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For all correspondence about the Staff Studies Journal, please contact:
Director of Economic Research
Central Bank of Sri Lanka
30, Janadhipathi Mawatha
Colombo 01
Sri Lanka
Email: directorerd@cbsl.lk

ABOUT THE AUTHORS

W. S. Navin Perera is a Senior Economist of the Money and Banking Division of the Economic Research Department of the Central Bank of Sri Lanka. He received his BSc in Business Administration with First Class Honors *(Summa Cum Laude)* from the Troy University of Alabama, USA, and an MSc in Economics with Distinction from the University of Warwick, UK. He also holds an MBA from the Institute of Chartered Financial Analysts of India (ICFAI), India. His research interests are in the fields of monetary policy, credit and financial markets and macroeconomic modelling.

Mayandy Kesavarajah is an Economist attached to the Economic Research Department of the Central Bank of Sri Lanka. He received his BA (Special) Degree in Economics with First Class Honours from the University of Colombo, Sri Lanka. He obtained Masters in Economics (MEcon) degree from the same university. Currently, he is reading for an Msc Degree in Economics at the University of Manchester, UK. His research interests are in the field of monetary policy, public finance and macroeconomic modeling.

Iwanthika Rajakaruna is a Senior Manager attached to the Public Debt Department of the Central Bank of Sri Lanka. She received a BA Special Degree in Economics with First Class Honours from University of Peradeniya, Sri Lanka, and Master of Economics from the University of Colombo, Sri Lanka. She also obtained a Master of Finance and Business Economics Degree from the University of Adelaide, Australia. Her research interests are in the fields of financial economics, Public Economics, fiscal policy and macroeconomic management.

Credit Intensity of Economic Growth – A Sectoral Analysis: Case of Sri Lanka

W S Navin Perera*

Abstract

This paper examines the dynamic relationship between credit and economic growth in Sri Lanka using aggregated and disaggregated data for the period 2003-2015 in an attempt to decipher the 'credit-GDP growth puzzle' experienced recently. The Unrestricted Vector Autoregression (UVAR) approach is followed to account for dynamics and causality tests conducted to determine the direction of the causality between real output and private credit. This is followed by a multiplier analysis to ascertain the direction, timing, magnitude and sensitivity of economic growth to unexpected shocks in private credit. We find evidence supporting the 'demand-following' hypothesis, and varying responses of real output to credit shocks at aggregate, sectoral and sub-sectoral levels imply the presence of sectoral heterogeneity to credit impulses. It is therefore imperative that policymakers account for these factors when formulating appropriate (stabilisation) policies to achieve its ultimate objective of price and economic stability.

Key Words: *(Sectoral) Credit, (Sectoral) Output, Vector Autoregression (VAR), Causality, Impulse Responses, Heterogeneity*

JEL Classification*: E50, E51, E52*

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1. Introduction

The credit-economic growth relationship has been a topic deliberated for over a century, but still stands out to be important to this day. Private credit and economic growth are said to have a close (positive) relationship, although the direction of causality is subject to debate. Nevertheless, it is widely accepted that the private sector is the engine of growth, especially for developing nations (OECD, 2006).

But what if it fails to fulfil this purpose? What if it fails to generate the economic stimulus that policymakers expect it to produce? Can this happen in the first place? This is the challenge that Sri Lanka has had to face from time to time. As a developing nation and a small open-economy with a GDP of around US dollars 82 billion (CBSL, 2016), Sri Lanka has predominantly relied on credit granted by commercial banks to finance investment and economic activity. More importantly, private credit to GDP has increased from 28.5 percent in 2003 to 30.8 percent by 2015.[1]

However, policymakers have been struggling lately to understand this *'credit-GDP growth puzzle'*, as the economy expanded only by 4.8 percent (year-on-year) in 2015 (as opposed to the growth of 4.9 percent in the previous year) in spite of the substantial growth of private sector credit by 25.1 percent in 2015 (compared to just 8.8 percent in the preceding year) (See Figure-1). Moreover, despite credit obtained by certain sectors or subsectors remaining elevated, growth of economic activity of those sectors or subsectors have been fairly dismal (and in some instances, contracted).

This gives rise to two important questions. Firstly, it is worth examining whether there exists a dynamic relationship between private credit and economic growth. Secondly, considering the diverse sectoral economic performances, it is worth investigating whether there are differential effects in economic activity to unanticipated shocks in credit, thereby providing evidence of sectoral heterogeneity.

The present study aims to bridge this gap in relevant literature by using aggregated and disaggregated data to analyse the credit-economic growth relationship in the context of Sri Lanka for the period 2003-2015. We follow the Unrestricted Vector Autoregression (UVAR) approach adopted by Ramaswamy and Slok (1998), and Ibrahim (2005), to account for dynamics, followed by conducting causality tests to determine the direction of the causal relationship between credit and economic growth, and multiplier analyses[2] to identify

[1] Larger the private credit to GDP ratio, the higher the income boost that the poor get from growth (Beck and Demirgüç-Kunt, 2005).

[2] This involves analysis by way of Impulse Response Functions (IRFs) and Forecast Error Variance Decompositions (FEVDs).

the *direction, timing, magnitude* and *sensitivity* of economic growth to unexpected shocks in private credit. We then perform two checks to test for robustness and suitability of the benchmark model for our analysis.

We present two sets of findings. First, we find evidence of unidirectional causality running from economic growth to private credit, thereby supporting the 'demand-following' hypothesis. This posits that the influence of private credit on economic growth is weak in the case of Sri Lanka during 2003-2015. This, however, could have been the result of many events such as economic instability due to the three-decade long war and quantitative restrictions on private credit in 2012.

Secondly, we find evidence of sectoral heterogeneity as different sectors (and sub-sectors) of the economy responded differently to positive shocks in private credit. Services sector output is the fastest to respond positively to a favourable shock in private credit (i.e. after 6 months), while the industry sector takes close to two years for the same. Economic activity in the agriculture sector, however, responds positively to a favourable credit shock after about a year. We also find agriculture sector output to be the most sensitive to credit shocks, while the least sensitive is industry sector output.

Results of the sub-sectoral data analysis indicate that the tea sector output increases in the short-run following a positive credit shock, while output in the fisheries sector respond negatively during the shorter time horizon. On the contrary, the subsectors of textiles and apparel, and food, beverages and tobacco show a relatively subdued response of output to a credit shock, while the construction sector suffers a long and persistent decrease in output, and responds positively only after about 18 quarters. The subsectors of wholesale and retail trade, and transportation and storage display more of an erratic response in output to positive credit shocks, while output in the financial and business services subsector displayed a relatively minimal response. Nevertheless, output of food, beverages and tobacco, wholesale and retail trade, transportation and storage, and tea subsectors were more sensitive to unanticipated credit shocks compared to the other sectors.

It is worth mentioning that this area of research is largely uncharted due to the unavailability of a long series of disaggregated data. However, regardless of the challenge posed, the relevance and need for such analysis encouraged us to explore this line of research, as these findings are expected to make valuable additions to the arsenal of knowledge and understanding of the policymakers.

The rest of the paper is structured as follows: Section 2 provides a detailed review of pertinent literature, followed by Section 3, which explains the methodology employed by us to analyse causality and potential disparities in the effects of credit shocks on economic activity (at aggregated and disaggregated levels) in Sri Lanka. Section 4 presents the results of this study, complemented by a comprehensive analysis. The final section summarizes the key findings and gives policy implications.

2. Literature Review

Schumpeter (1911), a pioneering-advocate of the notion of finance-led growth, highlighted the importance of financial institutions and financial sector development, and its relationship with economic growth. He emphasised the importance of services provided by financial intermediaries in generating technological innovation and economic development.

More interestingly, Patrick (1966), classified the causal relationship between economic growth and financial development into the hypotheses of 'supply-leading' and 'demand-following'. The 'supply-leading' hypothesis is when financial development causes economic growth, while its opposite is referred to as 'demand-following'. The dichotomisation of these hypotheses, along with continuous financial sector developments, led researchers to investigate the finance-growth nexus extensively.

Analysing data in 35 countries, Goldsmith (1969), found that there was a positive correlation between financial development and economic growth, but made no claim that financial development caused economic growth. However, McKinnon (1974) and Shaw (1973) argued that repressed financial sectors (due to excessive government intervention and regulation) impede the growth potential of economies. They support the 'supply-leading' hypothesis as they claim that financial development fosters economic growth by increasing savings and enhancing allocative efficiency of credit.

Using data on 80 counties over a period of 30 years, King and Levine (1993), conducted a cross-country study to evaluate the finance-growth relationship. They used the ratio of private credit to GDP, among other variables, as an indicator of the level of financial development and found that financial development promotes economic growth. Similarly, Bayoumi and Melander (2008), found that credit causes changes in economic activity. Analysing data from the US, they found that a decline in overall credit by 2.5 percent causes the level of GDP to decline by 1.5 percent.

Abu-Bader and Abu-Qarn (2008), using the augmented VAR methodology to test for Granger causality, examined the causal relationship between economic growth and financial development for six Middle Eastern and North African (MENA) countries.[3] They found evidence of unidirectional causality running from financial development to economic growth in five out of the six countries, with Israel being the only exception showing evidence of causal effects originating from economic growth.[4]

However, evidence from several other studies supported the 'demand-following' hypothesis of financial development and growth. Robinson (1952), claimed that causality stems from economic growth (causing growth to lead finance), and the role of finance and financial

[3] Algeria, Egypt, Israel, Morocco, Syria, and Tunisia.
[4] Several other studies by Hicks (1969), and Fry (1988), supported the 'supply-leading' hypothesis.

development is largely exaggerated. Kuznets (1955), Friedman and Schwartz (1963), Lucas (1988) and Kar and Pentecost (2000) shared the same thought.

In contrast to all of the above, some researchers found evidence of bidirectional causality between financial development and economic growth. Demetriades and Hussein (1996), after analysing data from 13 countries, found mixed evidence of unidirectional causality from credit to GDP, GDP to credit and also bidirectional causality. They claimed that the direction of causality is more country-specific.

Drawing evidence from Turkey, Ünalmiş (2002)[5] and Yucel (2009) found signs of bidirectional causality between financial development and economic growth in the long run.[6] However, Yucel (2009), found that financial development has a negative effect on economic growth. On the contrary, analysing data of 95 countries, Ram (1999), found no evidence of a positive relationship between financial development and economic growth.

More evidence of the positive relationship between financial development and economic growth can be found in different types of empirical studies: 1) firm-level studies (Demirgüç-Kunt & Maksimovic, 1998), 2) industry-level studies (Rajan & Zingales, 1998), 3) cross-country studies (Levine & Zervos, 1998), and 4) panel studies (Beck, Levine & Loayza, 2000).

In addition to the plethora of studies that have analysed the finance-growth nexus and its causal relationships, we also found interesting literature on response(s) of economic growth to innovations in credit. Using a Structural VAR (SVAR) model for Australia, Berkelmans (2005), examined the relationship between credit and other key macroeconomic variables. He found that monetary policy plays an important role in stabilising the economy (in terms of reining in inflation and reducing the overall impact on GDP and exchange rate), following a credit impulse. Nevertheless, impulse responses indicate that GDP would increase substantially and persist following a positive innovation to credit, in the absence of any monetary response.

Shan and Jianhong (2006), conducted a VAR analysis to assess the impact of financial development on economic growth in China, with total credit been used as the measure of financial development. They found that the response of GDP to a labour (employment) impulse is more persistent and stronger than the response of GDP to a shock on total credit, and hence referred to credit as the 'second force' that affects economic growth. Nevertheless, the effect of a credit shock on GDP growth lasts for nearly 3 years, before reaching its baseline.

A similar analysis for Vietnam was conducted by Hoang (2011), employing VAR models to estimate the response of GDP to shocks in different monetary policy instruments, which includes domestic credit among interest rates and exchange rates. She found that following a positive shock to domestic credit, nominal GDP responds positively during the first 3 quarters

[5] He also found evidence of unidirectional causality from financial development to economic growth in the short-run.
[6] Standard Granger causality tests and Vector error correction models (VECM) were used in their analyses.

followed by a negative response in the next. However, responses changed substantially when real GDP was considered. Real GDP responded negatively to an innovation in domestic credit, which turned positive after about 4 quarters. Also, Granger causality tests indicated bidirectional causality between domestic credit and real GDP.

Konečný and Kucharčuková (2013), in a somewhat similar analysis done for the Czech Republic, employing a Bayesian Threshold VAR (BTVAR) model, found that industrial production responded positively to a favourable innovation on credit.

Despite the fact that there is a large amount of literature on credit and economic growth, only a handful of research has been conducted to analyse the credit and economic growth relationship at a disaggregated level. Tang (2003), examined the above for Malaysia and found that bank credit on commercial, manufacturing and housing stimulates economic activity, while agriculture and real-estate related lending do not. Similar studies were also conducted by Cecchetti and Kharroubi (2012)[7] and Ananzeh (2016)[8].

Nevertheless, to our knowledge, we have found no literature that analysed how shocks to credit propagated to the real sector of the economy at a sectoral and sub-sectoral level; hence unexplored. However, there is a vast amount of literature that focus on how monetary policy (shocks) affect different sectors/regions of the economy. Bernanke and Gertler (1995), found that residential investment and durable consumption expenditures drop more strongly than its counterparts[9] in response to a monetary policy shock. Ramaswamy and Slok (1998), found evidence of differential effects of monetary policy among the EU nations. Ibrahim (2005) examined the impact of monetary policy on sectoral output in Malaysia and found that some sectors were impacted more by tight monetary policy.[10]

The contribution of this study to the existing literature is manifold. Despite there being a plethora of studies examining the credit-economic growth relationship, a sector-wise (and subsector-wise) multiplier analysis (of both private credit and GDP in a single study), to our knowledge, has not been performed yet. Also, this study focuses on Sri Lanka, for which a similar study has never been done before. Additionally, the new (and improved) data series on GDP (base 2010) will be used for this analysis, providing the most up-to-date work on this issue.

[7] Cecchetti & Kharroubi (2012), analysed just the industry sector of 50 countries and find that credit booms harm R&D-intensive industries.

[8] Ananzeh (2016), conducted a study on Jordan and finds that there exists a long term relationship between total credit, sectoral credit and economic development. Moreover, he finds unidirectional causality from economic growth to bank credit in the Agriculture sector, while also concluding that there exists bidirectional causality between economic growth and bank credit in the Construction sector.

[9] Business fixed investment and non-durable consumption, respectively.

[10] Studies by Carlino and DeFina (1998), for the US, Arnold and Vrugt (2002), for Netherlands, and Ganley and Salmon (1997), for the UK found similar evidence of differential effects of monetary policy.

3. Data and Methodology

3.1. Data

This study employs time-series (quarterly) data from 2003-2015, with each variable containing 52 observations. The availability of sectoral and sub-sectoral data of key variables in this study became available from 2003 onwards, causing us to limit the study to the above period. The variables used in this study include: real Gross Domestic Product (GDP), real Private Sector Credit by commercial banks (PSC), the Consumer Price Index (CPI) and the Average Weighted Call Money Rate (AWCMR)[11], which is used as a proxy for the policy rate. As this study ventures into the analysis of sectoral and sub-sectoral developments, disaggregated data on real GDP and real PSC were also obtained;

1. Sectoral – 1) Agriculture and Fisheries; 2) Industry; and 3) Services
2. Sub-sectoral – 1a) Tea; 1b) Coconut; 1c) Fisheries; 2a) Construction; 2b) Food, Beverages and Tobacco; 2c) Textiles and Apparel; 3a) Wholesale and Retail Trade; 3b) Financial and Business Services; and 3c) Transportation and Storage.

Data on real GDP and CPI were obtained from the Department of Census and Statistics – Sri Lanka (DCS), while data on real PSC and AWCMR were obtained from the Central Bank of Sri Lanka (CBSL). As data on real GDP and CPI were constructed in different base years, appropriate data modifications were conducted to bring both series to a uniform base year.[12] Moreover, both series of real GDP and real PSC were seasonally adjusted using the Census X12 quarterly seasonal adjustment method.[13] All variables, except AWCMR are log-transformed.

3.2. Methodology

In the past and even to date, a commonly used econometric tool to analyse multiple time series has been Vector Autoregressive (VAR) models, founded by Sims (1980). More importantly, it is one of the most popular methods used by monetary economists to unravel the impact of monetary policy on real economic activity (Walsh, 2010).

We follow the Unrestricted VAR (UVAR) approach adopted by Ramaswamy and Slok (1998) and Ibrahim (2005), as the primary focus of this study is to assess the dynamic responses of real economic activity to shocks in private credit at aggregate, sectoral and sub-sectoral levels.

[11] This variable is used later to test for the robustness of the benchmark VAR model.

[12] As this study focuses on the period of 2003-2015, we had to construct a single series of both GDP and CPI by way of splicing (and backcasting) as GDP had two series of data with base years 2002 and 2010, while CPI also had two series of data with base years 2002 and 2006/07. In order to bring both series to a uniform base year, the series of CPI was rebased to 2010.

[13] We used EViews 8 (statistical software) for this purpose.

The Toda-Yamamoto approach will be used to determine causality among these variables, while a multiplier analysis involving Impulse Response Functions (IRFs) and Forecast Error Variance Decomposition (FEVDs) will be conducted to measure the *direction, timing, magnitude* and *sensitivity* of real economic activity to an unanticipated innovation in credit.

Since our study involves analysis of data at three levels,[14] three major VAR systems will be estimated.[15] However, due to the limited number of observations available for this study, careful effort has been taken to build a well-suited, tractable and parsimonious model to evaluate the research question. As such, VAR systems for the sectoral and sub-sectoral levels will follow the technique adopted by Arnold and Vrugt (2002) and Ibrahim (2005), with the aim of saving valuable degrees of freedom.[16] As a result, the VAR model for the aggregate system will contain 3 variables, while models for the sectoral and sub-sectoral systems will contain 5 variables, with each system estimating separate VAR models for its respective individual sectors.[17]

3.3. Model Specification and Diagnostic Tests

3.3.1. Stationarity Tests

It is imperative that we consider the data temporal properties before proceeding with the VAR model specification, as this would enable us to decide whether the VAR model should be specified using variables in levels, first differences or else using a Vector Error Correction Model (VECM).[18] We performed the Augmented Dickey-Fuller (ADF) test (Dickey and Fuller, 1979) and preliminary results discussed in Section 4.1 indicate that almost all variables are non-stationary, alternatively referred to as integrated of order 1 or I(1), while some models show evidence of cointegration. It is suggested that a VECM be used in this circumstance as it yields both consistent and efficient estimates, conditional on the fact that the precise cointegrating relationship is known and specified. If this condition, however, is not met, estimates of the VECM will be inconsistent.[19] On the contrary, a VAR specified in levels in a similar circumstance would generate inefficient but consistent estimates (Sims, 1980); a better outcome than a VECM that produces inconsistent estimates.

As the main focus of this study is to not find evidence of possible long run relationships among the variables in concern (but to determine causality and produce unbiased IRFs and

[14] Aggregate, Sectoral and Sub-sectoral

[15] 13 VAR systems will be estimated in total: 1 Aggregate; 3 Sectoral and 9 Sub-sectoral systems

[16] More on this will be explained in section 3.3.2.

[17] The sectoral system will estimate 3 separate VAR models, while the sub-sectoral system will estimate 9.

[18] If the variables are stationary at levels (or integrated of order 0 (i.e. I(0)), then run a VAR model using levels of variables. If on the other hand the variables are non-stationary (or integrated of a higher order, for example I(1)) and cointegrated, that suggests that a VECM should be used (Johansen, 1988). However, if the variables are non-stationary and not cointegrated, specifying a VAR model using first differences of variables is recommended. However, this is the case if one is interested in obtaining correct parameter estimates for interpretation.

[19] As a result, impulse responses generated will be biased and therefore, inaccurate.

FEVDs), and also since the accurate cointegrating relationships are unknown, a UVAR model in levels seems appropriate. Moreover, the choice of a UVAR model over other variants of VAR models are in line with the strategy adopted for similar studies by other authors, which includes Ramaswamy and Slok (1998), Ibrahim (2005) and Dabla-Norris and Floerkemeier (2006).

