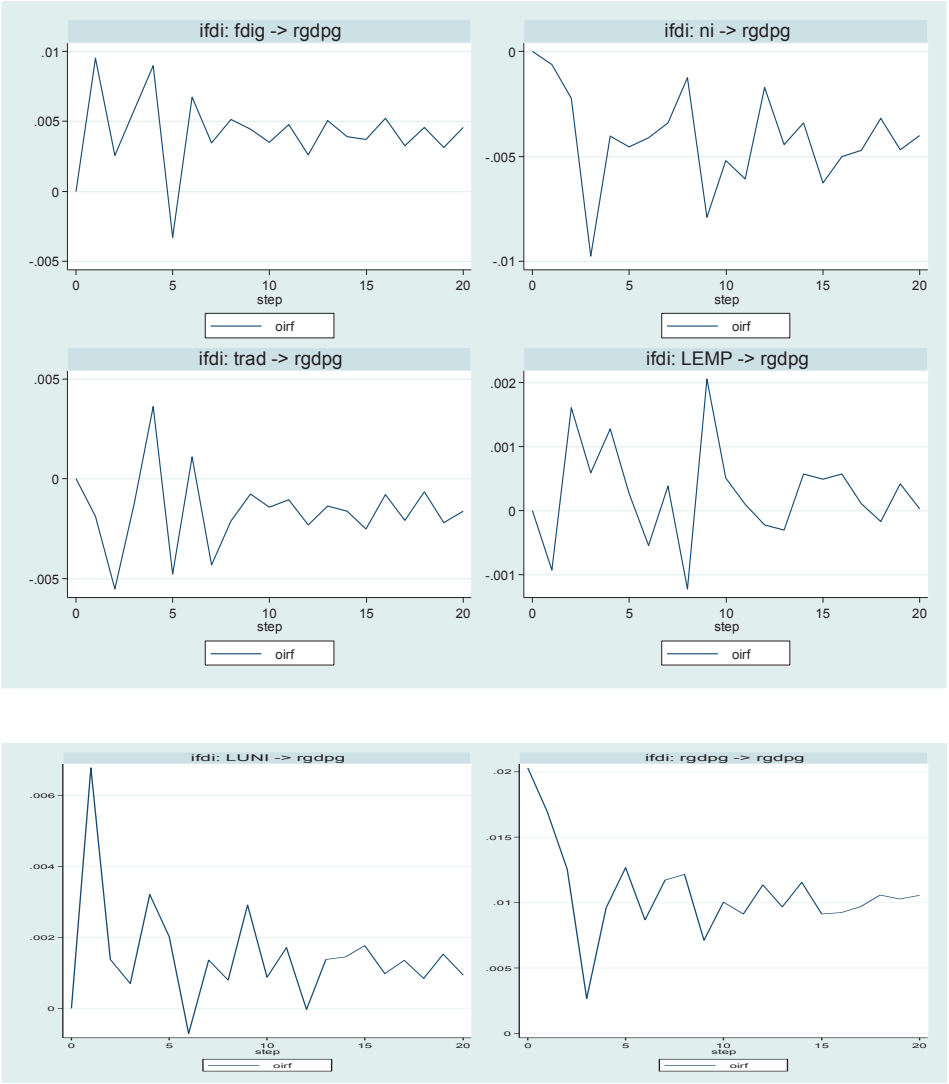
Table A2: VECM test result (with FDI/GDP)

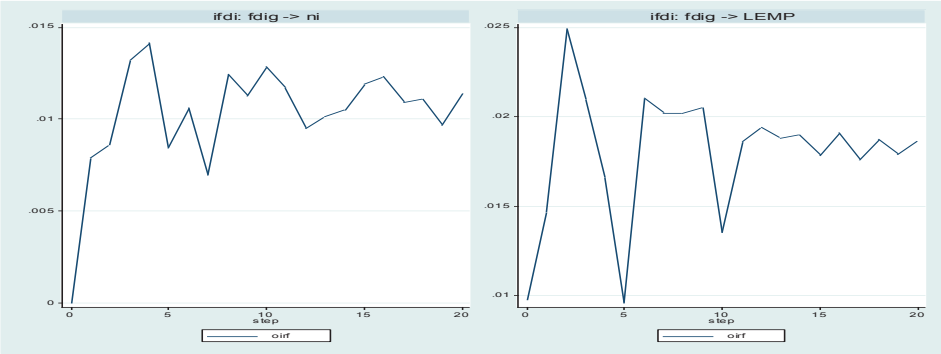
	Coef.	Std. Err.	Z	P>|z|	[95% Conf.	Interval]
D_RGDPG						
L1._ce1	- 1.9574	0.4697	- 4.1700	0.0000	- 2.8779	- 1.0368
RGDPG						
LD.	1.1033	0.4696	2.3500	0.0190	0.1830	2.0237
L2D.	1.0385	0.4103	2.5300	0.0110	0.2342	1.8428
L3D.	0.9889	0.3148	3.1400	0.0020	0.3719	1.6059
NI						
LD.	- 0.1076	0.2379	- 0.4500	0.6510	- 0.5738	0.3587
L2D.	0.5189	0.2258	2.3000	0.0220	0.0764	0.9614
L3D.	- 0.4188	0.1832	- 2.2900	0.0220	- 0.7778	- 0.0598
TRAD						
LD.	- 0.4438	0.1136	- 3.9100	0.0000	- 0.6665	- 0.2211
L2D.	- 0.0498	0.0933	- 0.5300	0.5940	- 0.2326	0.1331
L3D.	- 0.0755	0.0852	- 0.8900	0.3760	- 0.2426	0.0916
FDI						
LD.	- 3.4084	1.4793	- 2.3000	0.0210	- 6.3078	- 0.5090
L2D.	- 5.2750	1.1838	- 4.4600	0.0000	- 7.5952	- 2.9549
L3D.	- 3.1906	1.2451	- 2.5600	0.0100	- 5.6309	- 0.7503
LEMP						
LD.	0.3318	0.1317	2.5200	0.0120	0.0736	0.5899
L2D.	0.0933	0.1179	0.7900	0.4290	- 0.1379	0.3245
L3D.	0.4206	0.1367	3.0800	0.0020	0.1528	0.6885
LUNI						
LD.	0.0229	0.0098	2.3400	0.0190	0.0037	0.0421
L2D.	- 0.0121	0.0073	- 1.6600	0.0970	- 0.0264	0.0022
L3D.	- 0.0106	0.0075	- 1.4200	0.1550	- 0.0252	0.0040

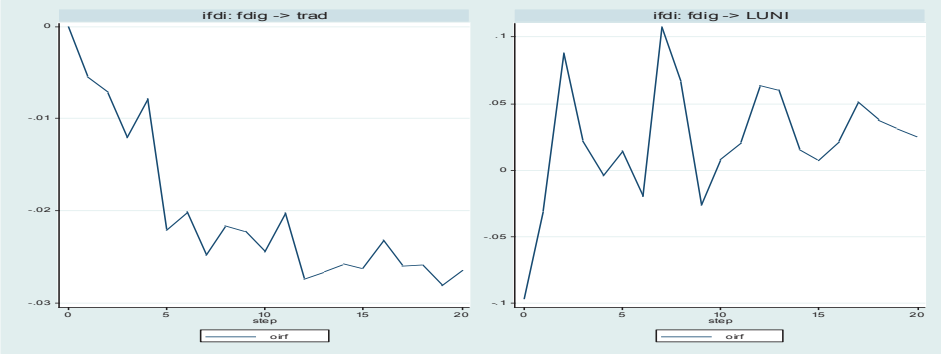
Table A3: VECM test result (with FDIG)

	Coef.	Std. Err.	z	P>|z|	95% Conf.	Interval
D_RGDPG L1._ce1	**-0.9692**	0.3085	-3.1400	**0.0020**	-1.5740	-0.3645
RGDPG						
LD.	0.7474	0.5425	1.3800	0.1680	-0.3159	1.8107
L2D.	0.9802	0.5074	1.9300	0.0530	-0.0144	1.9747
L3D.	0.8591	0.3531	2.4300	0.0150	0.1670	1.5512
NI						
LD.	-0.3499	0.2978	-1.1700	0.2400	-0.9337	0.2338
L2D.	0.1347	0.2513	0.5400	0.5920	-0.3579	0.6272
L3D.	-0.1495	0.2162	-0.6900	0.4890	-0.5731	0.2742
TRAD						
LD.	-0.2867	0.1161	-2.4700	0.0140	-0.5143	-0.0590
L2D.	-0.1237	0.1083	-1.1400	0.2540	-0.3360	0.0887
L3D.	-0.1361	0.1115	-1.2200	0.2220	-0.3547	0.0825
FDIG						
LD.	**-0.0182**	0.0096	-1.9000	**0.0580**	-0.0371	0.0006
L2D.	**-0.0181**	0.0086	-2.1100	**0.0350**	-0.0349	-0.0013
L3D.	**-0.0133**	0.0062	-2.1700	**0.0300**	-0.0254	-0.0013
LEMP						
LD.	0.1363	0.1350	1.0100	0.3130	-0.1282	0.4008
L2D.	-0.0088	0.1476	-0.0600	0.9520	-0.2980	0.2804
L3D.	0.1551	0.1345	1.1500	0.2490	-0.1085	0.4187
LUNI						
LD.	-0.0157	0.0148	-1.0600	0.2890	-0.0447	0.0133
L2D.	-0.0385	0.0124	-3.1000	0.0020	-0.0629	-0.0141
L3D.	-0.0263	0.0106	-2.4900	0.0130	-0.0470	-0.0056
_cons	-0.0035	0.0043	-0.8100	0.4210	-0.0119	0.0050