3.3.2. Benchmark VAR Model Specification (Model 1)

A basic Vector Autoregressive model of order p (VAR($\boldsymbol{p}$)) with $\boldsymbol{n}$ variables takes the following form:

$$\boldsymbol{y}_t = \boldsymbol{\alpha} + \sum_{j=1}^{p} \boldsymbol{\Phi}_j \boldsymbol{y}_{t-j} + \boldsymbol{\varepsilon}_t \qquad \boldsymbol{\varepsilon}_t \sim N(\boldsymbol{0}, \boldsymbol{\Sigma}_{\boldsymbol{\varepsilon}}) \qquad (1)$$

where $\boldsymbol{y}_t$ is a ($\boldsymbol{n}$ x 1) column vector containing endogenous variables, $\boldsymbol{\alpha}$ is a ($\boldsymbol{n}$ x 1) vector of constants, $\boldsymbol{\Phi}_j$ are ($\boldsymbol{n}$ x $\boldsymbol{n}$) matrices of autoregressive coefficients and $\boldsymbol{\varepsilon}_t$ is a $\boldsymbol{n}$-dimensional vector of white noise terms $(\varepsilon_{1t}, \varepsilon_{2t}, \dots, \varepsilon_{nt})'$ with covariance matrix $\boldsymbol{\Sigma}_{\boldsymbol{\varepsilon}}$, which is symmetric and positive definite.[20]

Considering the short series of data and the need to form parsimonious models due to the nature of the VAR framework, we followed the technique used by Arnold and Vrugt (2002) and Ibrahim (2005) when forming models for the sectoral and sub-sectoral systems. As these systems contained a relatively large number of control variables for both real GDP and private credit, several new series of data were generated, with a view to conserve degrees of freedom.[21]

Next, we used the Schwarz Bayesian Information Criterion (SBIC) and Hannan-Quinn Information Criterion (HQIC) to determine the lag order of the VAR model. The Lagrange multiplier (LM) test [22] for residual autocorrelation was conducted on the estimated VAR models to test for serial correlation. When we found evidence of serial correlation at that lag order, an extra lag of the variables was included until the residuals became serially uncorrelated.[23] This was consistent with the approach followed by Ibrahim (2005).

[20] Hamilton (1994), Lutkepohl (2005)

[21] For example, if we consider the VAR model for the Agriculture sector, rather than including 4 additional variables, which are GDP and private credit for both the Industry and Services sectors, we only include 2 where one series is Aggregate GDP less Agriculture GDP (which is referred to as Non-Agricultural GDP), while the other series is Aggregate Private Credit less Credit to the Agriculture Sector (which is referred to Non-Agriculture related Lending).

[22] Introduced by Johansen (1995)

[23] Most VAR models overcame the issue of serial correlation with the inclusion of 2 lags. The maximum VAR order of the other models came to be 3. Financial and Business Services sector was the only other exception with a lag order of 1.

The estimated benchmark model for the different VAR systems takes the following form, with the vector $\boldsymbol{y}_t$ been defined as:

a) Aggregate system: $\boldsymbol{y}_t = (\boldsymbol{LGDP}_t, \boldsymbol{LCPI}_t, \boldsymbol{LPSC}_t)'$

b) Sectoral system: $\boldsymbol{y}_{jt}^{S} = \left(\boldsymbol{LGDP}_{jt}^{S}, \boldsymbol{LGDP}_{-jt}^{S}, \boldsymbol{LCPI}_t, \boldsymbol{LPSC}_{jt}^{S}, \boldsymbol{LPSC}_{-jt}^{S}\right)'$

c) Sub-sectoral system: $\boldsymbol{y}_{mt}^{SS} = (\boldsymbol{LGDP}_{mt}^{SS}, \boldsymbol{LGDP}_{-mt}^{SS}, \boldsymbol{LCPI}_t, \boldsymbol{LPSC}_{mt}^{SS}, \boldsymbol{LPSC}_{-mt}^{SS})'$

where $j = 1, 2, 3$ denoting output and credit of each sector; and $m = 1,\ldots, 9$ denoting output and credit of each subsector. [24]

Most importantly, we have used the method of Cholesky decomposition to identify impulse-responses in our recursive VAR systems. In the aggregate system, the variables are ordered as real output, consumer price level and real private credit.[25] Findings from the causality study (refer section 4.2.1.) suggest that real output causes real private credit but not vice versa; hence real GDP is considered the most exogenous. Consumer price level is placed after real output but before real private credit, since we believe that credit will have little to no contemporaneous impact on the price level due to price stickiness.[26]

3.3.3. VAR Stability Test

A key prerequisite for a well-specified VAR model is stability, as unstable models invalidates standard asymptotic theory (Hatemi-J, 2002). Moreover, multiplier analysis have known interpretations only if the estimated VAR model is found to be stable (Hamilton, 1994; Lutkepohl, 2005).

The VAR(p) process in (1) is considered stable if all roots of the reverse characteristic polynomial lie outside the complex unit circle.[27] That is;

$$\det(I_n - \Phi_1 z - \cdots - \Phi_p z^p) \neq 0 \qquad \text{for } |z| \leq 1$$

All VAR systems in this study were tested and verified to have satisfied the stability conditions. (See Table 3)

[24] LGDP – log of real GDP; LCPI – log of CPI; LPSC – log of real private credit; ^{S} denotes 'Sector'; ^{SS} denotes 'Sub-sector'

[25] The ordering of the variables follows economic theory, with the idea that real GDP is the least responsive to shocks in other variables in the system, while real private sector credit is the most responsive.

[26] The ordering of variables remains unchanged in the sectoral and sub-sectoral VAR systems as we consider the recursive causal structure of the broader definitions to hold at the disaggregated levels (which is not unrealistic.)

[27] For a more detailed explanation (including technicalities), see Lutkepohl (2005). Alternatively, we can reach the same conclusion of VAR stability, if all roots of the companion matrix lie inside the complex unit circle.

3.4. Causality Testing and Multiplier Analysis

The most important techniques that help us analyse our research questions are causality tests and multiplier analysis. We adopt a variant of the Granger causality test introduced by Toda and Yamamoto (1995), to determine the direction of causality between private credit and economic growth in the context of Sri Lanka. Since we are dealing with non-stationary variables in a levels VAR framework, using standard Granger causality tests to determine causal relationships will be inaccurate as standard asymptotic theory is inapplicable, causing Granger causality (Wald) test statistics to suffer from specification bias and spurious regression (Sims, Stock and Watson, 1990; Toda and Phillips, 1993).[28]

This is then followed by a multiplier analysis, which includes orthogonalised Impulse Response Functions (IRFs) and Forecast Error Variance Decompositions (FEVDs). The impact of the CBSL's [29] credit policy on economic growth at both aggregated and disaggregated levels can be gauged by analysing the IRFs as it displays the *direction, magnitude* and *timing* of GDP's response to credit impulses. The varied responses in output in different sectors would provide evidence of sectoral heterogeneity to credit shocks.

Lastly, we conduct FEVDs to determine the relative *sensitivity* of output (at the aggregated and disaggregated levels) to shocks in private credit. As with IRFs, diverse results across sectors and sub-sectors would imply heterogeneity that policymakers should be aware of when formulating policy.[30]

3.5. Checks for Model Robustness and Suitability

We conducted two experiments to test for the robustness (and suitability) of our benchmark model (Model 1). It should be reiterated that the limited amount of observations in this study leaves us little space for generous additions of other potentially important control variables. With that in mind, we define our first robustness check by introducing the Average Weighted Call Money Rate (AWCMR) as a new control variable in place of log CPI (Model 2). Inclusion of AWCMR, which is the interbank money market rate, is expected to (reflect and) control the monetary policy stance of the Central Bank.

Secondly, we defined a model excluding log CPI as a control variable from the benchmark model to ascertain the significance of CPI in the credit-real output analysis. We refer to this as Model 3.

[28] More on the Toda-Yamamoto approach to test for causality can be found in Appendix D.
[29] Central Bank of Sri Lanka
[30] A detailed (general) explanation on IRFs on FEVDs can be found in Appendix E and F.

4. Empirical Findings

4.1. Preliminary results [31]

Prior to conducting a VAR analysis, it is important that we understand the data temporal properties. Therefore, the Augmented Dickey-Fuller (ADF) test was performed on the variables to identify their nature of stationarity, or in other words, their order of integration.

The results of the unit root tests, presented in Table 2, indicate that all variables associated with the aggregate and sectoral system are stationary in their first differences or I(1). Similarly, almost all of the variables in the sub-sectoral system are I(1) with the exception of Tea-GDP and Fisheries-Credit, which turned out to be stationary at levels or I(0). The results of the nature of stationarity of the above two variables were confirmed by the Phillips-Perron test (Phillips and Perron, 1988).

The Johansen Cointegration test (Johansen, 1988) was performed on those models involving purely I(1) variables. However, results of the above test have not been reported, as the main focus of this study is to determine causality and produce unbiased IRFs and FEVDs, and not to find evidence of possible long run relationships among those variables.

4.2. VAR results

4.2.1. Aggregate system results [32]

Prior to venturing into the main area of focus in this study, which is analysing the responses of aggregate output to shocks in private sector credit, it is prudent to determine the direction of causality, as it helps investigate whether lagged values of one variable help predict another. Also, results from the causality test would help determine the ordering of our variables in the system, (which is usually based on economic theory and fundamentals), when generating impulse response functions.

Table 5 presents results of the Toda & Yamamoto (1995), causality tests conducted on the aggregate system. It can be observed that the null hypothesis of *Real Private Credit does not cause Real GDP* cannot be rejected at the 5 percent level, implying that real private credit does not help predict real output in the Sri Lankan context. However, the null hypothesis of *Real GDP does not cause Real Private Credit* can be rejected even at the 1 percent level. This implies that real output significantly helps predict real private credit, and this result remains robust to longer lag lengths. Our findings therefore support the *'demand-following'* hypothesis evident in studies by Robinson (1952), Kuznets (1955) and Lucas (1988).

[31] For Descriptive (Summary) statistics, please see Table 1
[32] Refer Appendix J (Table 4) for a more detailed discussion on the aggregate results.

Table 5: Causality Test Results (Toda-Yamamoto Procedure): Aggregate System

Null hypothesis	Chi^2	Prob > Chi^2
Real Private Credit does not Granger [T-Y] Cause Real GDP	0.497	0.78
Real GDP does not Granger [T-Y] Cause Real Private Credit	**14.226**	**0.00**

Notes: The above table reports the results of the causality test (Toda-Yamamoto [T-Y] procedure) performed on the variables of the aggregate system | Results pertaining to CPI are not shown as that is not the main focus. | Both Real Private Credit and Real GDP are in logs | Lag length of VAR is 2 | Interpretation: The null hypothesis of Real Private Credit does not Granger [T-Y] Cause Real GDP cannot be rejected, which implies that Real Private Credit does not help predict Real GDP. However, the null hypothesis of Real GDP does not Granger [T-Y] Cause Real Private Credit is rejected even at the 1% level, which implies that Real GDP helps predict Real Private Credit, when the aggregate system is concerned.

Then, we proceed to evaluate the aggregate output responses to shocks in private credit in our benchmark system, which includes (and is ordered as) real Gross Domestic Product (GDP), consumer price index (CPI) and real private sector credit (PSC).[33] The aggregate analysis is conducted with the purpose of determining the nature of response of economic growth to unanticipated shocks in non-bank private sector credit, which is crucial for policymakers, in general, as the credit channel is one medium through which monetary policy transmission takes place. This analysis would also provide useful insights to policymakers in Sri Lanka, in particular, to make sense of the *'credit-GDP growth puzzle'*, an issue often deliberated during the last few years. Moreover, results of the aggregate system would also serve as a benchmark when evaluating sectoral and sub-sectoral effects of private credit shocks.

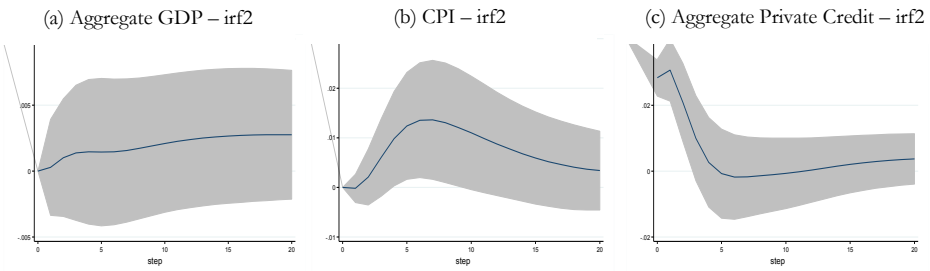
The orthogonalised IRFs in Figure 2 illustrate the response of aggregate real output, CPI and aggregate real private credit to a one standard deviation shock to private credit. It is evident that following a positive credit shock, aggregate real output responds positively with the effect reaching a peak at the 18-19 quarters. This is comprehensible as credit obtained by the private sector would be used to engage in economic activity, which fuels economic growth. Moreover, we could also infer that private credit and economic growth has a positive relationship.[34]

Further, the price level also increases in response to the positive credit shock with the effect dissipating from quarter 7 onwards. This is true as increased credit disbursements are likely to increase demand, which exert upward pressure on the price level of the economy.

[33] All of the variables mentioned herein were log transformed in this analysis.

[34] The response of private credit to an impulse in real output is positive and relatively more persistent (results of which are not shown in this study, but available from the author on request)

Figure 2: The effects of a Private Credit shock on Aggregate Real GDP, CPI and Aggregate Real Private Credit



Notes: Graphed above is the orthogonalised impulse response function – the response of aggregate GDP, CPI and aggregate private credit to a one standard deviation shock in aggregate private credit. The shaded area represents the 95% confidence band for the response function.

However, careful inspection of the IRFs (See Figure 3) indicates the presence of a *'second wave'* of growth of real output, that commences after the inflationary effect in prices recede.[35] This implies that credit, in the case of Sri Lanka, has more of an *inflationary* aspect rather a *growth-stimulating* aspect, which policymakers should be mindful about when formulating policy.

Results of the variance decompositions presented in Table 6 provide further insights to the above findings. Credit shocks account for only a small proportion of the variation in real output (less than 5 percent after 5 years) relative to that of CPI, where credit shocks explain about 21-27 percent of variation in the price level during the medium- to long-term. This implies that the aggregate output sensitivity to positive credit shocks are unexpectedly low in the Sri Lankan context, as in the case of Nigeria (Ifeakachukwu and Olufemi, 2012), highlighting a possible breakdown and the ineffectiveness of the credit (or bank lending) channel of monetary transmission.

[35] i.e., real GDP, which increases up until quarter 4, witnesses a stabilisation of the positive effect from that point on till quarter 7, before taking-off again. The corresponding positive response of CPI changes course from quarter 7 onwards.

Table 6: Variance Decompositions: Aggregate System

Horizons	GDP	CPI	PSC
(a) Variance Decomposition of GDP			
4	99.1	0.3	0.6
8	98.4	0.3	1.3
12	96.8	1.0	2.2
16	94.7	1.9	3.4
20	92.8	2.6	4.5
(a) Variance Decomposition of CPI			
4	2.4	94.4	3.2
8	2.6	76.7	20.8
12	6.8	66.1	27.1
16	12.9	59.4	27.7
20	18.9	54.5	26.6
(a) Variance Decomposition of PSC			
4	23.7	2.9	73.4
8	46.7	4.5	48.9
12	55.0	4.4	40.7
16	59.6	4.0	36.4
20	62.2	4.1	33.7

***Notes*:** This table presents the variance decompositions based on level VAR (with all variables in logs) | The lag order of the VAR is based on the Schwarz Bayesian Information Criterion/ Hannan-Quinn Information Criterion, while assuring that the error terms are serially uncorrelated | GDP = Real Gross Domestic Product ; CPI = Consumer Price Index ; PSC = Real Private Sector Credit | Cholesky ordering of the variables → [$\boldsymbol{LGDP_t, LCPI_t, LPSC_t}$] | Private Sector Credit contains commercial bank lending to the private sector (excluding lending to other banking entities) | Time horizon in quarters | All values are in percent.

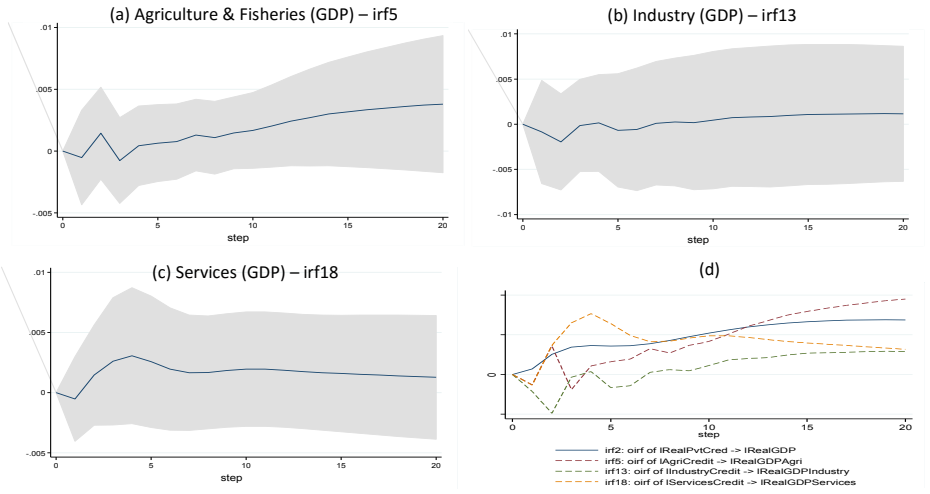
Moreover, the impulse responses depict that credit shocks appear to persist for about 4 quarters, and fade subsequently.

4.2.2. Sectoral system results [36]

Following the analysis of the aggregate output response to shocks in private sector credit, we continue to evaluate the same at the sectoral level. The primary reason for such sectoral analysis is to determine the asymmetric responses of output of various sectors to sector-specific credit shocks, which aids us to identify sectoral heterogeneity, if that exists, and fashion policy accordingly. Therefore, we estimate separate VAR models for each sector and compare that with the aggregate output responses, which serve as the benchmark.

Figure 4 illustrates the impulse responses of output of the three main sectors of the economy to a one-standard deviation shock to sector-specific private credit. It can be observed that all sectors respond positively, with a lag, to a credit impulse. Results indicate that output of the agriculture and fisheries sector responds positively to a credit shock from quarter 4 onwards. Variance decompositions provided in Table 7 indicate that credit impulses explain nearly 9 percent of the variation in that sectors' output in the long-term.

Figure 4: The effects of sector specific credit shocks on sectoral GDP



Notes: Graphed above are the responses of sectoral GDP, namely Agriculture, Industry and Services to orthogonalised (one standard deviation) shocks to sector-specific private credit. | The shaded area represents the 95% confidence band for the response functions. | Plot (d) denotes the asymmetric sectoral output responses to shocks in sector-specific credit.

[36] Refer Appendix J (Table 4) for a more detailed discussion on the sectoral results.

Table 7: Variance Decomposition of Sectoral GDP to Sector-specific Private Credit Shocks

Horizons	Agriculture & Fisheries	Industry	Services
2	0.1	0.1	0.1
4	0.6	0.5	1.4
8	1.0	0.4	2.7
12	2.3	0.3	2.8
16	5.3	0.4	2.8
20	8.7	0.6	2.7

Notes: This table presents the variance decompositions based on level VAR (with all variables in logs) | The lag order of the VAR is established to obtain serially uncorrelated error terms | Cholesky ordering of the variables → $[LGDP_{jt}^{S},\ LGDP\__{jt}^{S},\ LCPI_{t},\ LPSC_{jt}^{S},\ LPSC\__{jt}^{S}]$ | $LGDP^{S}$ = Log Sectoral Real GDP; $LPSC^{S}$ = Log Sectoral Private Sector Credit | Private Sector Credit contains commercial bank lending to the private sector (excluding lending to other banking entities) | Time horizon in quarters | All values are in percent.

The response of industry sector output to shocks in credit directed to the sector appears to be unsteady at short horizons, but takes off from the seventh quarter onwards. However, results from the variance decomposition suggests that shocks to industry credit explains only a marginal variation in the output of the industry sector throughout the forecast horizon, highlighting the weak sensitivity of the industry sector output to sector-specific credit impulses.

The services sector, unlike the other two sectors, responds positively to shocks in services sector-related credit in the shorter horizon, which gradually tends towards the pre-shock output level from quarter 4 onwards. The sensitivity of services sector output to sector-specific credit shocks remain relatively subdued, albeit it being higher than that of the industry sector.

It can be inferred that the agriculture and fisheries sector output is the most sensitive to sector-specific credit shocks, while the industry sector is the least sensitive. The weak sensitivity of the industry and services sectors to credit shocks could be primarily due to the fact that firms in those sectors have access to alternate sources of funding in the domestic equity and capital markets and therefore are less susceptible to unanticipated shocks in credit disbursed by commercial banks, unlike their agriculture sector counterparts that are highly reliant on bank credit.

Furthermore, since agricultural production is more seasonal, an unexpected influx of credit is likely to take about a year to yield positive results as shown by the IRFs. Also, since most agricultural output producers are individuals and small scale enterprises, they have limited

access to alternate sources of funding, which makes them heavily dependent on bank credit. Moreover, as per a direction issued by the CBSL (CBSL, 2010), all licensed banks are required to lend a minimum of 10 percent of their lending portfolio towards agricultural activity. This could well be another reason why agricultural output responds the most to a positive credit impulse compared to the industry and services sectors in Sri Lanka.

4.2.3. Sub-sectoral system results [37]

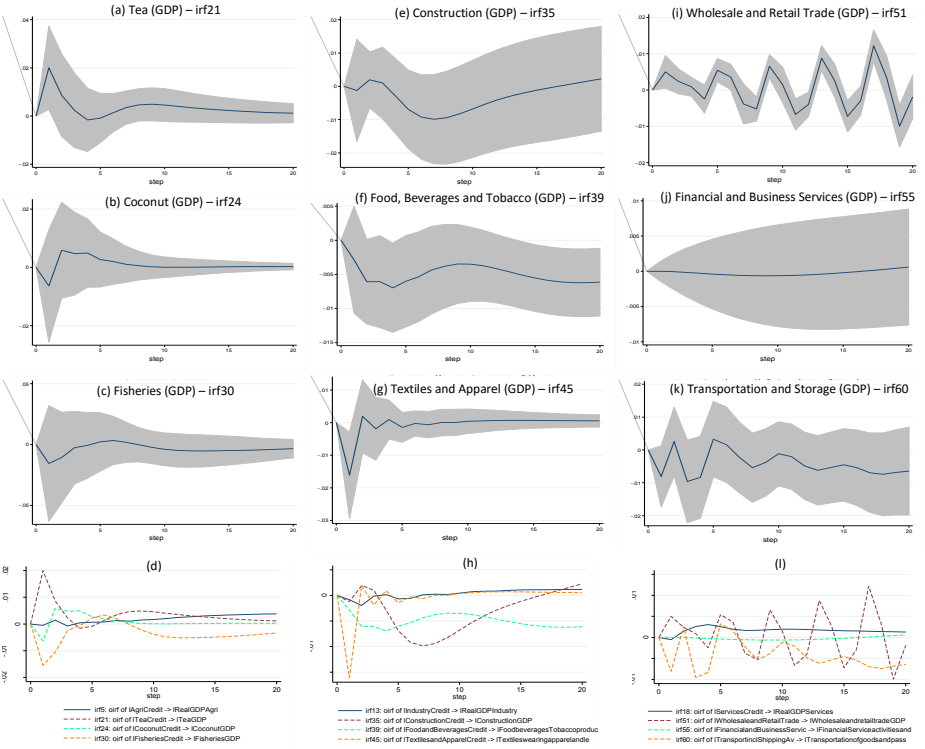
The analysis is extended further by investigating the effects of shocks to private credit on output at the sub-sectoral level. Separate VAR models are estimated for each of the selected nine sub-sectors,[38] impulse response functions (Figure 5) and forecast error variance decompositions (Table 8) are simulated to identify the possible asymmetric responses of sub-sectoral output to sub-sector specific private credit impulses.

The response of the tea sector output to a credit impulse shows an immediate positive response in the short-term with the same effect resurfacing after about 6 quarters and remaining persistently above the baseline thereafter. Moreover, the tea sector output appears to be quite sensitive to a sub-sector specific credit expansion, with credit accounting for 8-10 percent of the variation in tea output during the forecast horizon. The short-term effect on tea sector output remains notably higher than the long-term effect following a credit impulse, which could largely be due to credit being used to meet working-capital requirements, that aid production to continue unaffected from adverse demand and supply conditions. Policymakers must pay careful attention to ensure that credit obtained by the tea sector is channelled efficiently to yield a sustainable growth in its production.

[37] Refer Appendix J (Table 4) for a more detailed discussion on the sub-sectoral results.

[38] Sub-sectors were selected based on the availability of sub-sector specific GDP and private credit data and their importance to the Sri Lankan economy (based on the sub-sectoral share of GDP).

Figure 5: The effects of sub-sector specific credit shocks on sub-sectoral GDP



Notes: Graphed above are the responses of sub-sectoral GDP, (namely Tea; Coconut; Fisheries; Construction; Food, Beverages and Tobacco; Textiles and Apparel; Wholesale and Retail Trade; Financial and Business Services; and Transportation), to orthogonalised (one standard deviation) shocks to sub-sector specific private credit | The shaded area represents the 95% confidence band for the response functions | Plot (d), (h) and (l) illustrates the asymmetric sub-sectoral output responses to shocks in subsector-specific credit.

Table 8: Variance Decomposition of Sub-sectoral GDP to Sub-sector-specific Private Credit Shocks

Horizons	Agriculture & Fisheries			Industry			Services		
	Tea	Coconut	Fisheries	Construction	Food, Beverages & Tobacco	Textiles & Apparel	Wholesale & Retail Trade	Financial & Business Services	Transport & Storage
2	7.6	0.7	0.6	0.0	0.7	9.2	4.5	0.0	4.3
4	8.7	1.5	0.8	0.1	5.7	9.1	3.7	0.0	5.9
8	8.6	2.0	0.8	3.1	12.0	8.5	5.8	0.1	6.7
12	9.7	2.0	0.9	4.8	13.4	7.9	9.1	0.1	7.1
16	10.0	2.0	1.1	4.3	16.2	7.8	12.5	0.1	8.7
20	10.1	2.0	1.3	3.7	20.5	7.7	15.4	0.1	11.0

***Notes*:** This table presents the variance decompositions based on level VAR (with all variables in logs) | The lag order of the VAR is established to obtain serially uncorrelated error terms | Cholesky ordering of the variables → $[LGDP_{mt}^{SS}, LGDP_{-mt}^{SS}, LCPI_t, LPSC_{mt}^{SS}, LPSC_{-mt}^{SS}]$ | $LGDP^{SS}$ = Log Sub-sectoral Real GDP; $LPSC^{SS}$ = Log Sub-sectoral Private Sector Credit | Private Sector Credit contains commercial bank lending to the private sector (excluding lending to other banking entities) | Time horizon in quarters | All values are in percent.

Output in the coconut sector increases marginally following a shock to credit, with its effect then gradually dissipating thereafter. Also, credit shocks account for only a small fraction of the sector's output variation. This implies that credit only has a short-term impact on the output of the coconut sector and is relatively insensitive to credit impulses.

Conversely, the fisheries sector output declines instantaneously during the first 6 months, improves marginally during the short- to medium-term before turning negative again over the remainder of the forecast horizon following a positive credit impulse. Moreover, the output of the fisheries sector displays very low sensitivity to credit shocks. It is worth noting that the contribution of the fisheries sector output[39] (and even the coconut sector) to overall GDP remains higher than that of the tea sector, despite credit directed to the sector remaining comparatively lower (See Table 9). Therefore, this is one area policymakers should pay

[39] In terms of both value and growth

attention to as this would imply that credit channelled to the fisheries sector might be insufficient to generate a sizeable increase in production.

The construction sector output increases in the short-term in response to a credit impulse, which is followed by a prolonged period of contraction between years 1-4. However, the construction sector output improves after 4 years, signifying the long-run effect of construction on economic growth. Moreover, output in this sector is barely sensitive to positive credit impulses, in the short run, albeit a small increase in sensitivity is visible in the medium- to long-term.

On the contrary, output of the food, beverages and tobacco sector tends to be negatively impacted by a positive credit impulse. This could be due to the fact that this sector primarily borrows on a very short term basis (such as temporary overdrafts), which has relatively less to do with the sector's output and its growth. Nevertheless, credit shocks account for a considerable proportion of output variation in the sector, making it the most sensitive sub-sector in our analysis.

The response of output of the textiles and apparel sector to a credit impulse appears to be erratic at short horizons, albeit the effect turns out to be positive from quarter 8 onwards. This indicates that credit has a lagged effect on this sector's output, which is typical of any industry-related sector, as credit-funded investments take time to generate returns. However, unlike other sectors, the sensitivity of this sector's output to positive credit shocks dissipates over time.

The wholesale and retail trade sector is the largest contributor to the economy's GDP. The IRFs indicate that the output of this sector behaves erratically during the entire forecast horizon to a credit impulse, which could be attributed to the short-term nature of activity in this sector in the case of Sri Lanka. The cyclical nature of output responses indicates that credit does not have a persistent effect on the output of this sector. However, this sector's output is relatively more sensitive to credit impulses, where credit accounts for 6-15 percent of the output variation in the medium- to long-term.

Output of the financial and business services sector shows only a marginal response to a sector-specific credit impulse. This result, though quite alarming, makes sense due to shortcomings in the data. GDP data pertaining to this sector includes all bank and non-bank financial business services, while credit data includes only that of non-banks, and therefore is not fully comparable. Most importantly, since the banking sector accounts for nearly 70 percent of assets of the financial system (CBSL, 2016), credit excluding interbank lending, will prove less useful to our analysis. It is due to this reason we observe that output of this sector is insensitive to credit impulses.

Lastly, the response of the transportation sector output to a positive credit shock is erratic. In the shorter horizon, we can observe positive responses occasionally, but turns negative in the

medium-term and lasts thereafter till the end of the forecast horizon. This could largely be due to the transportation sector in Sri Lanka being predominantly state-run and a positive private credit impulse, therefore is unlikely to impact this sector's output notably. Nevertheless, 11 percent of the variations in the output of this sector is due to credit impulses.

Most interestingly, careful inspection of plot (d) in Figure 4 and plots (d), (h) and (l) in Figure 5 depicts the differential effects of sector/ sub-sector specific credit shocks on the output of those respective sectors/ sub-sectors. In other words, there is clear evidence of sectoral heterogeneity and identification of these potential differences in the effects of credit shocks on output at the sectoral and sub-sectoral levels, will provide policymakers valuable guidance and understanding when fashioning and implementing policies to achieve their ultimate objective of price and economic stability.

One important observation is that overall agricultural output appears to be responding well to a positive credit shock in the long run, while its sub-sectors respond positively as they should in the short- to medium-run, unlike the other sectors. However, the agriculture share of GDP has averaged only about 8 percent during the last 5 years, while the share of agriculture-related credit has increased to 12.2 percent (See Table 9). This could imply that too much credit has been channelled to a sector that is relatively less productive and contributes less to overall GDP.

However, (CBSL, 2016) provisional statistics indicate that the agriculture sector has recorded the highest sectoral growth in 2015 and a satisfactory level of growth in 2014.[40] One could argue that the agriculture sector received the *right amount* of credit (if not more), unlike its other sectoral counterparts (especially the industry sector), as banks increasingly channel credit to the agriculture sector possibly due to higher demand, the mandatory lending requirement or simply because banks are able to charge relatively higher rates of interest (for e.g. lending for agricultural purposes via pawning of gold articles at rates of around 20-24 percent per annum), which they find lucrative from their perspective. This practice crowds out credit available for industry and services sectors, which are relatively more productive and contributes more towards overall GDP, which could be the reason why the expected response of output of these two sectors to credit impulses are imperceptible. Therefore, a careful attempt to redirect credit to non-agricultural sectors (predominantly, the industry sector) should be evaluated and acted upon.

Moreover, due to uncertainty in the global and domestic financial markets, a majority of the banks focused more on short-term lending, rather than medium- or long-term lending. Certain sectors require long-term funds and careful attention by policymakers to reverse this said phenomenon by ensuring financial stability would enable these sectors (e.g. construction sub-

[40]Real GDP growth of the agriculture sector was 5.5 percent in 2015, compared to 3.0 percent (industry) and 5.3 percent (services). Agriculture recorded the second highest growth rate in 2014 (which was 4.9 percent), compared to 3.5 percent (industry) and 5.2 percent (services).

sector under industry) to obtain funds on a longer-term basis, which would generate sustainable economic growth.

Also, in the Sri Lankan context, policymakers (predominantly the Central Bank), in different occasions have adopted strategies such as quantitative restrictions on credit (to slow credit growth when credit is buoyant) and the use of moral suasion (to encourage lending when credit is depressed or needs to be directed to certain sectors), apart from the use of interest rates. Awareness of potential disparities in the effects of credit impulses on disaggregated output will aid policymakers in many respects. They will be able to evaluate the *direction*, *magnitude, timing* and *sensitivity* of responses of output of relevant sectors and sub-sectors of the economy to credit impulses, and when used in conjunction with a similar analysis on sectoral output responses to interest rate shocks, policymakers will be able to make well informed decisions.

5. Checks for Model Robustness and Suitability

5.1. Introducing AWCMR as a New Control Variable in place of CPI (Model 2)

The analysis done so far was based on the benchmark VAR model, which features log of CPI as a key control variable. To assess the robustness of the model, we introduce the variable of AWCMR, replacing log of CPI and refer to this as Model 2.

IRFs generated from Model 2 are illustrated in column 2 of Figure 6. Responses of output to credit impulses in Model 2 appear to be quite similar to the responses of the benchmark VAR (Model 1), especially in the shorter horizon, while some deviation in the magnitude of responses could be observed thereafter. The only exception is the financial and business services sub-sector, where Model 2 demonstrates a somewhat different output response. Nevertheless, as the responses of Model 2 are broadly qualitatively similar to that of Model 1, it suggests that our benchmark VAR model is robust to alternate model specifications.

5.2. Excluding CPI as a Control Variable (Model 3)

Further to the above, a separate exercise was conducted to assess the suitability of the benchmark VAR model to estimate output responses to credit impulses. For this purpose, a VAR model without log of CPI as a control variable was formed (referred to as Model 3) and impulse responses were drawn to test for the appropriateness of the benchmark model for this study.

The inclusion of CPI (Model 1) as an additional control variable appears to add more explanatory content to Model 3, as factoring in the price level when dealing with real variables produce realistic results. Moreover, output responses of Model 2 move quite closely with those of Model 3. This implies that excluding log CPI from the benchmark model would have biased the impulse responses generated in this study, while also suggesting that including AWCMR

in place of log of CPI as a control variable would have had less value addition to the model in terms of explanatory power.[41]

6. Concluding Remarks and Policy Implications

The relationship between credit and economic growth has been a long discussed topic over the past century. In this paper, we investigate the causal nexus between economic growth and private credit in Sri Lanka, and the response of output to innovations in private credit, using data from 2003-2015. The analysis is carried out using 3 levels of data: aggregate, sectoral and sub-sectoral, with the aim of determining possible disparate effects of output to credit impulses.

We follow the unrestricted VAR (UVAR) approach using techniques such as Toda-Yamamoto causality testing and multiplier analysis, which includes generating Impulse Response Functions (IRFs) and Forecast Error Variance Decompositions (FEVDs). We find evidence supporting the *'demand-following'* hypothesis in the case of Sri Lanka, with unidirectional causality running from economic growth to private credit.

The multiplier analysis involving IRFs and FEVDs are estimated for 3 VAR systems. Results of the aggregate system indicate that both aggregate output and the price level responds positively to credit impulses. However, a *second wave* of growth in output can be observed as the effect of the credit shock on the price level starts dissipating. This indicates that credit in Sri Lanka tends to have more of an *inflationary* aspect rather than a *growth-stimulating* aspect. Moreover, sensitivity of aggregate output to credit shocks is unexpectedly low in the case of Sri Lanka.

Similarly, sectoral output responds favourably to positive credit impulses in the long run. However, varying responses of the three sectors in the short run demonstrates evidence of sectoral heterogeneity to credit shocks. Services sector output responds quickly and positively to a credit impulse, while agriculture and fisheries sector's outputs respond positively in the medium-term. Output of the industry sector behaves erratically in the shorter horizon. With respect to sensitivity, agriculture and fisheries sector output is the most sensitive to credit shocks, while the industry sector output is the least sensitive.

Further evidence of sectoral heterogeneity to credit shocks was found when the study was extended to analyse responses of output of the sub-sectors. Within the agriculture and fisheries sector, output of both tea and coconut sectors responded positively to credit impulses at different magnitudes, while the fisheries sector output suffered a decline.

Sub-sectors belonging to the industry sector showed equally diverse responses with construction output responding negatively in the short-term, which eventually turned positive

[41] See columns 3 and 4 in Figure 6

at the end of the forecast horizon. Output of the food, beverages and tobacco sector responded negatively throughout the entire forecast horizon, while that of the textiles and apparel sector was unsteady during the short-term, but turned marginally positive over the medium-term.

Responses of those sub-sectors under services to a credit shock were irregular. Response of output of the wholesale and retail trade, and transportation and storage sectors were erratic, while that of the financial and business services sector was marginal.

Output of the food, beverages and tobacco, wholesale and retail trade, transportation and storage, and tea sectors were the most sensitive to credit shocks, while output of financial and business services, fisheries, coconut and construction sectors were the least sensitive.

The above findings have important implications to both literature as well as policymakers in several ways. Although the literature focuses extensively on analysing the causal relationship between credit and economic growth, little attention has been paid to analyse the disparate effects of credit policy on different sectors and sub-sectors of the economy. While this study focuses on Sri Lanka, conducting similar studies for other countries in the future could yield interesting and varying results due to cross-country variations in terms of the structure of the economy and the financial system. Moreover, future research can also focus on regional output disparities of credit policy, as all these would imply the need for a careful approach for policy.

Moreover, findings of this study provide valuable insights to policymakers both in Sri Lanka and globally. Since there is evidence of differential effects of output to private credit impulses in the context of Sri Lanka, careful attention should be given when formulating policies to ensure that each sector or sub-sector of the economy benefits from the policy actions taken.

Also, policymakers in Sri Lanka should fashion policy to encourage more medium- to long-term lending, particularly to the industry and services sectors, which would help improve the *growth-stimulating* aspect of private credit, while also allowing them to achieve their core objective of price and economic stability. Such changes to the lending structure (in terms of sectors lent to and tenure of loans) would be an appropriate policy, over quantitative restrictions on overall credit during periods when credit expands beyond the desired level.

The significance and relevance of these findings and policy recommendations not only applies to Sri Lanka, but to all policymakers globally. Heterogeneity in sectoral output responses to credit requires policymakers to be mindful of the disparate effects that policy actions could entail. Even countries like the US, the UK and the European Union can find relevance to this study as policymakers in those nations would have to be conscious about how unconventional monetary policy, particularly credit easing, affects different sectors (and regions) in disproportionate ways, thereby warranting a careful approach to credit that stimulates economic growth.

It should be mentioned that the sample period of this study, 2003-2015, was eventful in terms of policy measures and economic background, both locally and globally, and the results are likely to have been affected by those incidences.[42] It should also be noted that employing superior methodologies such as structural VARs (SVARs), along with the inclusion of more control variables to analyse this issue would have been more appropriate.

Nevertheless, the present study and its findings are likely to generate discussion and interest on the credit-growth nexus and this approach to analyse such relationship at disaggregated levels (sectoral and regional) for different countries will be an area for future research.

[42] Policy measures such as quantitative restrictions on credit (in 2012), the 3-decade long civil war (ending in 2009) and turmoil in the global financial market (in 2008/09) are some events that are likely to have affected credit and economic growth in numerous ways in Sri Lanka.