Figure A1: IRF from VECM (95 per cent confidence interval)







Source: Author's calculations

Import Demand Elasticities of Sri Lanka from January 2010 to March 2021 and the Change in Elasticities during the COVID-19 Pandemic

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Abstract

Elasticity of demand for imports of Sri Lanka in the post-Civil War period up to March 2021 and the change in them during the COVID-19 pandemic were estimated. (Relative) price elasticity, (production) activity elasticity and exchange rate elasticity were estimated for aggregate and disaggregated imports using Ordinary Least Squares (OLS) techniques with and without dummies, Autoregressive Distributed Lag (ARDL), and Error Correction Modeling. We found that price elasticity of aggregate import demand is inelastic. With the removal of fuel from aggregate imports, elasticities increase marginally. Activity elasticities of aggregate import demand, non-food consumer goods, intermediate goods and investment goods are inelastic over the short run and elastic over the long run while short run elasticity declined during the pandemic. Demand for food is elastic with respect to relative prices and the exchange rate and price elasticity declined during the pandemic. Intermediate goods are not significantly related to prices and exchange rates but are related to production activity. Our results are important for implementation of monetary, exchange-rate, fiscal, and trade policies of Sri Lanka.

Key Words: *Imports, Import elasticities, Sri Lanka*

JEL Classification: *F1, F4*

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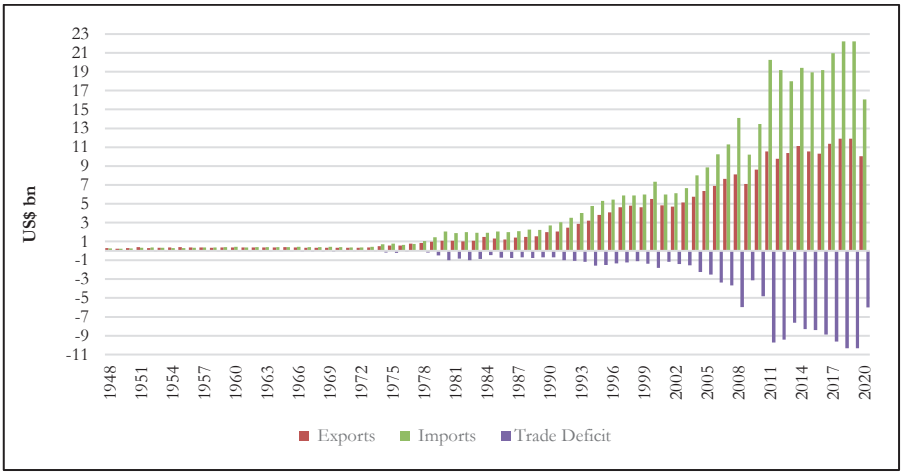
1. Introduction

Sri Lanka is a small open economy that espoused open economic policies in 1978 after about two decades of relatively closed economic policies. Throughout the entire post-independence history (i.e. since 1948), different policy regimes in respect of current account openness and exchange rate management affected the trade performance of Sri Lanka, together with various domestic and international socio-political factors. Trade deficits were recorded each year since the adoption of open economic policies in 1978, and almost every year before that as well (Figure 1). However, the period since 2010 is one distinct phase in the behaviour of imports in particular. Import expenditure increased significantly after the Civil War ended in 2009 and development activities escalated, and remained at high levels thereafter, without a commensurate increase in exports. This led to a gradual widening of the trade deficit and thereby widening of the current account deficit as well. This situation has created a burden on management of the exchange rate, international reserves, capital flows, and foreign debt of the Government. A high level of imports is also alleged by some to discourage local production. Therefore, it is of great interest to policymakers to understand how and why import demand behaved in the way it did during this period, as can be explained through import demand elasticities.

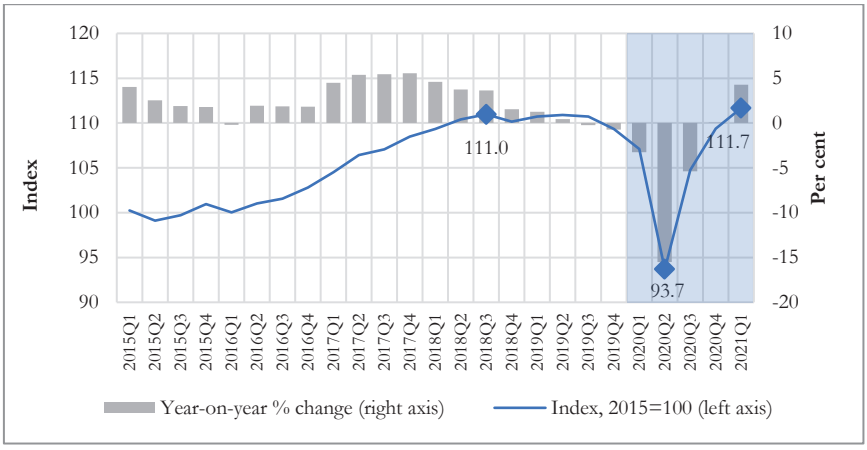
Figure 1: Exports, Imports and the Trade Balance of Sri Lanka from 1948 to 2020



Source: Central Bank of Sri Lanka

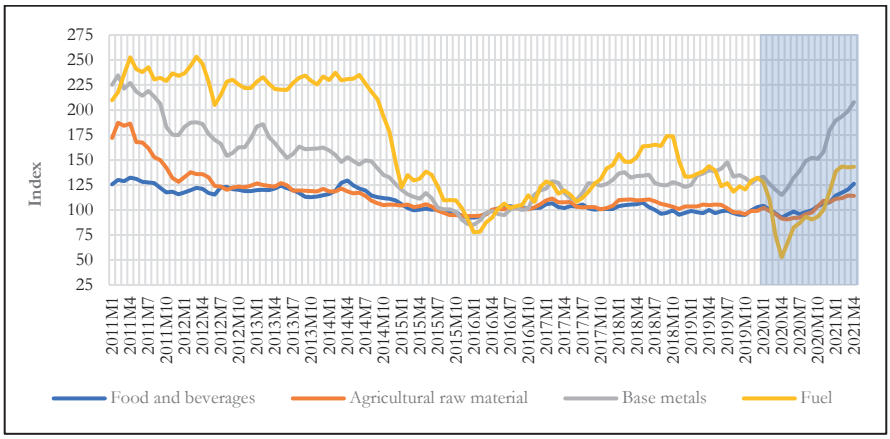
Meanwhile, the outbreak of the COVID-19 pandemic created different dynamics in global trade and trade of Sri Lanka. Global trade volumes decreased significantly as the uncertainties and speculations about the pandemic started to take toll in the tail end of 2019 (Figure 2). Trade volumes reached record low levels in the second quarter of 2020. Low economic activities due to lockdowns, reduction in incomes and demand, and disruption to maritime and logistical activities contributed to the reduction in global trade volumes. Further, commodity prices including prices of fuel plummeted as the pandemic started, reducing the cost of imports for importing countries in the year 2020 even though prices started to increase in the latter part of 2020 (Figure 3). However, trade volumes started to recover in the third quarter of 2020 as the effect of the economic stimulus measures implemented in almost all countries of the world started to take effect and trade started to adjust towards a "new normal".