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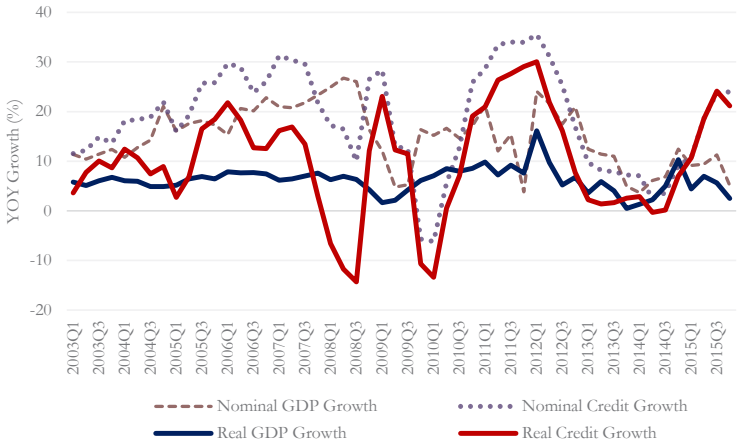
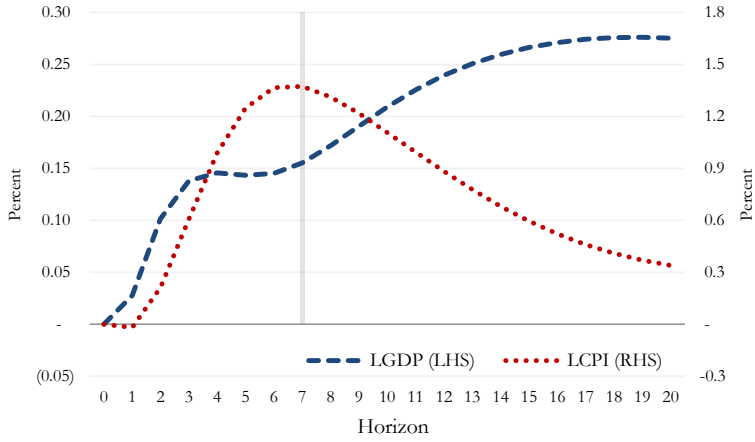
Appendices

A. Figure 1: Real Credit Growth Vs. Real GDP Growth



B. Figure 3: Response of log GDP and Log CPI to a Credit Impulse



C. Table 1: Definitions, Sources and Descriptive Statistics

Variable	Definition/ Description	Source	Mean	Std. Deviation
Real GDP	Real Gross Domestic Product - Seasonally adjusted (Base: 2010=100)	DCS	1,558,622	364,535
Real Private Sector Credit (PSC)	Seasonally adjusted credit granted by commercial banks to non-bank private sector (adjusted for inflation)	CBSL	1,475,514	494,309
Consumer Price Index (CPI)	Colombo Consumers Price Index (rebased, so that Base: 2010=100)	DCS	90.9	28.0
Average Weighted Call Money Rate (AWCMR)	Interbank money market rate for unsecured lending	CBSL	10.1	3.9
Agriculture & Fisheries (GDP)		DCS	130,385	22,523
Industry (GDP)			413,206	100,678
Services (GDP)			862,683	213,104
Agriculture & Fisheries (Credit)		CBSL	173,655	63,838
Industry (Credit)			555,503	173,841
Services (Credit)			332,539	143,685
Tea (GDP)		DCS	17,419	1,371
Coconut (GDP)			19,133	1,680
Fisheries (GDP)			21,054	6,615
Construction (GDP)			91,598	36,929
Food, Beverages & Tobacco (GDP)			104,267	21,489
Textiles & Apparel (GDP)			61,263	6,425
Wholesale & Retail Trade (GDP)			175,701	38,357
Financial & Business Services (GDP)			167,971	47,476

Transportation & Storage (GDP)	CBSL	158,266	47,657
Tea (Credit)		40,155	5,822
Coconut (Credit)		3,738	1,721
Fisheries (Credit)		5,382	2,094
Construction (Credit)		238,325	79,625
Food, Beverages & Tobacco (Credit)		40,855	8,236
Textiles & Apparel (Credit)		76,570	15,035
Wholesale & Retail Trade (Credit)		175,809	37,312
Financial & Business Services (Credit)		75,151	30,299
Transportation & Storage (Credit)		17,538	10,399

Notes: This table reports the definitions/descriptions, sources and summary statistics of all the variables used in our analysis | DCS: Department of Census and Statistics - Sri Lanka; CBSL: Central Bank of Sri Lanka | GDP and Private sector credit figures (aggregate, sectoral and sub-sectoral) are in Millions (Sri Lanka Rupees); CPI contains index values; AWCMR is in percent.

D. The Toda-Yamamoto Approach to test for Granger Causality

Toda and Yamamoto (1995), introduced an alternative approach to test for Granger causality, which could be applied on VAR models, irrespective of their order of integration or cointegration; hence requiring no pre-testing. It generates a modified Wald test statistic (MWALD) [43] based on the estimation of an augmented VAR model.

The Toda-Yamamoto (TY) procedure involves two steps:

I. Determine the maximum order of integration (d_{max}) of the series in the VAR model (by performing the ADF test)
II. Form a well-specified levels VAR model of order k (VAR(k)) [44]

As we test for causality only in the aggregate system, the VAR($k + d_{max}$) model will take the following specific form:

$$\begin{bmatrix} y_{1t} \\ y_{2t} \\ y_{3t} \end{bmatrix} = \begin{bmatrix} \beta_{10} \\ \beta_{20} \\ \beta_{30} \end{bmatrix} + \sum_{i=1}^{k} \begin{bmatrix} \beta_{11,i} & \beta_{12,i} & \beta_{13,i} \\ \beta_{21,i} & \beta_{22,i} & \beta_{23,i} \\ \beta_{31,i} & \beta_{32,i} & \beta_{33,i} \end{bmatrix} \begin{bmatrix} y_{1t-i} \\ y_{2t-i} \\ y_{3t-i} \end{bmatrix} + \sum_{j=1}^{d_{max}} \begin{bmatrix} \beta_{11,k+j} & \beta_{12,k+j} & \beta_{13,k+j} \\ \beta_{21,k+j} & \beta_{22,k+j} & \beta_{23,k+j} \\ \beta_{31,k+j} & \beta_{32,k+j} & \beta_{33,k+j} \end{bmatrix} \begin{bmatrix} y_{1t-k-j} \\ y_{2t-k-j} \\ y_{3t-k-j} \end{bmatrix} + \begin{bmatrix} \nu_1 \\ \nu_2 \\ \nu_3 \end{bmatrix} \quad (2)$$

where, $y_1 = LGDP$; $y_2 = LCPI$; $y_3 = LPSC$

We focus on testing for variable-to-variable causality, with the purpose of identifying causal relationships among (just) two variables, where we test the following null hypothesis [45] (e.g. causality from LPSC to LGDP):

$$H_0: \beta_{13,1} = \beta_{13,1} = \cdots = \beta_{13,k} = 0$$

[43] When a levels VAR of order $k + d_{max}$ is estimated, the MWALD test statistic has an asymptotic chi-squared (χ^2) distribution.

[44] Determine the optimal lag length by using selection order criteria such as Akaike Information Criterion (AIC), Hannan-Quinn Information Criterion (HQIC) or Schwarz Bayesian Information Criterion (SBIC) and ensure that the VAR model is well-specified by testing for stability and serial correlation.

[45] The null hypothesis implies that one variable (LPSC) does not cause the other (LGDP), while its rejection presents evidence of causality.

E. Orthogonalised Impulse Response Functions (IRFs)

Impulse Response Functions help trace out the responses of one variable (e.g. real GDP) to an unanticipated shock in another variable (e.g. real private credit) in the VAR system. The impulse responses are obtained by rewriting the VAR in its moving-average (MA) form. The MA(∞) representation of the VAR(p) model in (1) can be written as:[46]

$$\boldsymbol{y}_t = \boldsymbol{\mu} + \sum_{i=0}^{\infty} \boldsymbol{\phi}_i \boldsymbol{\varepsilon}_{t-i} \tag{3}$$

where, $\boldsymbol{\mu} = E(\boldsymbol{y}_t)$; $\boldsymbol{\phi}_i = J\boldsymbol{\Phi}^{\boldsymbol{i}}J'$; and $J = [I_n : 0 : \ldots : 0]$

Unreasonable assumptions, such as the occurrence of shocks only in one variable at a particular point in time, and shocks among variables being independent, warrant for the generation of orthogonalised impulse responses. By decomposing the original innovations in the VAR,[47] we are able to represent our VAR(p) model in its MA form:

$$\boldsymbol{y}_t = \boldsymbol{\mu} + \sum_{i=0}^{\infty} \boldsymbol{\Psi}_i \, \boldsymbol{\eta}_{t-i} \tag{4}$$

where,

$\boldsymbol{\Psi}_i = \phi_i P$

$\boldsymbol{\eta}_t = P^{-1}\varepsilon_t$ (a vector of orthogonal residuals) [48]

μ is the mean of y_t, which is constant $\forall\, t$.

The components in the vector $\boldsymbol{\eta}_t$ are contemporaneously uncorrelated as these orthogonalised shocks hold the property of $\varepsilon_t \sim (0, I_n)$.[49] In addition, the $\boldsymbol{\Psi}_i$ matrix contain information on the impulse responses.

[46] We broadly follow notation by Lutkepohl (2005). The same source could be referred for a more detailed explanation (including technicalities).

[47] We decompose the covariance matrix Σ_ε, which is symmetric and positive definite as: $\Sigma_\varepsilon = PP'$ (where P is a lower triangular matrix). This is the Cholesky decomposition of matrix Σ_ε. Using this equality, we rewrite equation (3) as: $y_t = \mu + \sum_{i=0}^{\infty} \phi_i P P^{-1} \varepsilon_{t-i}$

[48] Its covariance matrix takes the form $\Sigma_\eta = P^{-1}\,\Sigma_\varepsilon (P^{-1})' = I_n$

[49] A unit shock to any component in the vector $\boldsymbol{\eta}_t$ is equal to a one standard deviation shock since $\Sigma_\eta = I_n$. See Lutkepohl (2005) for a detailed explanation.

F. Forecast Error Variance Decompositions (FEVDs)

Forecast Error Variance Decompositions (FEVDs) provides information on the proportion of the total h-period ahead forecast error variance of an endogenous variable resulting from orthogonalised shocks to itself as well as to other variables in the VAR system.

Using equation (4) in conjunction with orthogonalised shocks $(\Sigma_\eta = I_n)$, the optimal h-step ahead forecast error can be shown as;

$$\boldsymbol{y}_{t+h} - \bar{\mathrm{y}}_t(h) = \sum_{i=0}^{h-1} \boldsymbol{\Phi}_i \boldsymbol{\varepsilon}_{t+h-i} \tag{5}$$

where, $\boldsymbol{y}_{t+h}$ = actual value at time $t + h$

$\bar{\mathrm{y}}_t(h)$ = h-period ahead forecast value of $\boldsymbol{y}_t$ made a time t

Then, with a bit of algebra, equation (5) can be modified as;

$$\boldsymbol{y}_{t+h} - \bar{\mathrm{y}}_t(h) = \sum_{i=0}^{h-1} \boldsymbol{\Psi}_i \boldsymbol{\eta}_{t+h-i} \tag{6}$$

Most importantly, the forecast error of each individual component will therefore possibly contain all the shocks.[50]

[50] We have followed the methods and expressions outlined by Lutkepohl (2005).

G. Table 2: Results of the Augmented Dickey-Fuller (Unit Root) Tests

Variable	Level		First Difference		Remarks	Model Specification at Level	ADF Lags
Real GDP	-2.038		-4.738	*	I(1)	C&T	2
Real Private Sector Credit (PSC)	-3.039		-3.597	*	I(1)	C&T	2
Consumer Price Index (CPI)	-0.672		-3.096	**	I(1)	C&T	2
AWCMR	-1.160		-4.216	*	I(1)	C	2
Agriculture & Fisheries (GDP)	-3.394		-6.590	*	I(1)	C&T	1
Industry (GDP)	-2.114		-6.197	*	I(1)	C&T	2
Services (GDP)	-1.992		-4.699	*	I(1)	C&T	2
Agriculture & Fisheries (Credit)	-1.244		-6.754	*	I(1)	C&T	1
Industry (Credit)	-0.902		-3.861	*	I(1)	C&T	2
Services (Credit)	-1.729		-3.467	*	I(1)	C&T	2
Tea (GDP)	-3.393	**			I(0)	C	2
Coconut (GDP)	-2.615		-5.768	*	I(1)	C	1
Fisheries (GDP)	-1.324		-5.046	*	I(1)	C	2
Construction (GDP)	-2.326		-5.118	*	I(1)	C&T	2
Food, Beverages & Tobacco (GDP)	-2.241		-4.176	*	I(1)	C&T	2
Textiles & Apparel (GDP)	-2.698		-6.688	*	I(1)	C&T	2
Wholesale & Retail Trade (GDP)	-2.937		-9.572	*	I(1)	C&T	2
Financial & Business Services (GDP)	-0.458		-4.226	*	I(1)	C&T	1
Transportation & Storage (GDP)	-3.252		-7.011	*	I(1)	C&T	2
Tea (Credit)	-0.984		-3.696	*	I(1)	C	2
Coconut (Credit)	-2.556		-3.831	*	I(1)	C&T	2
Fisheries (Credit)	-3.706	**			I(0)	C	2
Construction (Credit)	-0.686		-3.419	**	I(1)	C&T	1
Food, Beverages & Tobacco (Credit)	0.067		-3.311	**	I(1)	C	2
Textiles & Apparel (Credit)	-2.605		-4.314	*	I(1)	C&T	2
Wholesale & Retail Trade (Credit)	-1.808		-5.109	*	I(1)	C&T	2
Financial & Business Services (Credit)	-2.330		-3.400	**	I(1)	C&T	1
Transportation & Storage (Credit)	-2.262		-4.639	*	I(1)	C&T	2

Notes: This table presents the unit root test results for 28 variables | The null hypothesis is that the variable follows a unit root process | * - significant at 1% ; ** - significant at 5% | I(0): Stationary at levels; I(1): Stationary at first difference | C: ADF test with constant; C&T: ADF test with trend and constant

H. Table 3: Optimal Lag Order of VAR Models

VAR Model	Model 1 (Benchmark VAR)	Model 2	Model 3
Aggregate System			
Base VAR - Aggregate	2	2 $^{\Delta}$	2
Sectoral System			
VAR 1 - Agriculture & Fisheries	3	3	3
VAR 2 - Industry	2	2 $^{\Delta}$	2
VAR 3 - Services	2	2	2
Sub-sectoral System			
VAR 4 - Tea	2	3	3
VAR 5 - Coconut	2	1 $^{\Delta}$	2
VAR 6 - Fisheries	2	2	2
VAR 7 - Construction	2	2 $^{\upsilon}$	2
VAR 8 - Food, Beverages & Tobacco	2	2 $^{\Delta}$	2
VAR 9 - Textiles & Apparel	2	2	2
VAR 10 - Wholesale & Retail Trade	2	2 $^{\Delta}$	2 $^{\Delta}$
VAR 11 - Financial & Business Services	1	1	1
VAR 12 - Transportation & Storage	2	3	3

Notes: This table presents the optimal lag order of the different, stable VAR models | The lag order of the benchmark VAR (Model 1) is established to obtain serially uncorrelated error terms (at the 5% level), while the lag order of other models are decided to match the lag order of the benchmark VAR (Model 1) provided the VAR model is stable | Δ indicates presence of serial correlation at that lag order; υ indicates that the VAR model is unstable at that lag order | Model 1: Benchmark VAR, which includes log CPI as a control variable; Model 2: includes AWCMR in place of log CPI as a control variable; Model 3 excludes log CPI from the benchmark VAR model.

I. Table 4: Results of Multiplier Analyses

VAR Models - Benchmark VAR	Findings Explained	
	IRFs	**FEVDs**
Aggregate System		
Base VAR - Aggregate	*GDP:* Following a positive credit shock, aggregate real output responds positively with real output increasing by around 0.15% above baseline after 1 year. It remains at that level for about 2 more quarters before increasing again and peaks at the 18-19 quarters with real output remaining around 0.28% above baseline. However, this effect is not statistically significant.	*GDP:* Credit shocks account for only about 2% of the fluctuations in aggregate output by the end of 3 years, with this proportion increasing to less than 5% after 5 years.
	CPI: In response to the positive credit shock, the price level increases by around 1% above baseline within 4 quarters, peaks at 1.4% at quarter 7 before dissipating towards the steady state level, with effects from quarter 4 to 9 remaining significant.	*CPI:* Credit shocks explain about 3 percent of variation in the price level during the first year, which subsequently increases to 21% at the end of 2 years and around 27% (on average) during the 3- to 5-year horizon.
Sectoral System		
VAR 1 - Agriculture & Fisheries	The sector responds positively from quarter 4 onwards with the increase being marginal in quarter 4, but persists to end up at 0.4% above baseline at quarter 20.	Shocks to credit explains only around 1% of the variation in output of the sector during the first 2 years, while it increases to nearly 9% by the end of 5 years.
VAR 2 - Industry	Output responses appears to be unsteady at short horizons, starting off negatively and bottoming out at 0.2% below baseline in quarter 2. However, from the seventh quarter onwards, industry sector output takes off and peaks at 0.1% above baseline in quarter 19.	Shocks to credit explains only about 0.5% of the variation in output of the industry sector from the first year till the end of the forecast horizon on average.

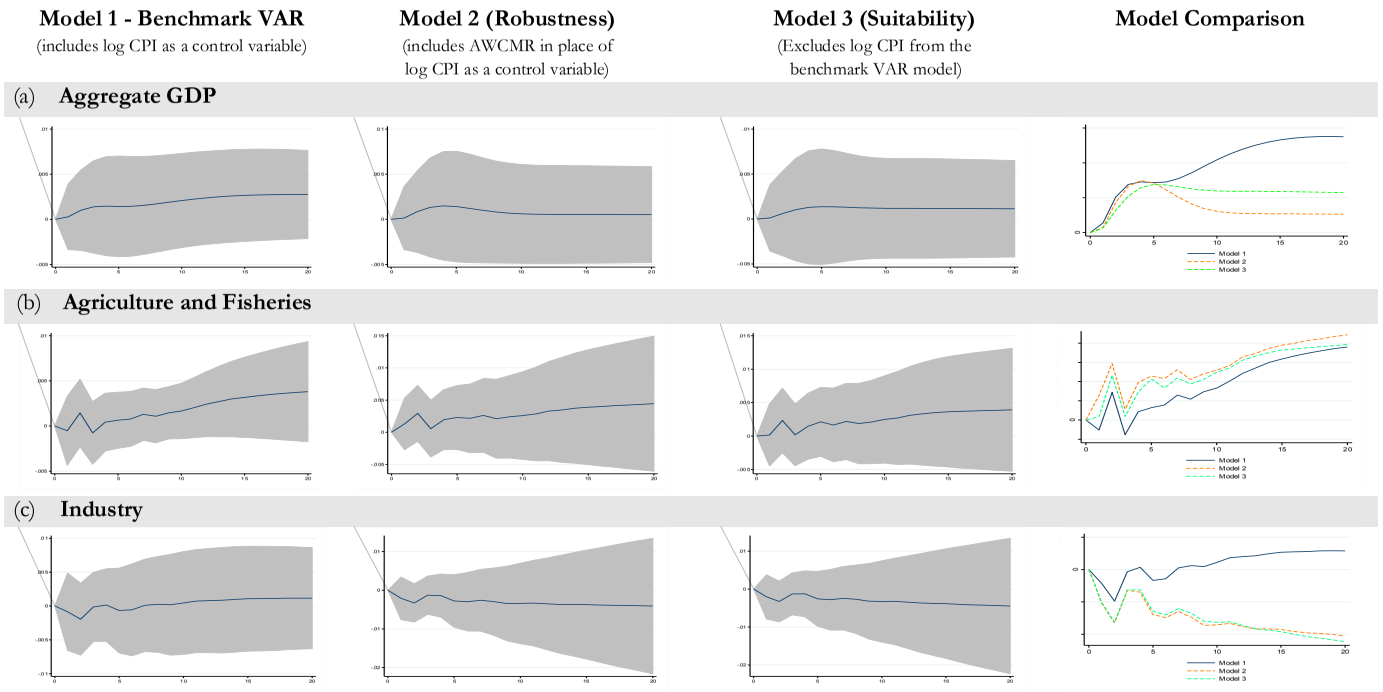
VAR Models - Benchmark VAR	Findings Explained	
	IRFs	**FEVDs**
VAR 3 - Services	The sector responds positively to shocks in services sector-related credit in the shorter horizon, where it peaks at 0.3% above baseline in quarter 4, after which it gradually tends towards the pre-shock output level over the forecast period of 5 years	Sensitivity of services sector output to sector-specific credit almost doubles after the first year, where shocks to services sector credit explains around 3% of the variation in services sector output, on average, during years 2-5.
Sub-sectoral System		
VAR 4 - Tea	The sector shows almost an immediate positive response to a credit shock, peaking at 2% above baseline in quarter 1, which is statistically significant. However, this effect fades out gradually and reaches baseline by about quarter 4 before the positive effect re-appears in quarter 6 and remains persistently above baseline by around 0.1-0.5% over the forecast horizon.	Credit account for nearly 8% of the variation in tea output during the first 2 quarters, which then increases to around 9-10% thereafter.
VAR 5 - Coconut	Output increases marginally to about 0.6% above baseline in quarter 2, following a shock to credit, with its effect then gradually dissipating thereafter.	Only a minuscule fraction of the sector's output variation is attributable to credit shocks.
VAR 6 - Fisheries	Output of the sector declines instantaneously by about 1-1.6% below baseline during the first 2 quarters, and only turns positive during quarters 5-7 recording a 0.3% increase on average. This effect then fades away and remains negative thereafter.	Output of the sector displays very low sensitivity to credit shocks, with credit impulses accounting for only around 1% of the variation (on average) in this sector's output.