Figure 2: World Merchandise Trade Volume Index (2015=100)



Sources: World Trade Organization United Nations Conference on Trade and Development

Figure 3: IMF Commodity Price Indices (2016=100)

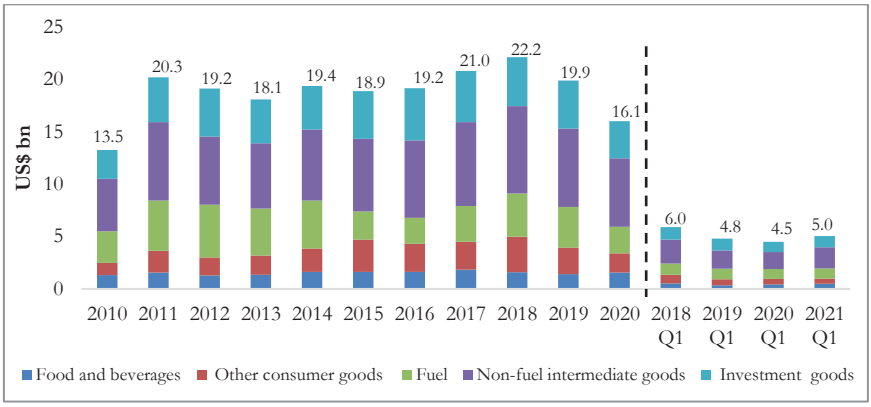


Source: International Monetary Fund

Sri Lanka's exports and imports broadly followed this pattern in global trade from 2020. Exports recorded a large decline during the first wave of the pandemic but started to recover thereafter. Import expenditure also plummeted in 2020 (Figure 4). In addition to the global supply chain issues, low global commodity prices and low economic activity in the country owing to lockdowns, import controls introduced by the Central Bank and the Government to curb non-urgent and non-essential imports to safeguard external sector stability in the face of compelling exchange rate and reserve management issues also contributed to reducing the import expenditure. However, imports displayed a lower inclination to stay low during the pandemic and a greater inclination to increase as the pandemic shock started to recede, when the aggregate import expenditure numbers are observed through the naked eye. For instance, although import expenditure during the first quarter of 2020 declined to US dollars 4.5 billion from the US dollars 6.0 billion and US dollars 4.8 billion recorded in the first quarters of 2018 and 2019 respectively, import expenditure during the first quarter of 2021 increased to US dollars 5.0 billion, despite the import controls, comparatively lower oil prices and the ongoing pandemic. This effect was more pronounced in some import categories than others. Therefore, credible estimations of import elasticities are necessary to understand import demand characteristics to devise economic policies, since the limited foreign exchange reserves and lack of foreign currency inflows have

made careful management of import expenditure and other outflows important, in order to maintain price, macroeconomic and financial system stability. Further, better understanding of import demand behaviour is also necessary to design trade, industrial, agricultural and development policies as well. Meanwhile, uncertainties created by the pandemic over economic activities, the exchange rate, and the policy environment may have changed import demand characteristics. Therefore, examining to what extent import elasticities changed since the outbreak of the COVID-19 pandemic is also of interest to policymakers, since the pandemic has aggravated external sector issues in the country.

Figure 4: Import Performance of Sri Lanka 2010 to 2021 Q1



2. Review of relevant and related past studies

The notion of elasticity of demand which was introduced to the technical literature of economics by Alfred Marshall, stipulates that quantity demanded of a product varies less or more with price, and its measurement is invariant to the measurement of quantities and prices. This concept has been applied in trade research in a widespread manner throughout the last several decades to gauge the degree of sensitivity of import and export quantities to factors affecting those quantities. Research points to the works of Joan Robinson (Robinson, 1937) as the origin of this application (Bahmani et.al., 2013; Eita, 2013), who explained the conditions under which devaluation of the exchange rate improves the trade balance and estimated trade elasticities. Her work formed the basis for estimating import and export

elasticities to research into numerous aspects of international trade, such as welfare effects of trade, direction of trade, exchange rate management and assessment of impact of trade policies such as tariff changes and preferential trade agreements.

However, it is the simple reduced form equations used by Houthakker and Magee (1969) that have become the workhorse model in import and export elasticity estimation. These equations present export and import quantities as a function of income and relative prices. Income is the gross value addition in the economy under concern or a reasonable proxy, while relative prices refer to import and export price indices in relation to some inflation measure. Income and relative prices encompass the main factors that theory identifies as affecting import demand, including tariff changes, global and local price levels, the exchange rate, and economic activity. There is a plethora of research that estimates import and export elasticities using these equations for various countries and for various time periods to determine whether the Marshall-Lerner condition and the J-Curve effect hold.[5] A lot of research also estimate elasticities for imports and exports with individual trading partners. It can be seen that the econometric techniques used in these research have gradually improved over time. Whereas earlier studies did not deal with the issue of stationarity, more recent research use cointegration approaches (mainly the Johansen and Juselius (1990) method), dynamic Ordinary Least Squares (OLS), Autoregressive Distributed Lag (ARDL) method of Pesaran et al. (2001) and Error Correction Modeling.

Neoclassical trade theory indicates that activity elasticity in the long run should be equal to about one based on marginal income propensity to consume and import of normal goods (Hong, 1999). However, results obtained by conventional methods as well as the new methods reveal that in some cases, it is higher than one for reasons such as new goods that are not included in the import price indices leading to underestimation of price elasticities and overestimation of income effects, the model in neoclassical theory applying more to final goods than intermediate goods, and greater intra-industry trade (Hong, 1999). The magnitude

[5] The Marshall Lerner condition states that the absolute value of price elasticities for imports and exports must sum to greater than one for a devaluation to be effective in improving a country's trade balance. The J-Curve effect states that a country's trade balance will initially deteriorate with the depreciation of its currency before improving.

of price elasticities, on the other hand is more difficult to predict as many factors can affect demand for imports through relative prices. However, price elasticity estimates are generally lower than unity (inelastic).

Import and export elasticities of Sri Lanka have been estimated in four previous published research papers to the best of our knowledge. Reinhart (1995) estimates import and export elasticities for twelve developing countries including Sri Lanka for the period of 1970 to 1991 using the Stock and Watson specification of estimating cointegrating relationships. His estimate for relative price elasticity for Sri Lanka is -0.304 while the income elasticity is 1.976. Subsequently, Sinha (2001) had estimated import and export elasticities for five Asian countries, including Sri Lanka. The period for imports under consideration for Sri Lanka in this research is 1950 to 1997 and an income elasticity of -0.39 and a relative price elasticity of -0.48 had been arrived at using ARDL techniques (both coefficients are statistically significant). It is noteworthy that the income elasticity of import demand is negative and inelastic in these findings, meaning that as income grows, imports decline by a magnitude less than proportionate. The negative sign is not consistent with conventional wisdom but the author presents this as a valid result. Further, it is concluded that the Marshall-Lerner condition does not hold for Sri Lanka and that devaluation as a strategy to reduce the trade deficit is unlikely to succeed in Sri Lanka.

Subsequently, Emran and Shilpi (2010) undertake research into import demand elasticities of Sri Lanka and restrict their analysis only to Sri Lanka. According to the paper, studies that undertake cross-country comparisons ignore implications arising from changes in policy regimes and hence could give biased results. In this research, the aggregate imports of Sri Lanka from 1960 to 1995 have been analysed using a structural econometric model of a two-good representative agent economy that incorporates a binding foreign exchange constraint at the administered prices of imports. Dummy variables have been used to distinguish the Civil War period from 1983 to 1989 and the period with protectionist policies prior to 1978. Using ARDL and Dynamic Ordinary Least Squares (DOLS) methods, they find that income elasticity is in the range of 0.96 and 1.09, while the price elasticity estimate is -0.78. They argue that they

found a higher (or different) price elasticity estimate compared to Reinhart (1995) and Sinha (2001) because those two studies did not take into account the differences in the policy regime that existed before 1978 with more trade and exchange rate interventions. As for foreign exchange availability as a binding constraint, they argue that if foreign exchange availability is used as a regressor when the foreign exchange constraint is binding, it alone determines the volume of imports completely, resulting in a near identity problem. This research also estimates that the magnitude of inter temporal elasticity of substitution of Sri Lanka is only slightly higher for home goods consumption (0.92 to 1.04) compared to imports (0.78), whereas some other research has found that it is 2 times as higher compared to the USA. This paper concludes by calling for more in depth country studies that take into account policy changes and other specific factors affecting imports and exports of the countries during certain periods of times, as studies which do not take into account such country specific factors produce biased results.

Tennakoon (2010) is a more recent research paper that contributes to the literature on trade elasticities of Sri Lanka by estimating import elasticities for total imports as well as three broad categories of imports, i.e., consumer goods, intermediate goods and investment goods. The period under concern is 1977 to 2007. Further, in addition to relative prices and incomes, this research also uses foreign exchange availability as one of the regressors. Using OLS techniques, it has been estimated that relative price elasticity for consumer goods, intermediate goods and investment goods are -0.99, -0.46 and -0.75, respectively, while foreign exchange elasticity for intermediate and investment goods is 0.497 and 0.705, respectively. Income elasticity estimates had not been statistically significant for all three types of imports. This shows that elasticities for different types of imports can be different. However, the results of this paper are contrasting with those of previous research to some extent and the differences could be due to the use of OLS as the analytical method, the inclusion of foreign exchange availability as an explanatory variable and the difference in time periods under concern. These differences have led to contrasting interpretations about import demand characteristics of Sri Lanka. In addition to the above four research, Sri Lanka is among a study carried out on 152 importing countries that uses a database covering the universe of exporters, importers and products at the 6-digit level of the Harmonised System (Fontagné, Guimbard and Orefice, 2020). This

research shows that when homogenous (or country-level) trade elasticities are used, a downward bias in the estimation of welfare gains from trade for developing countries can result, particularly for countries with high import penetration in less elastic sectors.

Past research shows that import demand elasticities need to be estimated again using the latest data, if they are to be used in policy decision making in the current context. Past research also provides guidance by showing that different types of imports can have different demand characteristics, and that differences in policy regimes should be accounted for while using robust empirical methods based on time series properties of data.

Since international trade was severely affected by the COVID-19 pandemic, there are numerous studies that investigate the size and nature of the pandemic's impact on trade and economic growth of individual countries and regions. The International Finance Corporation (2020) surveyed policy research carried out by other international organisations and trade data of individual countries in the first few months of 2020 and forecasted that in the short term, global trade will fall. The IFC publication has also noted that in the medium term, trade can help expedite economic recovery for many countries. It is also expected that global inventory management strategies may change and innovations in trade digitalization will continue while trade corridors may shift offering opportunities for high potential countries to take on greater leadership roles in regional trade networks (International Finance Corporation, 2020). Trade patterns and import demand are in fact shifting towards a "new normal". To the best of our knowledge, there are no published research papers that estimate import elasticities for any country for the COVID-19 pandemic period, or the change in import elasticities for this period. Most of the studies that are currently published were undertaken in the initial phase of the pandemic and aim to simulate and predict the pandemic's effects, taking into account that the pandemic brought both demand and supply shocks to trade. Since most of the projections on trade and GDP outcomes of the pandemic in 2020 are realised and measured by now, these studies are useful to determine the best methodologies to carry out predictions in the future.

In a seminal study that attempted to gauge the impact of the COVID-19 pandemic on trade, Hayakawa and Mukunoki (2020) investigate trade among 186 countries in the first quarter of

2020 and conclude that the pandemic had a negative effect on exporting countries, particularly developing countries, but not importing countries. Further, these negative effects had been more salient in some industries including textile, footwear and plastic industries. Textiles is a main import of Sri Lanka. A simulation using a Global Trade Model with early 2020 data that assumes global GDP and trade will be affected through three channels, viz, reduced labour supply, reduced demand and supply in specific sectors, and rising trade costs, predicted a decline in global GDP growth and trade in 2020 and 2021 (Bekkers & Koopman, 2020). Meanwhile, a simulation exercise on a General Equilibrium Model with trade cost and an endogenous trade imbalance structure using 2018 data for China, the EU and USA has found that the pandemic will hurt global trade and exports, though trade diversion and price increases will lead to an increase in imports of some countries (Li & Lin 2021). This simulation has assumed that COVID-19 will increase the trade cost between countries and decrease labor supply in production. Trade carried out by Commonwealth countries is also expected to be affected, though with greater effect on developed countries based on the duration and severity of the pandemic, according to simulations that use variations from the pre-pandemic trend in intra and extra Commonwealth trade in goods; and consensus, pessimistic and optimistic scenarios developed using macroeconomic forecasts published by the International Monetary Fund, World Bank and World Trade Organisation in the third and fourth quarters of 2020 (Escaith & Khorana, 2021). Meanwhile, the negative impact of the pandemic has been found to be greater for countries that were members of regional trade agreements before the pandemic, while the impact of the pandemic is negative and significant when indicators related to governmental actions are considered (Barbero et al. 2021). This negative effect has been found to be more intense when the exporter and importer countries share identical income levels, and the highest negative impact is found for exports among high income countries. The results have been derived using export data for 68 countries between January 2019 and October 2020.

Many countries responded to the pandemic with trade policy measures. Trade policy responses to the pandemic upto October 2020 had amounted to about 701 policy measures across 135 customs territories and had been substantially varied across countries (Evenett et. al., 2021). Trade policy measures are mainly export restrictions and import liberalisations on medical and

food products with measures targeting medical products accounting for two-thirds of such trade measures, amounting to US dollars 135 billion of export restrictions and US dollars 165 billion of import liberalisations. The comparable totals for food products had been US dollars 39 billion and US dollars 42 billion, respectively (Evenett et. al., 2021). Based on product level trade elasticities in global trade estimated by Fontagné et.al. (2020), the export restrictions had resulted in a 0.7 per cent increase in food prices and a 3.3 per cent increase in prices of medical products. Sri Lanka is among the countries that imposed certain export restrictions (oxygen) and import liberalisation (face masks). Import restrictions imposed on certain non-urgent non-essential goods in Sri Lanka from March 2020 are interpreted as Covid-19 policy responses in some contexts while not being interpreted so in others as they were imposed to manage external sector issues that prevailed for some time and got aggravated by the pandemic.

In this background of the related and relevant past studies, our research attempts to provide more up-to-date estimates of import elasticities of Sri Lanka for disaggregated imports and to do so using more rigorous econometric techniques than previous studies on Sri Lanka. In doing so, we also aim to give guidance to the policy decision making process on management of foreign currency flows of Sri Lanka. Our research also addresses contrasting results found by previous research on Sri Lanka. Building on the research findings that the pandemic affected international trade significantly, and that the magnitude differed according to country characteristics, we also estimate the import demand elasticities for Sri Lanka for the pandemic period up to the first quarter of 2021. Our study is the first that estimates import demand elasticities taking into consideration a period of time that was affected by different supply and demand characteristics in international trade created by a global pandemic, to the best of our knowledge.

3. Analytical framework

Elasticity of import demand in respect of three types of factors that affect import demand were estimated in this study, namely, relative prices, economic activity and the nominal exchange rate. Elasticity is defined as the percentage change in the quantity demanded, for a 1 per cent change in the factor affecting demand. Whereas most of the previous research estimate relative price elasticity and income elasticity, we decided to add the nominal exchange

rate as a separate variable, on account of the sizable exchange rate depreciation, speculation on the exchange rate and the policy measures aimed at managing the exchange rate that took place in Sri Lanka after the outbreak of the pandemic. Monthly data from January 2010 up to March 2020 were used. The period that was impacted by the pandemic was taken as the 12 months from April 2020 to March 2021. April 2021, rather than January, February or March 2021 was regarded as the first month of the pandemic period because rapid spread of COVID-19 and mobility restrictions in Sri Lanka commenced in late March 2021. Most of the economic policy measures were also implemented during March 2020. Thus, the impact of COVID-19 on the economy was more salient from April 2021.

Since the demand for the four major types of imports according to the Central Bank trade classification system could be different from each other as suggested by previous research findings, the analysis was conducted separately for the four main types of imports, namely, food; non-food consumer goods; intermediate goods; and investment goods, in addition to total imports. Since fuel imports amounted to about 20 per cent of total import expenditure (in US dollars) from 2010 to 2020, and since fuel imports have different demand characteristics than other imports, the analysis was carried out for total imports excluding fuel as well.

We were unable to estimate "income elasticity" as previous research had done, since we were considering monthly changes in import demand in this research. Although we tried to interpolate quarterly GDP numbers, time series properties of this series were not appropriate to use in our analysis. Therefore, we estimated "production activity elasticity" or "activity elasticity" by using data on industrial production instead of GDP. Since economic activities in the agricultural, services, mining and construction sectors are strongly linked to industrial production activities, our "activity elasticity" is a reasonable proxy for "income elasticity". Further, since industrial production activities require imports to be used as intermediate and investment goods, our "activity elasticity" gauges elasticity of import demand for industrial production needs in the country as well.

Real import demand (the dependent variable) was proxied by import quantity indices for the import categories mentioned above. To calculate relative prices, import unit value indices (in

Rupee terms) for the above categories of imports were divided by the Colombo Consumer Price Index (CCPI). For the exchange rate, the Nominal Effective Exchange Rate (NEER-24) index was used while the Index of Industrial Production (IIP) which was backcasted with the Factory Industry Production Index (FIPI) for the pre-2017 months was used for (production) activity elasticity estimation.