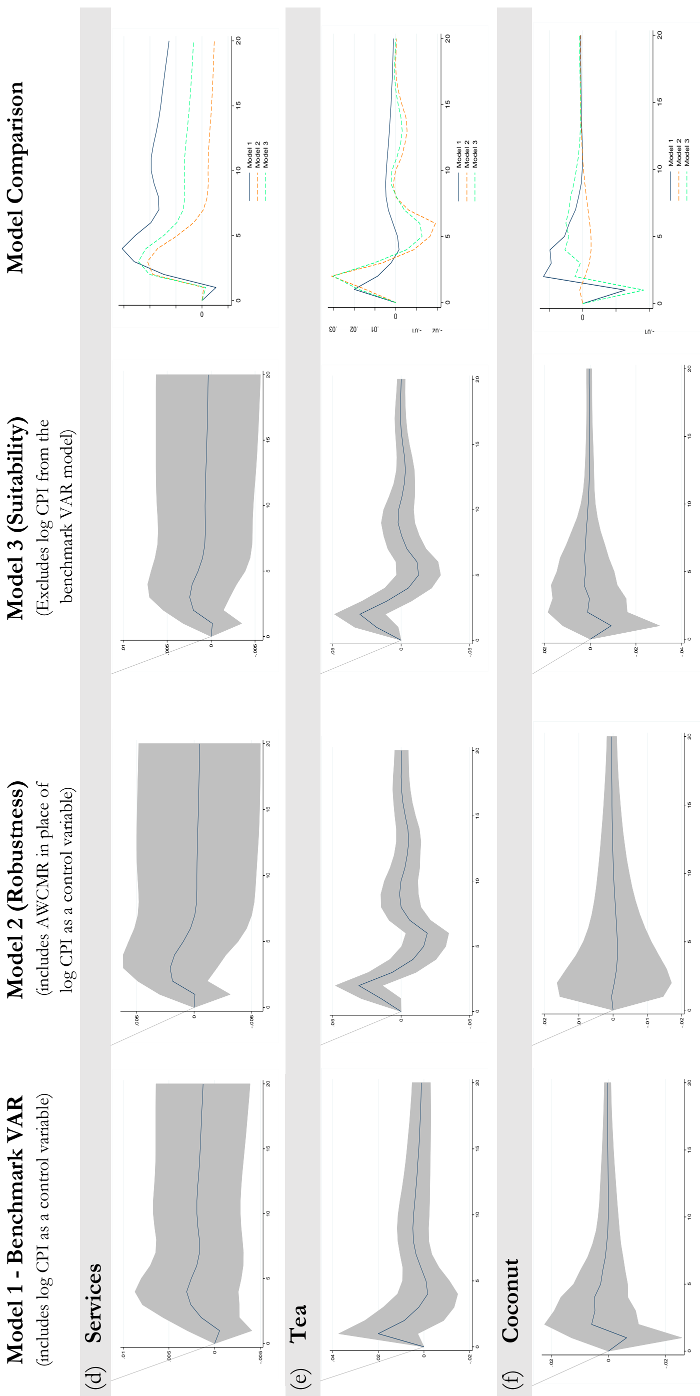
VAR Models - Benchmark VAR	Findings Explained	
	IRFs	**FEVDs**
VAR 7 - Construction	Output in the sector increases by about 0.1-0.2% percent in the shorter end of the spectrum. However, output seem to suffer from the quarter 4 onwards till the sixteenth quarter, where the largest drop (of around 1%) takes place at the end of the second half of year 2. This, however, gradually improves and reaches positive territory from year 4 onwards.	Output in this sector is hardly sensitive to positive credit impulses, in the short run, while credit shocks only account for about 3-4%, on average, in the longer term.
VAR 8 - Food, Beverages & Tobacco	Output of this sector tend to be negatively impacted by a positive credit impulse. It declines by about 0.7% below baseline after 1 year, with the negative effect fading away to last only for 5 more quarters, before it starts declining again.	Credit shocks account for 12% of output variation in the sector after 2 years, and almost 21% after 5 years, making it the most sensitive sub-sector in our study.
VAR 9 - Textiles & Apparel	Response of output of this sector to a credit impulse appears to be erratic at short horizons, although the effect turns out to be positive from quarter 8 onwards. However, the maximum positive effect can be quantified to be around 0.1% above baseline in quarter 14.	Credit shocks account for 9% of output variation in the shorter horizon, followed by a gradual slowdown to about 7.7% by the end of 5 years.
VAR 10 - Wholesale & Retail Trade	Output of this sector is quite erratic during the entire forecast horizon. A positive credit shock has a positive effect on this sector's output for about 2 to 3 quarters before it turns negative for another couple of quarters and this cyclical trend continues.	Credit shocks account for 6% of the output variation by the end of 2 years, doubles to around 13% at the end of 4 years, before ending at 15% after 5 years.
VAR 11 - Financial & Business Services	Output of this sector tends to decline to a maximum of 0.1% below baseline up until the end of 4 years, after which a slight positive effect could be seen towards the end of the forecast horizon.	Credit shocks causes almost no variation in output of this sector.

VAR Models - Benchmark VAR	Findings Explained	
	IRFs	**FEVDs**
VAR 12 - Transportation & Storage	Output of this sector displays a somewhat erratic behaviour to a positive credit shock. Occasional positive effects of credit shocks could be witnessed in this sector's output in the shorter horizon, but moves on to the negative territory from quarter 7 onwards and persists thereafter till the end of the forecast horizon.	Credit shocks account for 6% of the output variation by the end of 1 year, which increases to around 11% after 5 years.

Notes: This table provides a detailed report of findings from the multiplier analysis.

J. Figure 6: Model Robustness and Suitability





Model 1 - Benchmark VAR
(includes log CPI as a control variable)
Model 2 (Robustness)
(includes AWCMR in place of log CPI as a control variable)
Model 3 (Suitability)
(Excludes log CPI from the benchmark VAR model)
Model Comparison
(d) Services
(e) Tea
(f) Coconut
Model 1
Model 2
Model 3

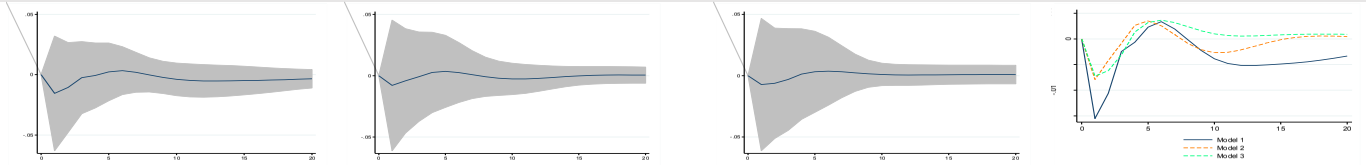
Model 1 - Benchmark VAR
(includes log CPI as a control variable)

Model 2 (Robustness)
(includes AWCMR in place of log CPI as a control variable)

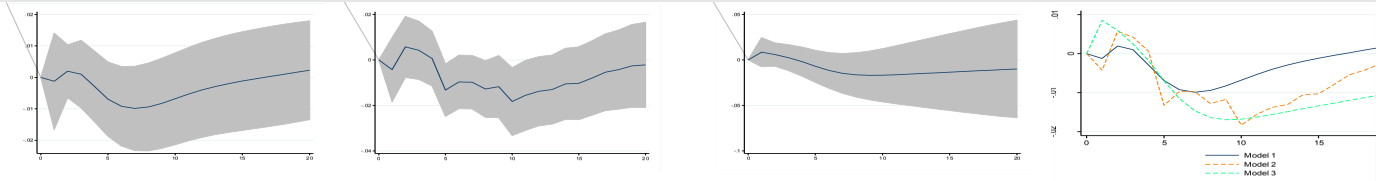
Model 3 (Suitability)
(Excludes log CPI from the benchmark VAR model)

Model Comparison

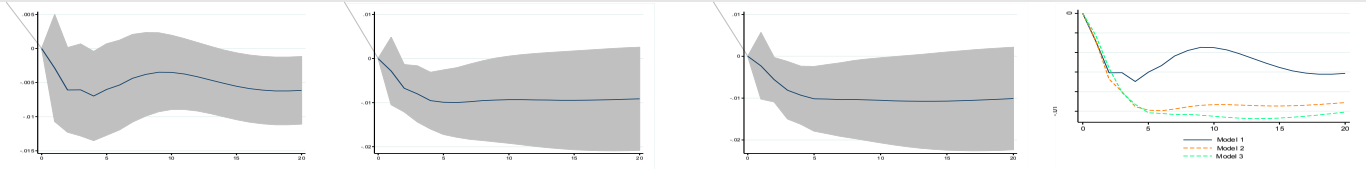
(g) **Fisheries**



(h) **Construction**

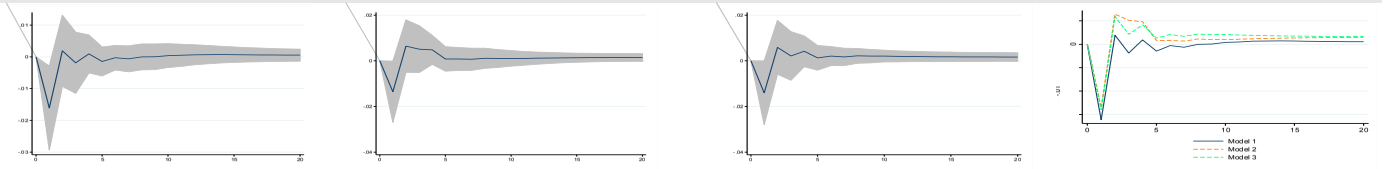


(i) **Food, Beverages and Tobacco**

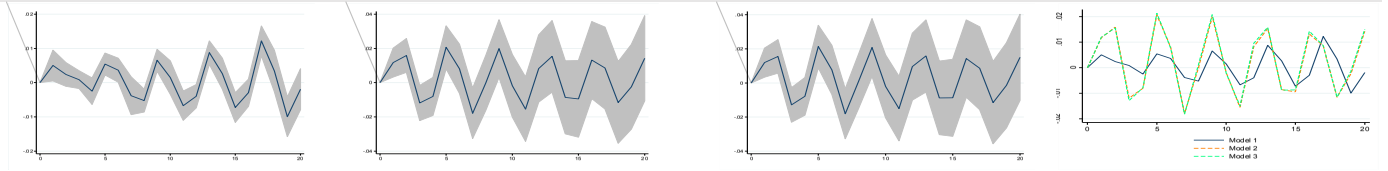


Model 1 - Benchmark VAR (includes log CPI as a control variable)	Model 2 (Robustness) (includes AWCMR in place of log CPI as a control variable)	Model 3 (Suitability) (Excludes log CPI from the benchmark VAR model)	Model Comparison

(j) **Textiles and Apparel**



(k) **Wholesale and Retail Trade**



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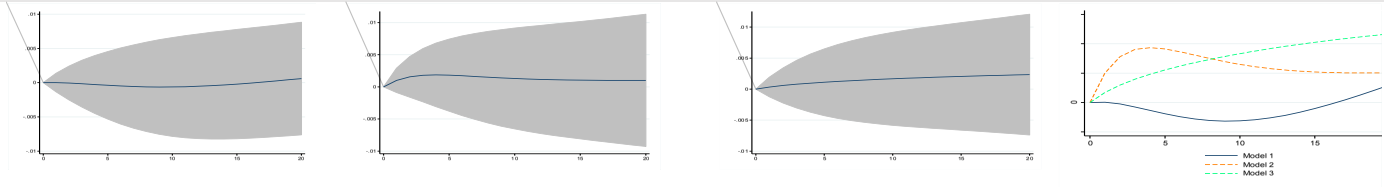


Growth Effects of Fiscal Deficits in Sri Lanka

Mayandy Kesavarajah

Abstract

This study examines the economic growth effects of fiscal deficits in the light of policy debates on the Sri Lankan economy during the period 1970 to 2015. More specifically, the study attempts to answer whether the persistent increase in fiscal deficit in Sri Lanka hindered or supported economic growth during the period under review. If it is concluded that economic growth has been negatively affected by fiscal deficits, then the deficits targeting within the Sri Lankan economy becomes extremely important. On the contrary, if fiscal deficits have positively contributed to economic growth, then controlling the size of fiscal deficits becomes expensive in terms of economic development. The empirical evidence in this study confirms that fiscal deficits had an adverse impact on the output growth of the Sri Lankan economy, implying that policy makers needed to control high levels of fiscal deficits to attain the desired levels of growth. The findings further confirm the neoclassical view, which indicates that an increase in fiscal deficits would reduce economic growth, as in the context of the Sri Lankan economy. Moreover, the results reinforce the argument in favour of expeditiously implementing effective strategies for deficit reduction.

Key Words: *Fiscal deficits, Economic growth and Sri Lanka*

JEL Classification*: E62, O47*

1. Introduction

It is well established in the macroeconomic literatures that maintaining macroeconomic stability is an essential prerequisite for robust and sustainable economic growth. Policy uncertainty created by macroeconomic instability affects growth through the volatility of returns on investment and misallocation of resources as price signals become distorted (Fischer, 1993; and Fatas & Mihov, 2013). Although the instruments of fiscal policy are widely used to maintain price stability and achieve better financial management (Jayasundara, 1986), the persistently increasing high levels of fiscal deficit have created several repercussions for maintaining macroeconomic stability and emphasised the importance of managing fiscal sustainability in the economies. As large fiscal deficits reduce aggregate savings and may lead to high inflation, high interest rates and balance of payments pressures, with negative growth consequences, much more attention has been widely given to the impacts of fiscal deficit on growth in both developed and developing economies in the recent past. In the aftermath of the global financial crisis, many countries engaged in fiscal and monetary stimuli to revive their economies. In order to revive the economy, the central banks also sharply lowered policy rates, several of them to zero.

The economic theory highlights that there is a clear association between fiscal deficit and economic growth. An increased fiscal deficit leads to an increase in interest rate, which in turn increases the interest rate and reduces investment, and therefore slows down the growth of capital stock and economic activities. Therefore, when fiscal deficit shows a continuously increasing trend over the period, it can considerably reduce a country's capacity to produce goods and services (Saleh, 2003). Furthermore, an increase in the interest rate would result in an exchange rate appreciation, which in turn would create lower net exports and result in trade deficit and a slowdown in economic activities. However, over the period, the experience in many developing economies suggests that although countries attempted to control its level of fiscal deficit, a reduction in fiscal deficit has not always led to a better economic outcome. In particular, if a reduction in fiscal deficit is achieved by a reduction in expenditure, notably through a reduction in development expenditure rather than by an expansion in revenue collection, the long term impact of such a reduction of fiscal deficit may indeed be negative in terms of output growth, which in turn can hinder the creation of public revenues for financing public expenditure.

There has been considerable research inquiry into the causes and nature of differences in growth rates across countries and regions over time. Even small differences in these growth rates, if cumulated over a long period of time, may have substantial impact on the living standards of the people. Despite considerable research on the subject, cross-country and cross-regional income disparities are on the rise over time. Understanding the causes behind such inequalities is essential to formulate appropriate policies and bring about required institutional changes to spread the benefits of growth processes across regions. Against this background,

one important question refers to the economic consequences of a regime of high and potentially persistent fiscal deficit. While the economic growth rate is likely to have a linear negative impact on the fiscal deficit-to-GDP ratio (a decline in the economic growth rate is, ceteris paribus, associated with an increase in the fiscal deficit-to-GDP ratio), high levels of fiscal deficits are likely to be harmful for growth. Potentially, this effect is non-linear in the sense that it becomes relevant only after a certain threshold has been reached.

The channels through which fiscal deficit can potentially affect economic growth are diverse. Several studies in both developed and developing countries have extensively examined the impacts of fiscal deficit on economic growth through various channels. Many studies have focused on the impacts of fiscal deficit on selected macroeconomic variables such as inflation, economic growth, interest rate, exchange rate, private investment, and current account deficit. Although all these macroeconomic variables are crucial in maintaining macroeconomic stability, it is also noted that these variables do play an important role in determining the output growth as well. Nevertheless, although there is no direct relationship between fiscal deficit and economic growth, the possible growth effects of increasing fiscal deficit need to be examined through its implications on other macroeconomic variables. In the case of Sri Lanka, while some studies (Akram, 2012, Jayawickrama, 2006, Jayawickrama, 2004, de Silva, 1992, Jayasundara, 1986) have described the key features of fiscal policy and/or examined the impact of fiscal policy variables on selected economic and social variables such as inflation, unemployment, poverty and equity, to our knowledge, no previous studies have focused on modeling the impacts of fiscal deficit on economic growth and therefore, the present study is expected to address the gap in the literature. Specifically, this study aims to provide fresh theoretical understandings and empirical evidence on the impacts of fiscal deficit on economic growth in Sri Lanka and thereby seeks to provide insights to policy makers to improve the government finances, which could facilitate to expand economic activities and to preserve macroeconomic stability.

The remainder of the paper is organised as follows. Section Two presents the theoretical and empirical evidence on the relationship between fiscal deficits and economic growth. Section Three analyses the historical pattern of fiscal deficits in Sri Lanka, while data, model and estimation results are reported in Section Four. The final section presents the conclusion of the study.

2. Literature Review

The review of the existing literature highlights both the theoretical and empirical debate on the impact of fiscal deficit on economic growth. Theoretically, there are three major schools

of thought[1] pertaining to the growth effects of fiscal deficit; the neoclassical perspective, the Keynesian perspective, and the Ricardian Equivalence Hypothesis (REH). Fiscal deficit implies a reduction in the level of public saving. According to the neoclassical view, a reduction in national saving can have a negative impact on economic growth if the reduction in government saving is not fully compensated by a rise in private savings. As this could place pressure on domestic interest rates, it can ultimately undermine the level of output in the economy. However, the Keynesian paradigm argued in favour of the positive impacts of fiscal deficit on economic growth through the public expenditure multiplier, which is emphasised as a key policy variable to stimulate growth. More specifically, it asserts that fiscal deficits can enhance savings and investment even when the interest rate rises. This is largely due to the creation of employment opportunities or the utilisation of unutilised human and other resources, which can enhance the productive capacity of the economy. However, at full employment, deficits would lead to crowding out even in the Keynesian paradigm.

The Ricardian equivalence hypothesis advanced by Barro (1989) emphasizes that fiscal deficit is immaterial and claims it is neutral in terms of its impact on growth. It argues that changes between taxes and fiscal deficits do not affect real interest rate, level of investment, and the current account balance. Further, this approach implies that the government's financing decisions do not matter. In this context, the theory emphasizes that policy makers only need to be concerned with the size and composition of public expenditure and revenue to establish the growth effects of fiscal deficits. Considering the importance of these different approaches, some of the relevant empirical studies in this area have been highlighted below.

The theoretical debate has been extended empirically by several studies which have attempted to examine the nexus between the fiscal deficit and economic growth, by using aggregated data. Thus, many empirical literatures on both developed and developing economics has investigated the impact of fiscal deficit on economic activities using various models, including the Vector Auto Regressive (VAR) model. For instance, Vuyyuri et al., (2004), and Buscemi and Yallwe (2012) have explored the case of the India, Fatima et al., (2011) has analyzed the Pakistan economy.

A large number of studies have found positive or negative impacts of fiscal deficit on growth, while few studies have highlighted mixed results. There a number of factors including time dimension, types of countries, types of government administration, the degree of fiscal deficit, and the method of data analysis attributed to various outcomes, in the empirical literature (Rahman, 2012). These contrasting approaches have resulted in many discussions on both developed and developing economies on the role of fiscal deficit in the process of economic

[1] While the neoclassical and Ricardian schools focus on the long run; the Keynesian view focuses on the short run effects.

growth over the period. Considering the importance of these different approaches, relevant empirical studies in this area have been discussed below.

Vuyyuri et al. (2004) examined the relationship between the fiscal deficit of India with other macroeconomic variables such as nominal effective exchange rate, GDP, consumer price index and money supply (M3), using a cointegration approach and Vector Error Correction Models (VECM) over the period 1970 to 2002. The author concludes that there is a bi-directional causality between fiscal deficit and nominal effective exchange rates. However, the study did not find any significant relationship between fiscal deficit and other variables namely GDP, money supply and consumer price index. In addition, the researcher found despite the fiscal deficit was Granger caused by GDP, but the fiscal deficit did not have any reciprocal relationship.

Buscemi and Yallwe (2012) analysed the effects of fiscal deficit on the sustainability of economic growth for three emerging countries: China, India and South Africa, using the reduced form of Generalized Method of Moment's (GMM) method for dynamic panel data over the period 1990-2009. They found that the coefficients for fiscal deficit results are significant and positively correlated to economic growth. Bose et al. (2007) also found similar results using panel data for the period 1970 to 1990, for 30 developing countries. They suggested that fiscal deficit had a positive impact on the growth rate and highlighted that it was mainly as a result of increased productive expenditure such as education, health and capital expenditure.

However, some of the studies in this field have cited the negative impacts of fiscal deficit on economic growth. Fatima et al. (2011) studied the impact of government fiscal deficit on investment and economic growth using time series data from 1980 and 2009, in Pakistan. The study showed the negative impacts of fiscal deficit on economic growth. They also found that fiscal deficit creates many problems such as high levels of inflation, current account deficit, and high level of debt in the economy. Fatima et al (2012) again investigated the impact of the fiscal deficit on economic growth in Pakistan using time series data over the period 1978 to 2009. The findings showed a negative impact of fiscal deficit on economic growth and suggested that the government avoid certain levels of the fiscal deficit to achieve the desired level of economic growth. Huynh (2007) concluded a negative impact of fiscal deficit on the GDP growth by analyzing the trends in budget deficit and economic growth in Vietnam over the period of 1990 to 2006. A study conducted by the International Monetary Fund (IMF) during the mid-1980s on a group of developing countries also concluded that countries with high fiscal deficit had significantly lower economic growth than countries with low to medium fiscal deficits.

Similarly, Rahman (2012) examined the relationship between fiscal deficit and economic growth in Malaysia by employing quarterly data over the period 2000 to 2011. Although the author found that there was no long term relationship between fiscal deficit and growth, which

is consistent with the Ricardian equivalence hypothesis,[2] he showed that expenditure had a positive and significant impact on long term growth. Similarly, Fatima et al. (2011) also examined the impact of government fiscal deficit on investment and economic growth in Pakistan using time series data over the period 1980 to 2009. The study found that increasing fiscal deficit has undermined the growth objectives and thereby adversely affected the physical and social infrastructure within the economy.

Keho (2010) investigated the causal relationship between fiscal deficit and economic growth in the seven member countries of the West African Economic and Monetary Union using time series data. The empirical evidence showed mixed results. In three cases, the study did not find any causality between fiscal deficit and growth. However, in the remaining four countries, the author found that deficits had adverse effects on economic growth. These findings led to support the budgetary rule, aiming at obtaining positive total budget surplus as a prerequisite for sustainable growth and real convergence within the monetary union.

Vazquez and Rider (2006) examined the effects of fiscal decentralization for two fast growing emerging economies namely, India and China and the study concluded that neither country is fully using the potential of fiscal decentralization to improve allocation of resources and attain their growth potentials. Although both countries experience high rates of growth, the pace and the quality of the growth could have been even higher if appropriate fiscal reforms were undertaken in their inter-governmental fiscal systems.

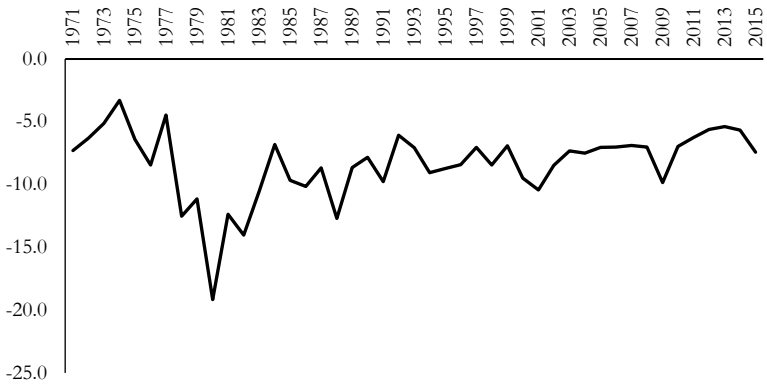
3. Historical Patterns of Fiscal Deficits in Sri Lanka

Fiscal deficits in Sri Lanka rose significantly over the past decades and this trend was generally accompanied by an expansion in the size of the government. The government's budget is primarily used as a mean of mobilizing resources to promote economic growth, as a mean of attaining social welfare objectives and as an instrument of demand management policies (Jayasundara, 1986). In this regard, fiscal deficit refers to the excess of the public sector's spending over its revenue. According to Jhingan (2002), the phrase "deficit financing" is used to mean any public expenditure that is in excess of current revenues. Similarly, fiscal capacity determines a country's ability "to finance larger fiscal deficits without creating any problem for macroeconomic stability and debt sustainability" (World Bank, 2009). However, a continually increasing high level of fiscal deficit in a developing economy like Sri Lanka would create a severe issue in maintaining macroeconomic stability. Moreover, a higher level of fiscal deficits implies the requirements of high government borrowing and high debt servicing, which in turn can place pressure on the government to reduce its expenditure on certain sectors such as health, education and infrastructure in order to control the increasing fiscal

[2] Ricardian equivalence hypothesis claimed that there is neutral relationship between budget deficit and economic growth.

deficit and to maintain internal stability. However, it is also noted that a reduction in these expenditures can reduce the level of human as well as physical capital in an economy which can positively contribute towards the long term growth rate.

Figure 1: Fiscal Deficit in Sri Lanka (Percentage of GDP)



Source: Central Bank of Sri Lanka

The Figure 1 above presents the trend of fiscal balance as a percentage of GDP during the period 1970 to 2015 in Sri Lanka. Despite the country having experienced a positive fiscal balance during the 1950s, the economy was marked by a significant change in its fiscal activities with the increasingly negative trend of revenue and expenditure following the economic liberalisation, As a result of high levels expenditure resulting in expenditure revenue gaps, fiscal balance has remained highly volatile under the period reviewed in this study.

Reinhart and Rogoff (2010) argue that war debts may be less problematic for future growth, partly because the high war-time government spending comes to a halt as peace returns, while peacetime debt explosions may persist for longer periods of time. The accumulation of government fiscal deficit during 1983-2008 was mainly in relation to the war. A large fiscal deficit took place in 1980, which was 19.2 per cent of GDP and then it gradually decreased to 6.8 per cent in 1984. However, this positive tendency appeared temporary and the fiscal deficit to GDP ratio moved slowly up in the succeeding years, to 9.7 per cent in 1985 and 12.7 per cent in 1988. The significant increase in fiscal deficit was mainly driven by decreased government revenue[3] and increased public expenditure, especially on food subsidy and defense. Further, a sharp increase is noted after the mid-1980s as a consequence of the massive increase in public expenditure on infrastructure during the initial stage of trade liberalisation. However, the most noticeable trend persisting over the recent five years has been a decline in

[3] This can be due to narrow tax base and inefficiency of tax collection in Sri Lanka.

total fiscal deficit as percentage of GDP, which decreased from 10.4 percent in 2001 to7.0 per cent in 2010 and then decreased again to 5.4 per cent in 2013. Improvement in both revenue and expenditure contributed to this noteworthy achievement. Government revenue exceeded the target, while expenditure was maintained within the original budgetary allocation, narrowing the government's gap and reducing the government's financing requirements (CBSL, 2010). Therefore, in recent years, Sri Lanka has experienced fiscal deficits ranging from 6 per cent to 9 per cent of GDP between 2006 and 2015. Although the fiscal deficit declined to around 7.4 per cent of GDP in 2015, it is still considered to be a major issue faced by the economy in maintaining its macroeconomic stability.[4] Hence, a significant rise in government revenues is necessary to maintain fiscal sustainability and achieve the government's economic targets.

The objective of government financing is to mobilize financial resources, taking into account elements of cost and risk as well as any macroeconomic and monetary implications (Montfort-Mlachila et al., 2002). Further, the impact of fiscal deficit on economic growth is theoretically explained through the effect of fiscal deficit on the flow of money into the economy and through the supply side.[5] The more government expenditure exceeds revenue the more money will be circulated in the economy, which leads to higher employment and output (McCandless, 1991). On the other hand, the larger amount of public borrowing can also crowd out private investment. Nevertheless, issues arise when a government needs to finance its fiscal deficit, which has been generated as a result of current expenditure rather than the capital expenditure.

While an economy can finance its fiscal deficit through domestic as well as foreign sources, these could generate negative consequences on other macroeconomic variables. For instance, fiscal deficit, which is financed by the Central Bank, can lead to inefficiencies in financial markets and can cause high inflation[6] in the economy (Shojai, 1999); on the other hand, bond financing of fiscal deficit can lead to a rise in interest rates, which in turn can crowd out private investment. Furthermore, increasing fiscal deficits can also distort the real exchange rate, which in turn undermines the international competitiveness of the economy and thereby generates external imbalances. Hence, the problems arise when the deficit level becomes too high and there is a persistent need to finance it.

[4] High fiscal deficit has increased aggregate demand results an inflationary pressures and higher external current account deficits.

[5] Fiscal deficit used for creating infrastructure and human capital will have a different impact than if it is used for financing targeted subsidies and recurrent expenditure.

[6] However, government expenditure on productive development projects in developing countries will not create inflationary situation in the economy since it can be assumed this projects generates greater output in the economy and in turn leads to lower the price level (Rao, 1953).

4 Empirical Model, Data and Methodology

This study uses time series annual data over the period from 1970 to 2015. All the data used in this study have been obtained from various issues of the annual report of the Central Bank of Sri Lanka. The empirical growth model used in this study is based on a conditional convergence equation,[7] which indicates that the GDP growth rate depends on the initial level of income per capita, the investment-to-GDP rate and the population growth rate. However, as the present study mainly attempts to examine the impact of fiscal deficits on growth, the above convergence model was augmented to include the level of fiscal deficit (as a share of GDP) and other related variables. Other control variables that were included into the growth equation were the long-term real interest rate (to capture the impact of inflation and the effects of the fiscal-monetary policy mix), indicators for the openness[8] of the economy. This would help to expand the model beyond a closed-economy.

The basic estimation equation is as follows:

$$g_{it+k} = \alpha_0 + \alpha_1 \ln PCGDP_{it} + \alpha_2 FD_{it} + \alpha_3 FD^2{}_{it} + \alpha_4 GCF_{it} + \alpha_2 POG_{it} + \alpha_3 OPP_{it} + \alpha_4 LIR_{it} + \varepsilon_{it} \ldots . (1)$$

The above equation measures the direct effect of fiscal deficits on economic growth. In general, most of the time series variables are nonstationary, containing a unit root. A standard regression with nonstationary data can lead to the problem of spuriousness, which can occur when two time series variables in a regression are highly correlated although there is no actual relationship between them. High correlation is due to the existence of a time trend in both time series variables. In an attempt to avoid the spurious problem, the difference of the variables has to be included for the cointegration analysis.

[7] Convergence refers to the process by which relatively poorer regions or countries grow faster than their rich counterparts. Conditional convergence implies that a country or a region is converging to its own steady state.

[8] The sum of export and import shares in GDP.

Table 1: Data Description and Sources

Variable Abbreviation	Variable Description	Source
EG	Growth rate of GDP	CBSL
$PCGDP$	Natural logarithm of the level of GDP per capita	CBSL
FD	Fiscal deficits as a share of GDP	CBSL
GDCF	Gross domestic capital formation as a share of GDP	CBSL
POG	Population growth rate	CBSL
OPP	Openness (Sum of exports and imports (% of GDP))	CBSL
LIR	Long term interest rate	CBSL
PCR	Private Sector Credit (percent of GDP)	CBSL
ε_{it}	Error term	

Note: Central Bank of Sri Lanka (CBSL)

The first step for cointegration test is to examine the stationery properties of all the variables. The Augmented Dickey Fuller (ADF) and Phillips Perron (PP) tests are employed to examine the order of integration of each time series variable. The unit root test was conducted both for the levels and the first difference of each series. Meanwhile, the Johanson and Juseliues (1990) method was used to examine the long run relationship among the variables selected in this study. The impulse response function was used to examine the dynamics of the selected variables in response to various shocks. Furthermore, the Granger causality test was used to determine whether one time series is useful in forecasting another. The optimal lag length that was selected in this study was based on lag order selection criteria (AIC or SBC) that minimize the overall sum of squared residuals or maximizes the likelihood ratio. The descriptive statistics of the variables used in this study are given in Appendix Table A1.

5 Results and Discussion

5.1 Impact of Fiscal Deficits on Economic Growth

This section investigates the direct impact of fiscal deficits on economic growth in Sri Lanka covering the period 1970-2015, employing annual time series data published in the various annual reports of the Central bank of Sri Lanka. Further, the unit root test results are provided in Appendix Table A2.

Table 2: VAR Lag Order Selection Criteria[9]

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-617.6300	NA	19520.32	29.74429	30.03390	29.85044
1	-461.9683	252.0238*	125.5855	24.66516	26.98205*	25.51439
2	-416.1214	58.94603	177.8009	24.81530	29.15948	26.40761
3	-350.8009	62.20998	145.7248	24.03814	30.40959	26.37353
4	-263.4270	54.08861	95.88180*	22.21081*	30.60955	25.28928*

Note: * indicates lag order selected by the criterion

Table 2 presents the results of VAR lag order selection criteria. According to the Sequential modified LR test statistic (LR), Final Prediction Error (FPE), Akaike Information Criterion (AIC), Schwarz Information Criterion (SC), and Hannan-Quinn information criterion (HQ) suggest that the optimum lag order for VAR in this model is four. Therefore the subsequent analyses in this study were based on four lags.[10]

Table 3: Johansen Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.795973	178.7523	125.6154	0.0000
At most 1 *	0.613018	110.4036	95.75366	0.0034
At most 2	0.472546	69.58042	69.81889	0.0522
At most 3	0.397230	42.07356	47.85613	0.1567
At most 4	0.291797	20.30612	29.79707	0.4023
At most 5	0.104193	5.470087	15.49471	0.7570
At most 6	0.017035	0.738804	3.841466	0.3900

Note: Trace test indicates 2 cointegrating equations at the 0.05 level, * denotes rejection of the hypothesis at the 0.05 level, **MacKinnon-Haug-Michelis (1999) p-values

[9] The endogenous variables considered in this study to examine the optimal lag are economic growth rate, fiscal deficit as a percentage of GDP, private sector credit as a percentage of GDP, population growth rate, openness, investment as a percent of GDP and long term interest rate.

[10] Since the number of observations in the time series was 46, with the purpose of avoiding the degrees of freedom problem the maximum number of lags was selected as four in the study.

Table 4: Johansen Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.795973	68.34870	46.23142	0.0001
At most 1 *	0.613018	40.82322	40.07757	0.0411
At most 2	0.472546	27.50686	33.87687	0.2372
At most 3	0.397230	21.76744	27.58434	0.2325
At most 4	0.291797	14.83603	21.13162	0.3005
At most 5	0.104193	4.731283	14.26460	0.7753
At most 6	0.017035	0.738804	3.841466	0.3900

Note: Max-eigenvalue test indicates 2 cointegrating equations at the 0.05 level, * denotes rejection of the hypothesis at the 0.05 level, **MacKinnon-Haug-Michelis (1999) p-values

The trace statistic and maximum Eigen value given in Tables 3 and 4 suggest that there exist at least 1 cointegrating vector among the seven variables considered in equation 1. The findings of this cointegrating vector imply that there exists a stable long-run equilibrium relationship between the economic growth, investment, fiscal deficits, long term interest rate, openness and growth rate of the population during 1970 to 2015 in the Sri Lankan economy.

Table 5: Estimated Long Run Equation

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-12.9719	8.10504	-1.60048	0.1178
PCGDP	0.75795	0.58719	1.29080	0.2046
FD	-0.13005	0.46396	-0.28029	0.7808
FD^2	-0.01646	0.02273	-0.72403	0.4735
GCF	0.24999***	0.08274	3.02129	0.0045
POG	0.76749*	0.39104	1.96269	0.0570
OPP	1.02604	0.64912	1.58066	0.1222
LIR	0.10216	0.07169	1.42519	0.1623
R-squared	0.42401	Mean dependent var		4.83695
S.E. of regression	1.69232	Akaike info criterion		4.04686
Sum squared resid	108.831	Schwarz criterion		4.36488
Log likelihood	-85.0777	F-statistic		3.99623
Durbin-Watson stat	1.86831	Prob(F-statistic)		0.00229
Method	Least Squares	Included observations		46

Dependent Variable: Growth Rate of GDP.

Note: *, **, and *** imply the significance at 10%, 5% and 1% respectively.

As summarised in Table 5, we find that the annual change in the gross domestic capital formation (investment) is statistically significant and positively associated with the economic growth. This implies that investment plays an important role in expanding economic activities in the Sri Lankan economy. Meanwhile, the study also finds that the population growth in Sri Lanka has a positive and statistically significant impact on the output growth. Turning to the fiscal deficits variable, somewhat surprisingly, no direct and significant impact of fiscal deficits, on economic growth is found; rather the impact may be indirect through the channel of long term interest rates. Increased deficits may increase interest rates and thus slow down economic growth. At the initial analysis, as the usage of fiscal deficits in a linear form does not yield significant results, we used a quadratic equation in fiscal deficits which would help to understand whether there exists a non-linear impact of fiscal deficits on growth. However, a nonlinear relationship between fiscal deficits and economic growth cannot be identified from the above results. Although the estimations of the long run regression demonstrates that the impact of fiscal deficits on growth is insignificant, the impulse response function and Granger causality test could be used to examine the possible impact of fiscal deficits on growth.

5.2 Temporary Shocks to Fiscal Deficits

While the economic growth rate is likely to have a linear negative impact on the fiscal deficits-to-GDP ratio, high levels of fiscal deficits are also likely to be harmful for economic growth, but potentially after a certain threshold has been reached. From a policy perspective, a negative impact of fiscal deficits on economic growth strengthens the arguments for ambitious deficits reduction through fiscal consolidation. This section seeks to examine this relationship using the impulse response function, which describes the dynamic behavior of the variables. Further, this function exhibits reactions of endogenous variables to shock from error term in equation.

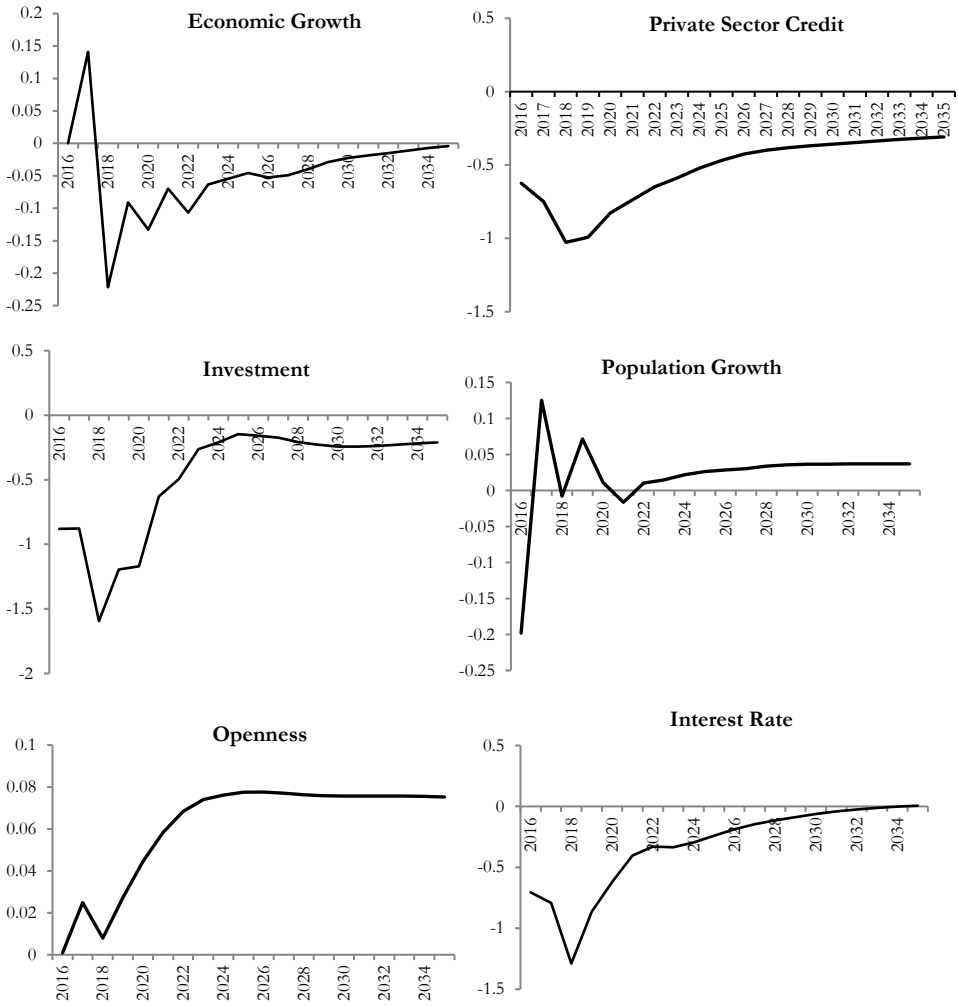
Figure 2 depicts dynamic response functions following a temporary fiscal deficits shock equal to a one-percentage point increase in standard deviation. All dynamic responses are shown as percentage-point deviations from steady state. The behavior of the impulse response functions following a fiscal deficits shock are in line with our expectations. An increase in fiscal deficits generate a negative effect on economic growth. Economic growth increases immediately after the shock and stays negative for a sustained period of time in the medium to long term, although it has a positive impact on growth in the short term. This indicates that an increase in the fiscal deficits as a proportion of GDP decreases economic growth in the case of the Sri Lankan economy. The negative effect of fiscal deficits on economic growth appears to be in line with the neoclassical growth model developed by Solow (1956) and Swan (1956), which indicates that an increase in fiscal deficits would reduce economic growth.