Negative coefficients are expected for relative price and exchange rate elasticities since increase in prices or the depreciation of the Sri Lankan Rupee against the US dollar should reduce quantity of imports demanded. Positive coefficients are expected for production activity elasticity since an increase in income or production level should increase quantity demanded of imported goods. Since Sri Lanka is a small open economy that is not much industrialised, it is not expected that import substitution has a considerable effect leading to negative elasticity of import demand in relation to production activity.

4. Methodology

We followed three empirical methods, namely, Ordinary Least Squares (OLS) regressions, OLS regressions with dummy variables, and Auto-Regressive Distributed Lag Modelling/Error Correction Modelling. Non-stationarity is a common property of time series data and different methods, including the above, can be employed when such properties are present. Since elasticity is defined as the percentage change in the quantity demanded for a 1 per cent change in the factor affecting demand, in an OLS regression, the coefficients derived when both dependent and explanatory variables are in log form can be interpreted as elasticities as defined above.

We tested whether our time series are stationary using Augmented Dickey-Fuller (ADF) unit root tests. Typically, for estimation of long run relationships, the stationarity property can be disregarded (though not for estimation of short run relationships). If there is a long run relation among variables, we can incorporate both short run and long run relations to the models. To explore the long run relationship among variables, we used the bounds test as an extension to the ARDL (defined below) which assesses the trend/first order stationarity of an underlying time series.

As our first empirical method, we ran OLS regressions first from January 2010 to March 2020 to estimate the elasticities in the pre-pandemic period, and subsequently for the full period from January 2010 to March 2021 to gauge how the elasticities had changed with the addition of the 12 months which were impacted by the pandemic. The generalised equation is as follows.

$$D\ log\ Y_t^i = \alpha_0 + \alpha_1 D\ log\ R\ P\_Y_t^i + \alpha_2 D\ log\ I\ IP_t + u_t$$

Where Y_t^i is import quantity, RP_Y_t^i is the relative price applicable for Y_t^i and IIP_t is the industrial production index. *D* denotes the first difference operator. $\alpha_{1,2}$ are elasticities.

Though OLS regressions for the pandemic period were also estimated, they were not used for interpretation of results since results were statistically non-significant in most cases, mainly due to the lack of data points.

As our second empirical method, we ran OLS regressions with intercept dummies and interactive dummies. The intercept dummies gauge how much import demand is higher/lower in the pandemic period when compared with the pre-pandemic period, holding all other factors constant, while the regressions with interactive dummies (slope dummies) for industrial production and relative prices for the pandemic period give how much a 1 per cent increase in industrial production or relative prices affect import demand in relation to the pre-pandemic period, holding other factors constant. However, when conducting the analysis as well as when interpreting results, we weighed on the fact that when a variable which is already used in the model as an explanatory variable is reconsidered to be used along with a dummy variable in the same model, concerns of multicollinearity could arise.

Two models were used to estimate relative price and production activity elasticities using the following generalised equation.

$$Y_t = \alpha + \gamma D + \beta X_t + \delta X_t D + u_t$$

Where, Y_t refers to import quantities (dependent variable) and X_t refers to independent variables. D denotes dummy variables.

Dummy variables are defined as follows;

D
- 1; if t represents a month from April 2020 to March 2021 (pandemic period)
- 0; if t represents a month prior to April 2020 (pre-pandemic period)

If D=0,

$$Y_t = \alpha + \gamma\,(0) + \beta X_t + \delta X_t\,(0) + u_t$$

$$Y_t = \alpha + \beta X_t + u_t$$

Considering variables in their log first difference form, elasticities for the pandemic period can be determined as follows.

If D=1,

$$Y_t = \alpha + \gamma\,(1) + \beta X_t + \delta X_t\,(1) + u_t$$

$$Y_t = (\alpha + \gamma) + (\beta + \delta) X_t + u_t$$

Since the coefficients of the slope dummy variable is interpreted as the change in elasticities over the base period, the above allows us to identify the change in elasticities in the pandemic period in relation to the non-pandemic period.

Non-stationarity is a common property of time series data, including the type of data used in our study, and different models can be employed when such properties are present in the data. We estimated elasticities using the ARDL modelling approach, in addition to the abovementioned methods, because of its ability to estimate the long run and short run parameters simultaneously. This econometric method is also commonly used in research papers on trade elasticities published in the recent years. We tested whether our time series are stationary using ADF unit root tests.

An ARDL representation of $Y_t = \alpha_0 + \alpha_1 X_1 + \alpha_2 X_2 + u_t$ is formulated as follows.

$$DY_t = \alpha_0 + \sum_{k=1}^{p} \alpha_{1,k} DY_{1,t-k} + \sum_{j=0}^{q} \alpha_{2j} DX_{1,t-j} + \sum_{j=0}^{r} \alpha_{3j} DX_{2,t-j} + \beta_1 Y_{t-1} + \beta_2 X_{1,t-1} + \beta_3 X_{2,t-1} + \varepsilon_t$$

Where, Y_t is the dependent variable and X_t refers to the independent variables. D denotes the first difference operator. α_0 is the interceptor (drift) and ε_t is the white noise residual. The coefficients β_1 to β_3 correspond to the long run relationship, whereas the coefficients α_1 to α_3 represent the short run relationship.

Three models were used to determine the relative price, production activity and exchange rate elasticity[6] using ARDL. If there is a long run relation among the variables, we can incorporate both short run and long run relations to the models. To explore the long run relationship among variables, we used the bounds test. If there is a cointegration relation, then the ARDL model above can be represented as the error correction form of the ARDL model, as follows.

$$DY_t = \alpha_0 + \sum_{k=1}^{p} \alpha_{1,k} DY_{1,t-k} + \sum_{j=0}^{q} \alpha_{2j} DX_{1,t-j} + \sum_{j=0}^{r} \alpha_{3j} DX_{2,t-j} + \lambda ECM_{t-1} + \varepsilon_t$$

Where $\boldsymbol{\lambda}$ is the speed of the adjustment parameter.

5. Results of the estimation

5.1.1 Interpretation of results

We have reported below results from all above regressions we ran for the seven categories of imports. In most cases, results from all types are similar, yielding the same coefficient sign, similar magnitudes of the coefficients and similar levels of statistical significance. Therefore, our results are reasonably robust.

Even in previous published research, different econometric techniques used by different researchers, even for the same country and the same time period have yielded different levels of elasticities. Therefore, an exact value of elasticities cannot be specified for any country and any time period. Yet, our analysis answers whether the negative relationship of import demand with relative prices and exchange rates and the positive relationship with income/production activity that are postulated by economic theory holds for Sri Lanka for the January 2010 to

[6] Since all the variables are in the log form, the regression coefficient can be reported as the elasticity.

$$e_{y,x} = \frac{dy}{dx}\frac{y}{x} = \frac{d\ ln\ y}{d\ ln\ x}$$

March 2021 period, and if so, what their general magnitudes are. Our analysis also provides an understanding of how these elasticities changed because of the COVID-19 pandemic.

In the OLS regressions, although the exchange rate was not statistically significant in most cases, we did not re-run the regressions excluding the exchange rate, since it is an important variable in determining import demand elasticities. However, for some ARDL models, the estimations were performed without the exchange rate to improve the efficiency/predictive capacity of the model, taking into account time-series properties of the data.

5.1.2 Results of unit root tests

Graphical view of the data is provided in Appendices. Results of the ADF unit root tests on whether our time series (in logs) are stationary are given in Table 1 below.

Table 1: Results of unit root tests

Variable	Level (in logs)		First Difference (in logs)		Order of integration
	Statistic	Probability	Statistic	Probability	
Import quantity index - total imports	-2.665*	0.083	-17.477***	0	I(1)
Import quantity index - non fuel imports	1.081	0.927	-6.971***	0	I(1)
Import quantity index - food	-3.647***	0.006			I(0)
Import quantity index- non food consumer goods	-2.756*	0.068	-17.018***	0	I(1)
Import quantity index - intermediate goods	0.548	0.833	-17.097***	0	I(1)
Import quantity index -investment goods	-2.707*	0.076	-12.946***	0	I(1)
Relative prices for total imports	-1.115	0.239	-2.422**	0.016	I(1)
Relative prices for food imports	-5.666***	0			I(0)
Relative prices for non-food consumer goods	-2.307	0.172	-2.307	0.172	I(1)
Relative prices for intermediate goods	-1.387	0.587	-5.080***	0	I(1)
Relative prices for investment goods	-0.01	0.955	-8.897***	0	I(1)
Relative prices for fuel	-1.243	0.655	-10.907***	0	I(1)
Nominal Effective Exchange Rate-24	0.037	0.96	-7.795***	0	I(1)
Index of Industrial Production/Factory Industry Production Index	-2.385	0.148	-3.718***	0.005	I(1)

***Significant at the 1% level, **Significant at the 5% level, *Significant at the 10% level

5.1.3 Elasticities for total imports

Our results presented in Table 2 show that, as expected, there is a negative relationship of import demand with (relative) prices, and a positive relationship with (production) activity. However, there is no statistically significant relationship with exchange rates.