The above negative impacts of fiscal deficits on economic growth in the case of the Sri Lankan economy can be explained from two channels. First, this might be as a result of increases in unproductive expenditure such as defense, subsidy and interest payments in the economy.

Secondly, this may be as a result of an impact of fiscal deficits on other macroeconomic variables such as interest rate, inflation and exchange rate. The negative effects of fiscal deficits on economic growth could be partly due to the nature of financing mechanisms adopted by the government to fulfill its deficits and financing requirements during the period under review, which is dominated by domestic sources especially from market and non-market borrowings. Thus, the findings suggest that the government should avoid high levels of fiscal deficits in order to achieve the desired level of growth. However, since the scope of this study is limited only to fiscal deficits and economic growth, the findings of this study paves the way to explore the overall effect of fiscal deficits on all other variables in the future. This model-based finding runs somewhat counter to Eisner and Pieper is (1987), finding regarding the positive impact of fiscal deficits on economic growth in the United States and other OECD countries. However, the findings of this study seems consistent with some other studies such as Fatima et al. (2011) who find negative impacts of fiscal deficits on economic growth, and show that fiscal deficits create many macroeconomic problems in the economy, such as high levels of inflation, current account deficits, and high level of debt which hinder the expansion of economic activities. The behavior of the rest of the impulse response functions also accord well with intuition.

Although our main objective is to identify the impact of fiscal deficits on economic growth, the analysis on the response of economic growth following temporary shocks in macroeconomic aggregates would provide some insights with regard to the nexus among the variables considered in this study. The literature on the macroeconomic impacts of various shocks on economic growth is relatively scarce in the case of the Sri Lankan economy and therefore discussion on the impacts of macroeconomic variables on economic growth can also provide a useful benchmark for future analysis in this area.

Figure 2: Dynamic Responses to Fiscal Deficits Shock



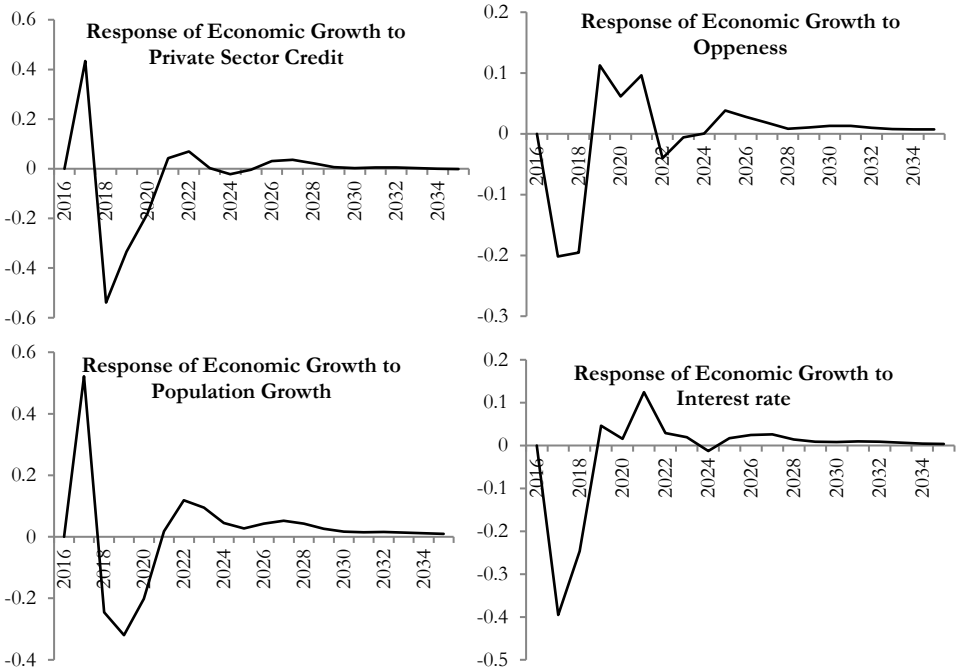
Source: Authors' Calculation

Note: All dynamic responses are reported as percentage point deviations from steady state

Figure 3 depicts dynamic response functions following a temporary shock, equal to a one-percentage point increase in steady state output on selected variables considered in this study. All dynamic responses are shown as percentage-point deviations from steady state. A positive impulse in private sector credit determines a small increase of economic growth in the short term. However, in the medium it tends to move towards the negative and takes about five years to reach the steady state level. Meanwhile, it is found that the effect on economic growth

in response to a monetary policy shock, indicated by increased long term interest rates, temporarily move downward in the short term and, however, it takes about four years to reach its steady state level and then it has a positive impact on the output growth in the medium term. Meanwhile, the decline in interest rates following the fiscal deficits shock has important qualitative and quantitative implications for the behavior of the rest of the variables in the model.

Figure 3: Dynamic Responses to Selected Shocks (per cent deviation from baseline)



Source: Authors' Calculation

Note: All dynamic responses are reported as percentage point deviations from steady state.

Meanwhile, the Granger causality test was also conducted with the view to examine the lead-lag relationship among the variables considered in this study. The results are reported in Appendix Table A4. The estimated results indicate that the null hypothesis of "Fiscal deficits do not Granger cause economic growth" cannot be rejected even at 10 per cent level of significance in all three lags considered in this study. At the same time, all other variables are not found to be Granger causing economic growth in pairs and jointly. Therefore, the empirical results derived from the Granger causality test do not reveal any causality between economic growth and the determinants. However, this study could be further extended by considering the composition of financing sources more intensively, which can help policy

makers gain a deeper understanding about the relationship between fiscal deficits and economic growth.

6 Conclusion

This paper examined the impact of fiscal deficits on growth in the small open economy of Sri Lanka over the period 1970 to 2015. Empirical evidence based on the impulse response function showed that the response of output in the long run with regard to an increase in fiscal deficits shock is negative. This demonstrates that the increased fiscal deficits, which had undermined the growth prospects while putting an additional burden on fiscal sustainability, had a significant and long term impact on growth, implying that policy makers avoid high levels of fiscal deficits in order to achieve desired levels of growth. The study also confirms the existence of the neoclassical view in the context of the Sri Lankan economy. Moreover, the results led to an additional argument in favour of expeditiously implementing ambitious strategies for deficits reduction. However, the key issue is the response of private investment to a change in the fiscal deficits. If private investment rises by the same amount as fiscal deficits rise, then there is no change in national saving and no further adjustments would be required. Further, while revenue measures should focus on minimizing distortions, expenditure reforms should primarily address inefficiencies in spending. Such policies would not only provide fiscal space, but also contribute directly to medium to long term growth.

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Appendix

Table A2: Descriptive Statistics

	EG	FD	LIR	GDCF	OPP	POG	PCR
Mean	4.8369	-8.2964	11.4367	24.7239	1.9983	1.1776	20.7611
Median	4.9500	-7.4572	11.0400	24.7500	1.3767	1.3396	22.5218
Maximum	9.1000	-3.2939	21.3000	39.1000	5.3461	2.3506	29.1573
Minimum	-1.5000	-19.1591	4.7600	13.7000	0.2632	-2.1323	8.9927
Std. Dev.	2.0491	2.7780	4.8281	5.5064	1.6531	0.7704	5.7888
Skewness	-0.5213	-1.4871	0.2993	0.0466	0.7992	-2.6657	-0.9029
Kurtosis	4.0695	6.6163	1.9233	2.9827	2.1347	11.8810	2.7645
Jarque-Bera	4.2760	42.0209	2.9087	0.0172	6.3320	205.6557	6.3571
Probability	0.1178	0.0000	0.2335	0.9913	0.0421	0.0000	0.0416
Sum	222.50	-381.63	526.09	1137.30	91.92	54.17	955.01
Sum Sq. Dev.	188.94	347.28	1048.98	1364.46	122.97	26.711	1507.98
Observations	46	46	46	46	46	46	46

Table A3: Unit Root Test Results

Variable	Indicator	ADF		PP	
		Level	1st Difference	Level	1st Difference
EG	Statistic	-2.6405	-6.2759	-2.6248	-6.2758
	P-Value	0.4832	0.0004	0.5234	0.0002
PCGDP	Statistic	0.2425	-2.3743	-3.1903	-5.7689
	P-Value	0.9976	0.0095	1.0000	0.0001
FD	Statistic	-5.6049	-4.2268	-3.9809	-10.8245
	P-Value	0.0003	0.0095	0.0161	0.0000
LIR	Statistic	-1.2825	-3.4425	-1.9394	-11.3463
	P-Value	0.8763	0.0615	0.6175	0.0000
GDCF	Statistic	-3.3827	-4.6628	-2.7336	-7.5005
	P-Value	0.0671	0.0035	0.2287	0.0000
OPP	Statistic	-4.2398	-3.6838	-1.6216	-7.0459
	P-Value	0.0097	0.0369	0.7685	0.0000
POG	Statistic	-6.0473	-5.3151	-7.0489	-29.1445
	P-Value	0.0000	0.0006	0.0000	0.0000
PCR	Statistic	-2.6119	-4.3149	-2.0836	-4.0352
	P-Value	0.2772	0.0072	0.5406	0.0145

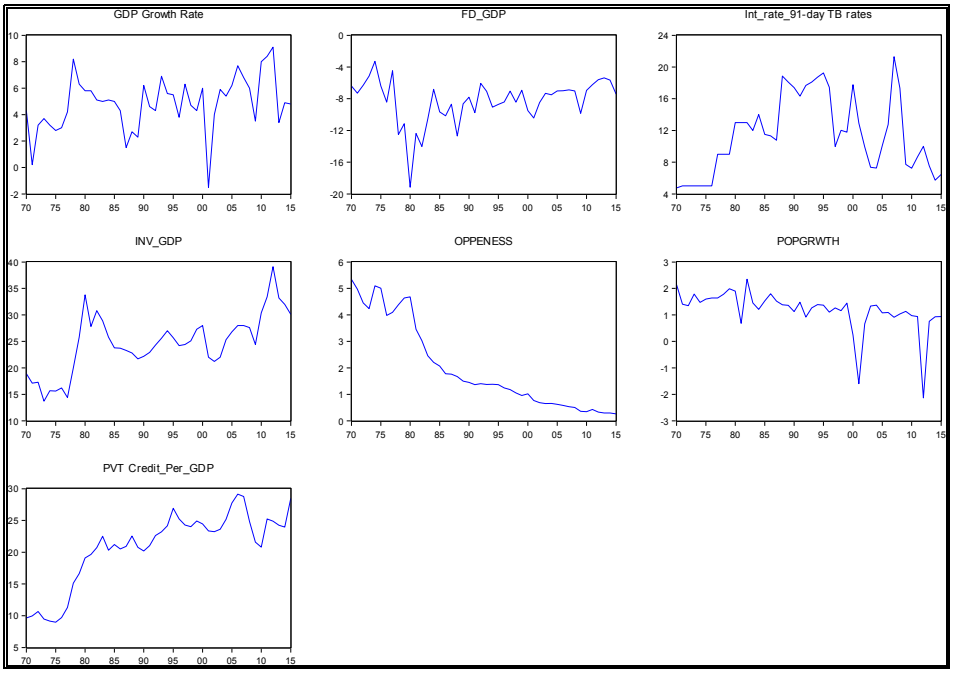
Note: Critical values are taken from MacKinnon, 1991

Table A4: Pair-wise Granger Causality Testing

Hypothesis	Lag 4		Lag 3		Lag 4	
	F-Statistic	Prob.	F-Statistic	Prob.	F-Statistic	Prob.
FD does not Granger Cause EG	1.1414	0.3542	0.7365	0.5371	1.1840	0.3168
EG does not Granger Cause FD	0.5137	0.7260	0.3645	0.7790	0.5275	0.5942
LIR does not Granger Cause EG	1.0010	0.4210	0.8058	0.4989	1.1794	0.3182
EG does not Granger Cause LIR	0.2859	0.8850	0.1884	0.9036	0.0844	0.9192
GDCF does not Granger Cause EG	0.0551	0.9941	0.0254	0.9944	0.0260	0.9743
EG does not Granger Cause GDCF	1.6463	0.1860	2.7279	0.0582	4.8547	0.0131
OPP does not Granger Cause EG	0.4352	0.7821	0.3612	0.7813	0.2986	0.7435
EG does not Granger Cause OPP	1.9484	0.1256	2.8738	0.0496	0.5593	0.5761
POG does not Granger Cause EG	0.7131	0.5889	0.7180	0.5477	1.1740	0.3198
EG does not Granger Cause POG	0.7223	0.5829	0.9832	0.4115	1.5354	0.2281
PCR does not Granger Cause EG	0.8512	0.5032	1.2269	0.3140	0.9268	0.4044
EG does not Granger Cause PCR	0.1490	0.9621	0.2365	0.8703	0.3485	0.7079
LIR does not Granger Cause FD	0.6063	0.6609	0.4977	0.6862	0.1456	0.8649
FD does not Granger Cause LIR	0.7302	0.5778	0.6697	0.5762	0.8567	0.4324
GDCF does not Granger Cause FD	0.4799	0.7502	0.7798	0.5130	0.9053	0.4127
FD does not Granger Cause GDCF	0.9155	0.4665	0.6425	0.5927	1.0942	0.3449
OPP does not Granger Cause FD	2.7191	0.0463	4.6429	0.0076	7.2106	0.0022
FD does not Granger Cause OPP	8.4343	0.0001	8.2124	0.0003	5.1087	0.0107
POG does not Granger Cause FD	0.7279	0.5793	0.7559	0.5262	0.8484	0.4358
FD does not Granger Cause POG	0.7792	0.5467	0.8263	0.4881	0.7612	0.4739
PCR does not Granger Cause FD	1.1217	0.3630	0.5571	0.6467	0.3235	0.7255
FD does not Granger Cause PCR	0.5006	0.7354	0.3553	0.7855	0.3193	0.7285
GDCF does not Granger Cause LIR	0.5628	0.6912	1.0862	0.3673	0.9179	0.4078
LIR does not Granger Cause GDCF	1.4490	0.2400	2.6215	0.0655	1.4116	0.2559
OPP does not Granger Cause LIR	0.2459	0.9100	0.0715	0.9748	0.1215	0.8859
LIR does not Granger Cause OPP	0.5855	0.6753	0.8148	0.4941	0.7070	0.4993
POG does not Granger Cause LIR	1.2314	0.3165	1.5159	0.2269	2.2362	0.1204
LIR does not Granger Cause POG	1.8189	0.1487	0.8314	0.4854	0.9967	0.3783
PCR does not Granger Cause LIR	1.8505	0.1427	3.6092	0.0224	6.0325	0.0052
LIR does not Granger Cause PCR	2.7177	0.0464	4.0666	0.0138	2.2545	0.1184
OPP does not Granger Cause GDCF	0.3024	0.8742	1.2444	0.3079	0.8917	0.4181
GDCF does not Granger Cause OPP	3.8990	0.0106	5.0109	0.0053	5.5880	0.0073
POG does not Granger Cause GDCF	0.7155	0.5873	1.4532	0.2435	1.0208	0.3697
GDCF does not Granger Cause POG	2.4762	0.0633	2.5672	0.0696	3.5243	0.0392
PCR does not Granger Cause GDCF	0.8128	0.5261	1.5035	0.2301	1.2150	0.3077
GDCF does not Granger Cause PCR	1.4870	0.2285	1.3028	0.2884	0.9480	0.3962
POG does not Granger Cause OPP	0.1484	0.9624	0.2313	0.8740	0.0861	0.9176
OPP does not Granger Cause POG	1.7526	0.1620	2.7663	0.0558	4.3086	0.0204
PCR does not Granger Cause OPP	5.2076	0.0023	6.6531	0.0011	4.7781	0.0139
OPP does not Granger Cause PCR	1.6105	0.1949	1.1663	0.3360	2.2162	0.1226
PCR does not Granger Cause POG	2.69515	0.0477	3.3167	0.0306	3.5310	0.0390
POG does not Granger Cause PCR	1.82621	0.1473	1.7629	0.1717	0.3650	0.6965

Note: Critical values are taken from MacKinnon, 1991

Figure A1: Behaviours of the Variables



An Investigation on Factors affecting Exchange Rate Fluctuations in Sri Lanka

S.H.I Rajakaruna

Abstract

This article examines the factors that affect exchange rate fluctuations in Sri Lanka. It attempts to identify how the changes in inflation, interest rates, terms of trade, Net Foreign Purchases (a proxy for Net Capital Inflows), official intervention and remittances affect the fluctuations in Sri Lanka's exchange rate. There are two specific objectives, which are identifying the relationship between the factors and the exchange rate fluctuations, and investigating the impact of the factors on the exchange rate. The Multiple Regression Model has been used to analyse the results, with monthly data, for the period 2001 to 2010. The Vector Auto Regression Model has been used an alternative specification to this model. Results obtained by the Multiple Regression model suggest that net official intervention is the most effective and significant determinant of the exchange rate during the sample period. Inflation and net foreign purchases (as a proxy for Net Capital Inflows) are reduced to be less effective and non-significant determinants of the exchange rate. However, it can be seen that there is a direct link between the two determinants of net official intervention and net foreign purchases. A negative relationship exists between the exchange rate and inflation, interest rate, remittances, and terms of trade, whereas a positive relationship exists between the exchange rate and net foreign purchases. According to the estimation results of the Vector Auto Regression model, net official intervention, net foreign purchases and call money rate cause the most fluctuations in the exchange rate.

1. Introduction

The exchange rate of a country's currency is the value of its money for international trade in goods, services and finance. Therefore, it is part and parcel of the monetary condition of a country. Hence, the central banks, being the monetary authorities, have been given discretionary powers under the relevant statutes to manage the exchange rate as part of its monetary, financial and economic development policies. From a macroeconomic perspective, exchange rate policy is instrumental in the mobilization of foreign savings and capital, to fill the domestic resource gap and expand investments. Various public views are often expressed as to how the central banks should manage the exchange rate and what factors should be taken into consideration.

The changes in exchange rates will have both favorable and unfavorable impacts on economic activities and living standard of the public because of the largely globalized trade and finance involving the exchange of currencies. In general, appreciation of a country's currency will have the following effects, whereas depreciation will have the opposite effects:

- Lowering the domestic prices of imports because the cost of imports in the domestic currency will be less due to the higher value of the domestic currency. As a result, inflation will be lower, depending on the extent of the imports in domestic consumption and production activities.
- The Country's outstanding foreign debt equivalent of domestic currency will be lower and, therefore, the burden on foreign debt repayment will be less.
- One unfavorable effect will be that the lower import prices will encourage imports and worsen the country's trade balance (net position between exports and imports).
- Another unfavorable effect will be that exporters will be discouraged by the reduction in their income in domestic currency, which will adversely affect the export industries. However, if domestic inflation will be lower due to reduced import prices, there will be higher foreign demand for exports, which will off-set the initial reduction in exporters' income.

As described below in the Literature Review, about ninety per cent of the studies (both internationally and locally) have used the following factors on exchange rate determinants, differentials in inflation, differentials in interest rate, current account deficit, public debt, terms of trade, political stability and economic performance and stock market. In many of the Sri Lankan studies mentioned, they have examined a particular issue. In other words, they have done a partial study of the exchange rate determinants.

Hence this paper attempts to fulfil that research gap and conducts a comprehensive study for the period 2001-2010 using interest rates, terms of trade, and capital inflows as the key exchange rate determinants in order to understand the relationship of these variables with the exchange rate. Especially, this paper examines the impact of capital inflows on the exchange rate, as the capital account was substantially liberalized during the year 2010.

The proposed empirical study will be deductive in nature, where well recognized theories will be tested using empirical data relating to Sri Lanka (2001-2010). Secondary data which are available at the Central Bank of Sri Lanka and IMF will be used for the empirical analysis. I intend to use different estimation methods to obtain outcomes such as Unit-root test, lag selection criteria, Impulse Response and Variance decomposition test, Vector Auto Regression and OLS method.

The study attempts to suggest a suitable regression line to determine the relationship between the factors and the exchange rate.