Import demand is inelastic to prices. In the short run, price elasticity ranges from -0.32 to -0.39 while in the long run, it records a value around -0.51. In the OLS regressions for the full period (both pre-pandemic and pandemic) price elasticity is higher than that recorded for the pre-pandemic period. Although the OLS regression with dummy variables to capture the change in price elasticity also indicate an increase in elasticity in the pandemic period over the pre-pandemic period, this result is statistically non-significant.

Activity elasticity on the other hand is inelastic in the short run and elastic over the long run. Activity elasticity in the pre-pandemic period ranged between 0.61 to 0.63 in the short run while recording a value of 1.1 in the long run. This is in consistency with the neoclassical trade theory and findings for other countries, that long run income elasticity of import demand is about 1 (Hong, 1999). In the OLS regressions for the full period, activity elasticity is lower than the pre-pandemic period and a similar outcome is shown in the OLS regressions with dummy variables as well. This indicates that the sensitivity of import demand to production activity declined in the pandemic period. However, in the ARDL model, the long run activity elasticity for the full period is 1.42.

Table 2: Elasticities for total imports

	OLS		ECM		ARDL	
	Pre-pandemic period	Full period	Pre-pandemic period		Full period	
			Short run	Long run	Short run	Long run
Price elasticity	-0.321***	-0.368***	-0.320**	-0.511***	-0.328***	-0.429**
Activity elasticity	0.614***	0.399***	0.630***	1.085***	0.448***	1.419***
Exchange rate elasticity	-0.145	-0.901	-0.332	-0.688***	Removed (note)	-0.347

	OLS with dummies			
	Estimation of activity elasticities with dummies		Estimation of relative price elasticities with dummies	
	Pre-pandemic period (a)	Change in pandemic period over (a)	Pre-pandemic period (b)	Change in pandemic period over (b)
Price elasticity	-0.394***		-0.309**	-0.688
Activity elasticity	0.624***	-0.514***	0.383***	
Exchange rate elasticity	-0.525		-0.853	

Note: Removed since it was not statistically significant in OLS models, in order to improve the efficiency of this model.
*** Significant at the 1% level
** Significant at the 5% level
* Significant at the 10% level

5.1.4 Elasticities for non-fuel imports

According to the results given in Table 3, both (relative) price and (production) activity elasticities increase when fuel (which represented about 20 per cent of import expenditure in US dollar terms from 2010 to 2020) is removed from total imports. This may be due to the low sensitivity of fuel imports to prices as fuel needs to be imported for electricity generation, transport sector operations, factory operations and for exporting as bunker and aviation fuel

apart from other uses. Further, fuel imports are also less sensitive to production activity in the country, as fuel imports are used for electricity generation for non-production purposes, exporting as bunkering and aviation fuel and to maintain fuel stocks. Exchange rate elasticity remains statistically non-significant.

When total imports excluding fuel is considered, price elasticity in the short run for the pre-pandemic period increases to about -0.53 to -0.56 while the long run elasticity increases to about -0.36 (marginally lower than total imports). When the pandemic period is also added, the short run elasticity stays at similar magnitudes. As in the case of total imports, production activity is elastic in the long run and inelastic in the short run. Activity elasticity of non-fuel imports in the pre-pandemic period lies between a 0.74 to 0.82 range in the short run, and at about 2.08 in the long run. Activity elasticity when the pandemic period is added reduces, according to OLS with and without dummy variables and the ARDL model for the short run and the long run, though still remaining higher than elasticities for total imports. The long run activity elasticity for the full period is 1.54.

Table 3: Elasticities for non-fuel imports

	OLS		ARDL			
	Pre-pandemic period	Full period	Pre-pandemic period		Full period	
			Short run	Long run	Short run	Long run
Price elasticity	-0.543***	-0.517***	-0.534***	-0.358*	-0.565***	-0.512**
Activity elasticity	0.738***	0.444***	0.816***	2.081***	0.542***	1.542***
Exchange rate elasticity	0.065	-0.7	Removed (note)	-0.198	Removed (note)	-0.424**

	OLS with dummies			
	Estimation of activity elasticities with dummies		Estimation of relative price elasticities with dummies	
	Pre-pandemic period (a)	Change in pandemic period over (a)	Pre-pandemic period (b)	Change in pandemic period over (b)
Price elasticity	-0.562***		-0.521***	0.037
Activity elasticity	0.742***	-0.684***	0.438***	
Exchange rate elasticity	-0.2		-0.62	

Note: removed to improve the efficiency of this model since it was not statistically significant in OLS models

*** Significant at the 1% level
** Significant at the 5% level
* Significant at the 10% level

5.1.5 Elasticities for food imports (subcategory of consumer goods)

Table 4: Elasticities for food imports

	OLS		OLS with dummies			
			Estimation of activity elasticities with dummies		Estimation of relative price elasticities with dummies	
	Pre-pandemic period	Full period	Pre-pandemic period (a)	Change in pandemic period over (a)	Pre-pandemic period (b)	Change in pandemic period over (b)
Price elasticity	-1.786***	-1.651***	-1.619***		-1.771***	2.421**
Activity elasticity	0.347	0.188	0.353	-0.285	0.271	
Exchange rate elasticity	-2.776**	-2.820**	-2.915**		-3.099**	

*** Significant at the 1% level
** Significant at the 5% level
* Significant at the 10% level

As seen in Table 4, since both the food import quantity and relative price are stationary at level, we used linear regression models to determine the elasticities of food import demand. We found that exchange rate elasticity of food imports is statistically significant while activity elasticity of food imports is not. Further, the demand for food imports with respect to the exchange rate and prices is elastic (and in the expected direction). Elasticities are higher with respect to the exchange rate than prices. In the pre-pandemic period, price elasticity of food imports is around -1.62 to -1.79 while exchange rate elasticity for food imports lie between -2.78 to -2.91. In the pandemic period, the magnitude of price elasticity reduces in relation to the pre-pandemic period, while also suggesting a change in the direction by the outcome of the model with a dummy variable for prices. When the full period is considered, exchange rate elasticity has increased, indicating that demand for food became more sensitive to changes in the exchange rate.

5.1.6 Elasticities for non-food consumer goods

According to results given in Table 5, price elasticity of import demand before the pandemic was inelastic at about -0.46 to -0.54 in the short run. Meanwhile, activity elasticity was about 1. Statistically significant results are not provided for the models considered to determine long run elasticity for the pre-pandemic period, as there is no evidence of cointegration. Price elasticity has reduced when the pandemic period is also taken into account, according to outcomes of all models (short run).

Meanwhile, activity elasticity declined substantially in the short run when the pandemic period is also considered, and according to OLS regressions with dummies, even turned into a negative relationship. Non-food consumer goods were subjected to import controls to some extent in the pandemic period. Imports of personal-use vehicles that are categorised under non-food consumer goods were restricted as the pandemic broke out. Medical and pharmaceutical goods, which is also a large item in this category became less sensitive to prices. It may also be the case that, when domestic production was restricted due to lockdowns, import demand for these goods increased. Exchange rate elasticity is not statistically significant.

Table 5: Elasticities for non-food consumer goods

	OLS		ARDL		ECM	
	Pre-pandemic period	Full period	Pre-pandemic period		Full period	
			Short run	Long run	Short run	Long run
Price elasticity	-0.540***	-0.468***	-0.527***	No Cointegration	-0.460***	-0.372*
Activity elasticity	0.919***	0.379***	1.064***		0.475***	1.742***
Exchange rate elasticity	0.207	-0.789	Removed (note)		Removed (note)	Removed (note)

	OLS with dummies			
	Estimation of activity elasticities with dummies		Estimation of relative price elasticities with dummies	
	Pre-pandemic period (a)	Change in pandemic period over (a)	Pre-pandemic period (b)	Change in pandemic period over (b)
Price elasticity	-0.522***		-0.463***	-0.072
Activity elasticity	0.915***	-1.181***	0.376***	
Exchange rate elasticity	-0.082		-0.746	

Note: removed in order to improve the efficiency of this model, since it was not statistically significant in OLS.

*** Significant at the 1% level
** Significant at the 5% level
* Significant at the 10% level

5.1.7 Elasticities for intermediate goods

As seen in Table 6, activity elasticity of import demand for intermediate goods is statistically significant under all methods, while the other two types of elasticities, i.e. relative price and exchange rate elasticities are not. Activity elasticity is inelastic with values from 0.43 to 0.55 before the pandemic and has decreased when the pandemic period is also taken into account

under OLS regressions with and without dummy variables. Meanwhile, the long run elasticity is higher than the short run elasticity, and is about unitary elastic.

In the short run, price elasticity of intermediate goods is not statistically significant, but becomes so when the pandemic period is also considered. Exchange rate elasticity is also not statistically significant in most of the cases but is significant when the full period is considered. This shows that demand for intermediate goods is less sensitive to exchange rates and to relative prices and is more sensitive to production levels.

Table 6: Elasticities for intermediate goods

	OLS		ARDL			
	Pre-pandemic period	Full period	Pre-pandemic period		Full period	
			Short run	Long run	Short run	Long run
Price elasticity	-0.054	-0.286	-0.076		-0.01	-0.321**
Activity elasticity	0.546***	0.364***	0.430***	No cointegration	0.442***	1.045***
Exchange rate elasticity	-0.31	-1.171	-0.758		-1.644**	-0.588***

	OLS with dummies			
	Estimation of activity elasticities with dummies		Estimation of relative price elasticities with dummies	
	Pre-pandemic period (a)	Change in pandemic period over (a)	Pre-pandemic period (b)	Change in pandemic period over (b)
Price elasticity	-0.236		-0.086	-2.549***
Activity elasticity	0.553***	-0.440*	0.458***	
Exchange rate elasticity	-0.811		-0.904	

*** Significant at the 1% level
** Significant at the 5% level
* Significant at the 10% level

5.1.8 Elasticities for investment goods

Elasticities for investment goods are given in Table 7. Price elasticity of import demand for investment goods is inelastic and is of a magnitude between -0.64 to -0.68 in the short run. Meanwhile, when the pandemic period is also added, or the change in the pandemic period over the pre-pandemic period is considered, there has not been a significant change in elasticities. However, for the long run, price elasticity is slightly higher at about -0.77.

Activity elasticity in the pre-pandemic period in the short run is between 0.56 to 0.75. When the full period is considered in the short run, activity elasticity reduced to some extent. In the OLS regressions with dummy variables, the change in activity elasticity in the pandemic period over the pre-pandemic period is also less. Exchange rate elasticity is not statistically significant for import demand for investment goods. Investment goods were also affected by import restrictions to some extent.

Table 7: Elasticities for investment goods

	OLS		ARDL			
	Pre-pandemic period	Full period	Pre-pandemic period		Full period	
			Short run	Long run	Short run	Long run
Price elasticity	-0.642***	-0.650***	-0.677***		-0.656***	-0.773***
Activity elasticity	0.561***	0.367***	0.748***	No cointegration	0.522***	1.855***
Exchange rate elasticity	0.462	-0.257	0.864		No cointegration	No cointegration

OLS with dummies

	Estimation of activity elasticities with dummies		Estimation of relative price elasticities with dummies	
	Pre-pandemic period (a)	Change in pandemic period over (a)	Pre-pandemic period (b)	Change in pandemic period over (b)
Price elasticity	-0.664***		-0.633***	-0.124
Activity elasticity	0.566***	-0.475*	0.345***	
Exchange rate elasticity	0.196		-0.16	

*** Significant at the 1% level, ** Significant at the 5% level, * Significant at the 10% level

5.2 Comparison of results with some previously published research on Sri Lanka

Our results for relative price elasticity are comparable with results stated in Tennakoon (2010) to some extent. We estimated relative price elasticities for the two components of "consumer goods", viz., "food" and "non-food consumer goods" (as per the Central Bank of Sri Lanka trade classification system) separately. Whereas Tennakoon (2010) reported a price elasticity of -0.99 for all of consumer goods, we found a higher (elastic) value of elasticities for food and a lower elasticity for non-food consumer goods. It is possible that the elasticities reported in Tennakoon (2010) is averaging the elasticities for the two types of imports. On price elasticity for intermediate goods, our findings were non-significant in the pre-pandemic period. However, the long run elasticity for the full period was estimated at -0.3. The estimate in Tennakoon (2010) is -0.46. On investments goods, our price elasticity estimate of -0.6 to -0.8 is about the same as -0.75 found in Tennakoon (2010). As for income elasticity/activity elasticity, we found statistically significant results. However, using GDP to estimate income elasticity, no statistically significant estimates had been derived in the study conducted by Tennakoon (2010).

Emran and Shilpi (2010) found that price elasticity for the total import demand function of Sri Lanka for 1960 to 1995 is -0.78 using an ARDL model, along with an income elasticity for the same period of about 1. While the price elasticity we found is somewhat lower, the income elasticity of these authors is comparable to our activity elasticity estimate. Our price elasticities are closer to those found by Sinha (2001) and Reinhart (1995) but the periods of time under consideration in these studies are much older than ours.

5. Conclusion

Table 8 provides the summary of the elasticity estimation exercise. As discussed in the previous section, in some cases, different models provided somewhat diverging outcomes. However, by comparing the models, the levels of statistical significance, outcomes in related model specifications, economic theory, behaviour of underlying data and other information known about trade outcomes of Sri Lanka, the following conclusions can be arrived at, with regard to elasticities and the change in elasticities during the pandemic.

Import demand of Sri Lanka in the post-Civil War period (i.e. from January 2010) up to the beginning of the pandemic (March 2020) or present (March 2021) was characterised by negative inelastic price elasticity (short run and long run) and positive inelastic activity elasticity in the short run that becomes elastic in the long run. Due to the pandemic, activity elasticity declined (became less sensitive) in the short run for total imports and for the three types of imports other than food. Meanwhile, import demand for food displayed a reduction in price elasticity during the pandemic period while other categories of goods did not.

Demand for imports of Sri Lanka (in total) in the post-Civil War period up to present (January 2010 to March 2021) was characterised by price elasticity of -0.3 to -0.5, short run activity elasticity of 0.6 in the pre-pandemic period that declined to 0.4 /0.5 with the pandemic, long run activity elasticity of 1.1 that increased to 1.4 with the pandemic and inelastic negative exchange rate elasticity. When elasticities are estimated excluding fuel imports, which accounted for about 20 per cent of import expenditure in the pre-pandemic period and which has unique demand characteristics, the abovementioned elasticities increase by small amounts, indicating that the demand for goods other than fuel is more sensitive to changes in relative prices and the level of economic activities. The long run activity elasticity of import demand of 1 to 2 we found is consistent with empirical results found by other researchers for other countries as well as economic theory.

Import demand for non-food consumer goods and investment goods basically have the same pattern of elasticities as total imports or total non-fuel imports, with inelastic price elasticity, inelastic activity elasticity in the short run and elastic activity elasticity in the long run. Further, short run activity elasticity declined for both non-food consumer goods and investment goods because of the pandemic, similar to total imports and total non-food imports. Statistically significant long run price elasticities and activity elasticities were also found for the full period that are comparable to those for total imports and total non-fuel imports.

On the other hand, import demand for food and intermediate goods displayed some different elasticity patterns. Import demand elasticity for food in relation to relative prices is elastic. Moreover, elastic demand was also found in relation to exchange rates. This indicates that the sensitivity of import demand for food to prices and exchange rates is higher than other goods.

Table 8: Summary of Results

Type of import	Pre-pandemic period (Jan 2010 to Mar 2020)						Change in elasticities during the pandemic period (Apr 2020 to Mar 2021)			Full period (Jan 2010 to Mar 2021)					
	Price elasticity		Activity elasticity		Exchange rate elasticity		Price elasticity	Activity elasticity	Exchange rate elasticity	Price elasticity		Activity elasticity		Exchange rate elasticity	
	Short run	Long run	Short run	Long run	Short run	Long run	Short run	Short run	Short run	Short run	Long run	Short run	Long run	Short run	Long run
Total imports	-0.3	-0.5	0.6	1.1	NS	-0.7	NCD	Decreased	-	-0.3 to -0.4	-0.4	0.4 to 0.5	1.4	NS	NS
Total non-fuel imports	-0.5	-0.4	0.7 to 0.8	2.1	NS	NS	NCD	Decreased	-	-0.5 to -0.6	-0.5	0.4 to 0.5	1.5		-0.4
Food	-1.6 to -1.8	-	NS	-	-2.8 to -2.9	-	Decreased	-	NCD	-1.6		NS		-2.8	
Non-food consumer goods	-0.5	-	0.9 to 1.1	-	NS	-	NCD	Decreased	-	-0.5	-0.4	0.4 to 0.5	1.7	NS	NS
Intermediate goods	NS	-	0.4 to 0.5	-	NS	-	-	Decreased	-	NS	-0.3	0.4	1.0	-1.6	-0.6
Investment goods	-0.6 to -0.7	-	0.6 to 0.7	-	NS	-	NCD	Decreased	-	-0.6	-0.8	0.4 to 0.5	1.8	NS	

Note: NCD = No considerable deviation
NS = Not Significant
S= Significant

Meanwhile, price elasticity of food had declined because of the pandemic. This could be because of food security concerns, due to which sensitivity of import demand for food for prices declined. Furthermore, import demand for food is not significantly related to production activities. Import demand for intermediate goods differed in that, significant relationships were not found in respect of prices and exchange rates, but a short run activity elasticity of 0.4 to 0.6 and a long run elasticity of 1 were found. Thus, demand for intermediate goods is sensitive to production activity, possibly because a significant amount of imports are used in production processes.

Short run activity elasticity declined for total imports as well as non-food consumer goods, intermediate goods and investment goods. This reflects the rigidity of import expenditure on these goods to decline when economic activity declined during the pandemic.

6. Policy implications

Sri Lanka is a small open economy with a low industrial base, heavy dependence on imports, persistent current account deficits, low international reserves, a high level of foreign debt commitments, and high fiscal deficits. Careful management of foreign currency outflows is necessary not only when the economy is undergoing an external shock, but also during more benign periods of time. Our results help explain the behaviour of imports of Sri Lanka in the post-Civil War period against key factors affecting import demand, taking into account the fundamental changes to import demand characteristics brought about by the COVID-19 pandemic. Our results also put in perspective the rigidity of import expenditure to decline, though the nominal exchange rate depreciated over a long period of time.

Tax policies in respect of imports should take into account import elasticities of different types of goods, and tax policies should be designed appropriately, based on whether the Government's aim is to increase import tax revenue or the curtailment of importation of certain goods. Meanwhile, monetary and exchange rate policy will have a significant bearing on determining relative prices of imports and thereby, import demand. Since import demand for food is elastic in relation to relative prices, price/tariff increases of even a small magnitude can help to bring down food imports and encourage their production domestically to improve

food security in the country. Meanwhile, low sensitivity of import demand to relative prices especially of non-food consumer goods and investment goods may require significant increase in prices through import taxes or other methods of curtailment of import quantities, if policymakers are trying to rationalise importation of goods that are non-essential or that can be produced in Sri Lanka. Therefore, at a time of economic crisis, our findings on import elasticities lend support to policy choices that placed direct quantity restrictions on certain imports such as personal use vehicles and luxury goods as a temporary measure to manage foreign currency outflows.

There is no clear-cut reason as to why activity elasticity of import demand and price elasticity of food declined in the pandemic period. One possible explanation is that, due to high uncertainties created by the pandemic in the world and the domestic markets, disturbing supply chains and distorting prices, and the undue speculation that occurred during this period on the exchange rate and foreign currency reserves, import demand for relatively durable items or those that can be stocked were high during the downturn as well as the revival phase of economic activity. Meanwhile, concerns over food security and tendency to import and stock certain food items by consumers as well as importers may have reduced the price sensitivity of import demand for food during the pandemic, while food prices in the world market also increased. However, restrictions on importation of certain food items may also have had a bearing on this outcome.

Our results indicate that an increase in economic activities in the country will put pressure on imports to increase because of the positive activity elasticity of demand for imports with high elasticity values. Therefore, policymakers should expect an increase in import expenditure when implementing growth policies and should design industrial, developmental and trade policies to ensure that the increase in import expenditure is compensated by an increase in earnings from export of goods and services that are benefited through such economic growth. Furthermore, higher domestic value addition for exports should be encouraged, while developing import substituting industries for finished and intermediate goods as well.

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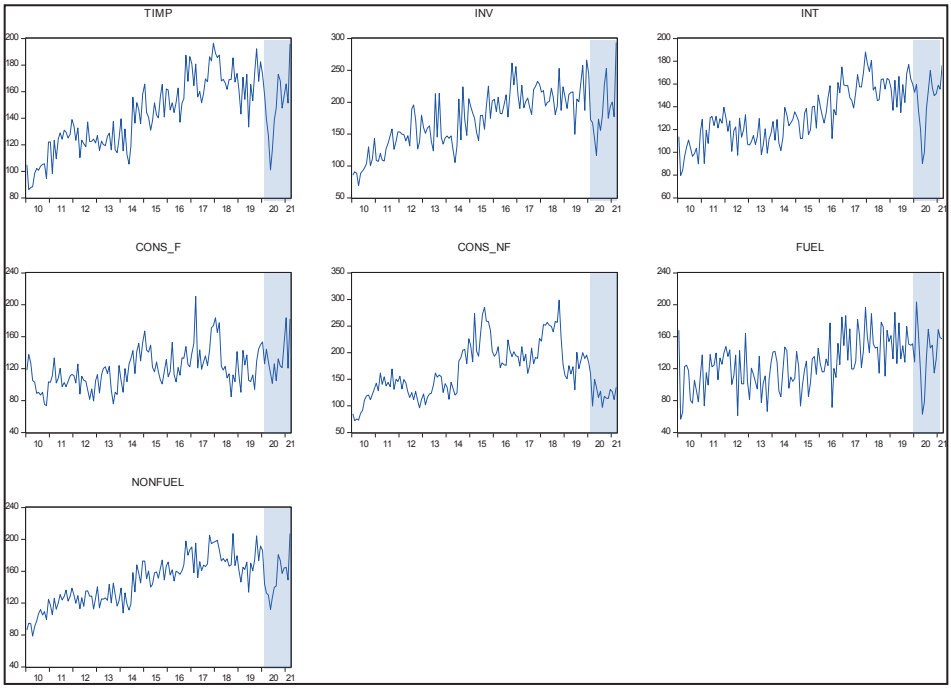
Appendices

Dependent variables: Import quantity indices for the following:

TIMP: Total imports
INV: Investment goods
INT: Intermediate goods
CONS_F: Food
CONS_NF: Non-food consumption goods
FUEL: Fuel
NONFUEL: Total imports except fuel

Figure A1: Graphical view of dependent variables

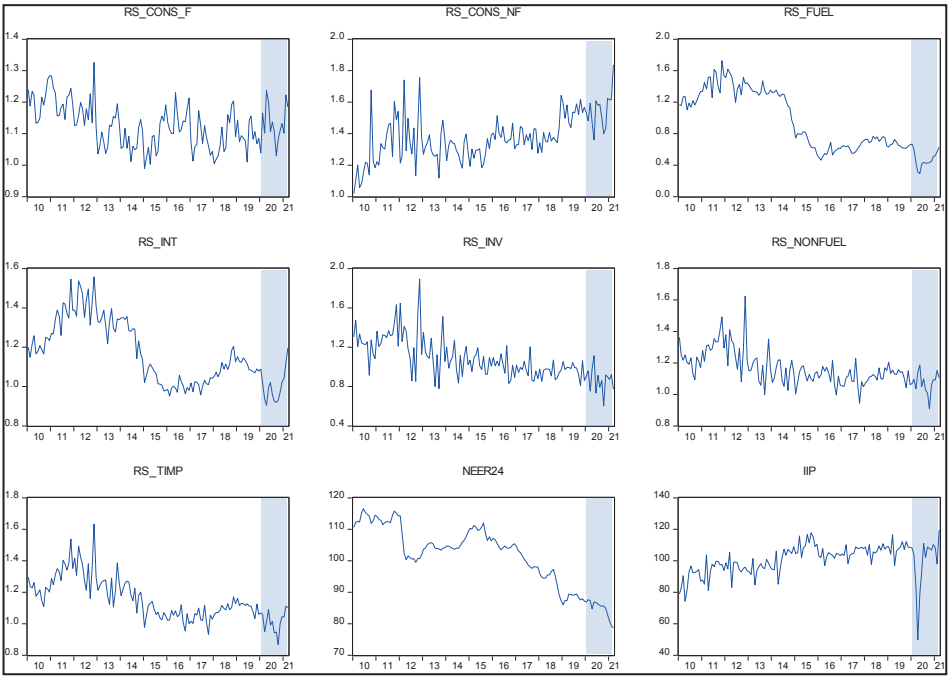


Independent variables

RS_CONS_F: Relative prices of food
RS_CONS_NF: Relative prices of non-food consumer goods
RS_FUEL: Relative prices of fuel
RS_INT: Relative prices of intermediate goods
RS_INV: Relative prices of investment goods
RS_NONFUEL: Relative prices of total imports except fuel
RS_TIMP: Relative prices of total imports
NEER24: Nominal Effective Exchange Rate – 24
IIP: Index of Industrial Production/Factory Industry Production Index

Note: Unit value indices (in Rs. terms) divided by the Colombo Consumer Price Index gives the relative price

Figure A2: Graphical view of independent variables



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