(i.e. Exchange Rate = β_0 + β_1 Interest Rate + β2 Inflation + β3 Balance of Trade + β4 net foreign purchases + β5 official intervention + β6 remittances + U)

The remainder of the paper is organized as follows. In Section 2, the literature on exchange rate determinants will be reviewed. In Section 3, the exchange rate policy in Sri Lanka will be described. In Section 4, the theoretical foundation relating to the study will be examined. The next section deals with the analytical framework, namely, the econometric models used for assessing the determinants of the exchange rate in Sri Lanka. The data employed to estimate these models will also be discussed in this section. Section 6 presents the preview of the data and Section 7 explains the findings in comparison with the findings of other researchers, who have studied the determinants of exchange rate in other countries. The final Section presents the conclusions of the study, limitations as well as recommendations for future research.

2. Literature Survey

Simone and Razzak (1999) have examined some unsettled theoretical and empirical issues regarding the relationship between nominal exchange rates and interest rate differentials and provide a model for the behavior of exchange rate in the long run, where interest rates are determined in the bond market. The model predicts that an increase in the differential appreciates the home currency. They have tested the model for the U. S. Dollar against the Deutsche Mark, the British pound, the Japanese yen, and the Canadian dollar. The first two pairs of exchange rates- for which purchasing power parity seems to hold- display a strong relationship with interest rate differentials.

In contrast to the preponderance of developed country studies of the behavior of exchange rates, evidence on the behavior of developing country exchange rates is scarce. Those studies which have examined the determinants of developing country exchange rates have largely focused on Latin America, and have emphasized the role of movements in terms of trade in driving exchange rate movements (see Diaz-Alejandro (1982), and Edwards (1989)). There is also extensive literature for some developed countries that links exogenous movements in terms of trade of commodity-exporting countries and changes in their exchange rates, particularly for commodity exporters in Canada and Australia (see Amano and van Norden (1995) and Gruen and Wilkinson (1994)).

The size of net foreign assets is likely to be associated with a more appreciated exchange rate in the long run. Higher net foreign assets induce larger expenditure on domestic goods, thus raising the price of non-tradables, and appreciating the exchange rate. An alternative mechanism is based on the absence of price equalization of tradables: a country that reaches a higher level of net foreign assets can afford to finance a worse current account balance and can therefore sustain a loss in competitiveness, associated with a more appreciated exchange rate. For a theoretical discussion and empirical evidence, see Lane and Milesi-Ferretti (2000).

Ezirim, and Muoghalu (2006) have used three theories namely, Debt Burden theory, Foreign Direct Investment theory and Contemporary Exchange Rate theory. The methods used in their study are OLS (Ordinary Least Square) Method and EML (Exact Maximum Likelihood) model. The study found clear cut and significant relationships between the three-external sector economic crises. Relatively, foreign investment burden, international oil prices and previous exchange rate conditions are important arguments in explaining current exchange rate crisis in a typical LDC. External debt burden was not found to be a consistent factor contributing to exchange rates crisis in Nigeria. A major imperative of these results is that the observed role of the investment burden was that of putting immense pressures on the exchange rates, and thus aggravating the crisis condition. External debt burden does not have the same magnitude of effect.

Wimalasuriya (2007) has used PPP as the theoretical basis to examine exchange rate pass-through into domestic prices in Sri Lanka. The relevance of the study lies on the fact that domestic price changes due to changes in the exchange rate could be significant in monetary policy decision making. Pass-through is estimated taking two approaches. First, pass-through into import prices is estimated with the use of a Log-Linear Regression Model. The results obtained suggest that exchange rate pass-through into import prices is around fifty per cent, that is, import prices increase by about 0.5 per cent as a result of a 1 per cent depreciation of the Nominal Effective Exchange Rate. Second, taking a Vector Autoregressive approach, exchange rate pass-through into a set of prices in the "pricing chain" is estimated. Namely, exchange rate pass-through to factors input prices, trade prices, wholesale producer prices and

retail consumer prices are examined, with the presumption that changes in the exchange rate are due to shocks exogenous to the model. The results obtained for this model suggest that exchange rate pass-through into consumer prices is about thirty per cent, although pass-through into wholesale producer prices was found to be complete. The findings from the second model further suggest that changes in the exchange rate could have significant implications for the trade balance.

Alawattage (2005) has examined the effectiveness of the exchange rate policy in Sri Lanka in achieving external competitiveness since the liberalization of the economy in 1977. This paper uses the Marshall- Lerner Theory and the conventional two-country trade model that explains the traditional approach to Balance of Payment (BOP) and was applied using quarterly data covering the period of 1978:1 to 2000:4. Results reveal that the Real Effective Exchange Rate (REER) does not have significant impact on improving the Trade Balance (TB) particularly in the short run, implying a blurred J-Curve phenomenon. Even though the co-integration tests reveal that there is a long run relationship between TB and the REER, it shows a very marginal impact in improving TB in the long run.

From the foregone review, we see that nationally the authors have done partial and comprehensive studies on exchange rates. Partial studies have only used one variable and its effect on the exchange rate. Comprehensive studies were mostly related to exchange rate regimes, using past data. However, internationally, authors have done cross sectional data studies using two countries. Further, when choosing the exchange rate determinants, they have taken into account the macro economic situation of that country. Both national and international studies have not used 'Net Capital Inflows' as a variable due to their capital account not being fully liberalized during the time of their study. This article sets out to contribute to knowledge in this area using simple and convenient procedure that would enable useful and reliable conclusions.

3. Exchange Rate Policy in Sri Lanka

Sri Lanka followed the fixed exchange rate system until November 15, 1977. During the period from 1950 to November 15, 1977, the exchange rate for US$ was revised from Rs. 4.76 to Rs. 8.60. Furthermore, the whole world followed the fixed exchange rate system until early 1970s under the Bretton Woods system which was set up by the IMF in 1947. Still, there are many countries that follow the fixed exchange rate system or some variants of it.

During the period from November 16, 1977 to January 22, 2001, Sri Lanka followed the managed floating exchange rate system. US$ was the foreign currency that the Central Bank engaged in transactions with banks and the band was fixed for the exchange rate for US$. During this period, the average of buying and selling rates for US$ was gradually revised from

Rs. 16.00 to Rs. 81.23. Accordingly, the band was increased from Rs. 15.97 (buying rate) and Rs.16.03 (selling rate) to Rs. 77.40 (buying rate) and Rs.85.13 (selling rate). However, due to heavy speculation toward the depreciation of the rupee during the second half of 2000, the CBSL several times revised the selling rate upward while selling a significant amount of US$ reserves.

The floating exchange rate system allows the market forces to determine the exchange rate without direct intervention of the central bank, given any prevailing controls on foreign exchange transactions. Accordingly, the exchange rate is free to fluctuate in response to changes in demand and supply factors. Since the central bank does not have to intervene in the foreign exchange market, it can conduct the monetary policy independently from the balance of payments as long as the exchange rate is free to fluctuate, to clear the imbalances in the foreign exchange market. However, if the exchange rate volatility at any time is considered high, the central bank will intervene in the market by buying or selling foreign exchange to maintain greater stability in the exchange rate. Sri Lanka has been following this system since January 23, 2001.

Finally, the CBSL decided to float the currency with effect from January 23, 2001 and discontinued its buying and selling dollars in the open market. According to some economists, the current exchange rate system is a managed float because the central bank intervenes (buy and sell) in the market to maintain the exchange rate without much volatility. However, the managed float system and the central bank's intervention under the floating rate system to reduce any unhealthy volatility, as decided by the central bank in view of the current macroeconomic circumstances, are completely two different systems of exchange rate management.

As Sri Lanka currently follows a flexible exchange rate regime, the exchange rate of the country is determined by the supply and demand for foreign exchange in the economy. The supply of foreign exchange depends on the inflows to the economy such as export proceeds, workers' remittances, tourist earnings, direct investment flows and foreign loans, while the demand for the same depends on outflows such as import payments and loan repayments. In Sri Lanka, foreign exchange earnings have persistently continued at a lower level than the demand for the same. Accordingly, a current account deficit has been a noticeable feature of the Sri Lankan economy.

4. Theoretical Foundation

General exchange rate equilibrium models include the Mundell- Fleming model, which deals with the equilibrium of the goods market, money market and balance of payments, but lacks micro-foundations to some extent; the Balassa-Samuelson model, which is built on the

maximization of firms profit; the Redux model developed by Obestfeld and Rogoff, the PTM (Pricing to Market) model, a simple monetary model with price flexibility created on the maximization of consumer's utility and the Dornbusch model (or Mundell-Fleming-Dornbusch model). These are actually obtained by combining the monetary equilibrium with the adjustment of price and the adjustment of output toward their long run equilibrium, and can be called hybrids of monetary equilibrium with PPP or UCIRP. The balance of payments is covered in this investigation since many studies regard it as a foundation of equilibrium exchange rate determination.

The basic idea of PPP was initiated by classical economists such as David Ricardo in the 19th century. PPP describes the theory of law of one price for a standard commodity basket applied internationally. According to this theory, the exchange rate between currencies of two countries should be equal to the ratio of price levels of two respective countries.

When the relationship of exchange rate is presented in an equation form, let 'Pr' be the rupee price of the standard commodity basket in Sri Lanka and 'P$' be the dollar price of the same basket in the United States. PPP states that the exchange rate between their rupee and the dollar should be,

$$S=Pr/P\$$$

Where 'S' is the rupee value of one dollar. The basic concept is that as a currency, it should be able to buy the same bundle of goods in the home country or abroad. In addition, to give an alternative approach to the PPP, the above – mentioned equation can be presented as follows;

$$Pr=S*P\$$$

This equation states that the Dollar price of the commodity basket in Sri Lanka, i.e. 'Pr', must be the same as the Sri Lanka rupee value of the commodity basket in USA. Therefore, PPP states that the price of the standard commodity basket be the same across countries when measured in a common currency.

If the above-mentioned condition is an absolute version of PPP, the relative version or rate of change form can be presented as follows;

$$e= \mu r - \mu\$$$

Where "e" is the rate of change in the exchange rate and 'μr' and 'μ$' are the inflation rates in Sri Lanka and the USA respectively.

It is important to examine the importance of PPP for international trade. The different interest rates to compensate deviations from the PPP are completely eliminated when PPP holds. Further, competitiveness in the world market will not be affected by the changes in the exchange rate when PPP holds. When there are deviations from PPP, changes in the nominal

exchange rate cause changes in the real exchange rates, affecting the international competitiveness of countries.

The second model, the Mundell-Fleming model, is extended from a closed IS-LM model. Unlike the simple monetary model, in which prices are viewed as flexible, it assumes that prices are preset in the short run. In addition to the internal monetary market equilibrium goods market equilibrium, and external equilibrium condition, the balance of payments is also considered in the Mundell- Fleming model. Thus, it can be viewed as a general equilibrium model. One of the most important forecasts of the model is the so called dilemma, which states that perfect capital mobility, monetary policy independence and a fixed exchange rate regime cannot be achieved simultaneously. In the long run, the exchange rate level is perfectly correlated with the level of monetary supply and monetary policy may only play a trivial role in economic growth. Another important forecast is that devaluation may lead to further devaluation if fiscal discipline, inflation and the balance of payments are not well managed, because a self-fulfilling bubble may be produced. Finally, the impact of devaluation on current account improvement may be weakened if an economy is heavily dependent on the re-export processing industry.

The third monetary model, the Dornbusch model, loosens the condition that prices must be preset, but allows for slow price adjustments. A famous insight into the policy implications of this model is the overshooting of the nominal exchange rate over its long-run equilibrium, when an economic system is shocked with monetary supply. This character is regarded as an advantage of a fixed exchange rate regime over a floating one. This model shows that once a real economic shock happens, markets may move to equilibrium either through a flexible exchange rate or change of prices. The difference between the two is mainly that in the latter, adjustment may consume more time and be less risky than in the former. If prices are relatively flexible and inflation can be controlled in a moderate range, a fixed exchange rate regime is desirable.

These models were criticized frequently for their lack of micro foundations and for their failure to elucidate the effect of the balance of payment on the determination of the exchange rate. However, their clear implications for policymakers should not be underestimated.

5. Methodology

The Multiple Regression Model

I intend to use the Multiple Regression model, which relates to a given dependent variable 'Y' to several independent variables, X1,X2,X3,……Xk. The multiple regression models have the following general formulation.

$$Y = \beta 1X + \beta 2X + \beta 3X + \ldots\ldots\ldots + \beta kX + U$$

The Econometric Model,

$$\mathbf{NER = \beta 1 + \beta 2INF + \beta 3IR + \beta 4NFP + \beta 5OINT + \beta 6TOT + \beta 7REM + U}$$

Where 'Y' is the dependent variable, ie Nominal Exchange Rate. β1, β2, β3, β4, β5, β6, β7 are the parameters known as the intercept and slope coefficient in the equation and U is the classical random disturbance term.

The main purpose of the study is to examine the factors that affect exchange rate fluctuations in Sri Lanka, using monthly data for the period 2001 to 2010. Given that some of the variables used in the above models are not directly available, a proxy variable (Net Foreign Purchases) would be used, which will be chosen on the basis of their economic and econometric properties. Secondary data was used from previous research, internal databases of the CBSL, Annual Reports of the Central Bank of Sri Lanka, Monthly Bulletin, recent development trends of the CBSL and other publications of the CBSL.

- Dependent variable - nominal exchange rate
- Independent variables – inflation rate, weighted average call money rate, net official interventions, net foreign purchases, terms of trade and monthly remittances.

To fulfill the specific objectives of the paper, this section tries to identify the main determinants of the exchange rate USD/LKR by utilizing the Multiple Regression Model and VAR techniques. The data is on a monthly basis and covers the period 2001:01-2010:12. All the variables are in logarithms except for the nominal exchange rate, inflation rates and call money rates.

Quite similar to prices of goods and services, exchange rates, being the prices of the currencies, are also determined by demand and supply conditions of the currencies. Any foreign receipts to Sri Lanka, i.e., exports, inward remittances, foreign investments inflow and foreign borrowing, create supply of foreign currencies and demand for Sri Lankan rupees in the foreign exchange market. Any payments to foreign countries, i.e., imports, foreign travel, foreign investments outflow, foreign loan repayments and other payments, involve the purchase (demand for) of foreign currencies and supply of Sri Lankan rupees. In addition, dealings (buying and selling) in foreign currencies seeking financial gain on account of speculation on changes in exchange rates also influence the market demand and supply, and such dealings in globalized foreign exchange markets are key factors in exchange rate volatility. The demand will have an upward pressure on the value of the foreign currency and supply will have a downward pressure. The increase in the value of a currency against another currency, is termed as appreciation of the currency whereas, a decline in the value is the depreciation of the currency.

The demand for and supply of foreign currencies will change due to various factors relating to the economic activities of the countries. The growth of the national income of a country is a factor that will increase the demand for foreign currencies because the high income will increase the demand for imports. Inflation in a country will increase the demand for foreign currencies due to the tendency to import more, on one hand, and reduce the supply of foreign currencies as a result of the declined demand for exports due to high domestic prices, on the other hand. Expansion in money supply is a factor that will increase the demand for foreign currencies because increased ability to spend due to increased availability of money will raise imports. Therefore, it is believed that exchange rates are determined by demand and supply conditions driven by macroeconomic fundamentals that are linked to transactions in international trade, services and finance.

Ordinary Least Squares (OLS) Method

In statistics, ordinary least squares (OLS) is a method for estimating the unknown parameters in a linear regression model. This method minimizes the sum of squared vertical distances between the observed responses in the data set and the responses predicted by the linear approximation. The resulting estimator can be expressed by a simple formula, especially in the case of a single regressor on the right-hand side.

The unit root test was used to identify whether time series variables are stationary or non-stationary using an Autoregressive Model through the Augmented Dickey–Fuller (ADF) test. Most of the macroeconomic variables appear to be non-stationary because time series data are highly dependent on the actual time and do not have constant mean and variance (Gujarati 2007). Hence, for non-stationary variables, the unit root test was used in order to avoid the problem of spurious regressions, as follows.

Augmented Dickey Fuller Unit root tests are carried out to test whether the series are level stationary (I (0)) or first difference stationary (I (1)). If the data series is non- stationary, the first difference or first difference with log value has to be taken. If the mean is not constant, the first difference of the series is taken. Then series can convert to stationary. If the mean and variance both are not constant, lag first difference is taken.

Unrestricted Vector Auto Regression Method.

The following econometric tool is used in this analysis:

A. Vector Auto Regression-Vector Auto Regression (VAR) model is a system of equation in which each variable is explained by its own lags and current value, and lags of the other variables in the system. The VAR approach also provides an appropriate framework for making sectorial comparisons. The same reduced from equations can be used in all sectors for estimating the response of output to monetary shock. Also, the VAR approach allows the data

to determine the shape of the impulse responses for different sectors. With the Vector Autoregressive model it is possible to approximate the actual process by arbitrarily choosing lagged variables. Thereby, one can form economic variables into a time series model without an explicit theoretical idea of the dynamic relations. The most easy Multivariate Time Series model is the Bivariate Vector Autoregressive model with two dependent variables 'y1,t' and 'y2,t', where t = 1, ..., T. This means, the explanatory variables in the Simplest model are 'y1,t-1' and' y2,t-1'. The VAR (1) with lagged values for each variable is determined by:

$$y1,t = \alpha 11 y1,t-1 + \alpha 12 y2,t-1 + \varepsilon 1,t$$

$$y2,t = \alpha 21 y1,t-1 + \alpha 22 y2,t-1 + \varepsilon 2,t$$

$$yt = A1yt-1 + \varepsilon t$$

$$A1 = \begin{pmatrix} \alpha 11 & \alpha 12 \\ \alpha 21 & \alpha 22 \end{pmatrix}$$

Assumptions about the Error Terms:

The expected residuals are zero: $E \quad \varepsilon i,t = 0$ with i=1,2

1. The error terms are not auto correlated:

$$E \quad [\varepsilon i,t \ . \ \varepsilon j,\dagger] = 0 \text{ with } t \neq \dagger$$

The VAR-model does not allow us to make statements about causal relationships. This holds when the VAR-model is only approximately adjusted to an unknown time series process, while a causal interpretation requires an underlying economic model. However, VAR-models allow interpretations about the dynamic relationship between the indicated variables.

VAR (p)-Models with more than two Variables

VAR (p)-model, with p variables, is given as:

$$yt = A1yt-1 + A2yt-2 + \ldots + Apyt-p + \varepsilon t$$

If one wants to expand the equation with a trend, intercept or seasonal adjustment, it will be necessary to augment the Vector 'xt', which includes all the deterministic components, and the matrix B (VARX-Model):

$$yt = A1yt\text{-}1 + A2yt\text{-}2 + \ldots + Apyt\text{-}p + Bxt + \varepsilon$$

B. Impulse Response - Impulse Response function gives how the other variables react when there is a shock to one variable. The dynamic adjustment of reciprocal dependency is immediately not considerable. The impulse response test shows the effects of an exogenous shock on the whole process over time. Therefore, one can detect the dynamic relationships over time. Initially, look at the adjustment of the endogenous variables over time, after a hypothetical shock in 't'. This adjustment is compared with the time series process without a shock, i.e, the actual process. The impulse response sequences plot the difference between these two time paths.

C. Variance Decomposition – It is necessary that all the variables in the model are stationary for analysis in terms of variance decomposition. An alternative to impulse response to receive a compact overview of the dynamic structures of a VAR model, is variance decomposition sequences. This method is also based on a Vector Moving Average model and orthogonal error terms. In contrast to impulse response, the task of variance decomposition is to achieve information about the forecast ability. The idea is that even a perfect model involves ambiguity about the realization of 'yt-1' because the error terms associate uncertainty. According to the interactions between the equations, the uncertainty is transformed to all equations. The aim of the decomposition is to reduce the uncertainty in one equation to the variance of error terms in all equations.

D. AR Root Test – The AR Root test confirms whether the variables used in the analysis are stationary or non- stationary.

6. Preview of Data

Aside from factors such as interest rates and inflation, the exchange rate is one of the most important determinants of a country's relative level of economic health. Exchange rates play a vital role in a country's level of trade, which is critical to most free market economies in the world. For this reason, exchange rates are among the most watched, analyzed and governmentally manipulated economic measures. But exchange rates matter on a smaller scale as well, they impact the real return of an investor's portfolio. The major forces behind exchange rate movements are described below.

- **Inflation**

As a general rule, a country with a consistently lower inflation rate exhibits a rising currency value, as its purchasing power increases relative to other currencies. Countries with higher inflation typically see depreciation in their currency in relation to the currencies of their trading partners. A higher rate of inflation leads to the depreciation of a currency vis-a-vis another where inflation is lower. A relationship can be established between appreciation/depreciation and inflation rates. This is also usually accompanied by higher interest rates.

The figure 01 illustrates a weak negative relationship between nominal exchange rate and inflation during the period 2001 to 2010. The correlation coefficient between exchange rate and inflation is **-0.03**.

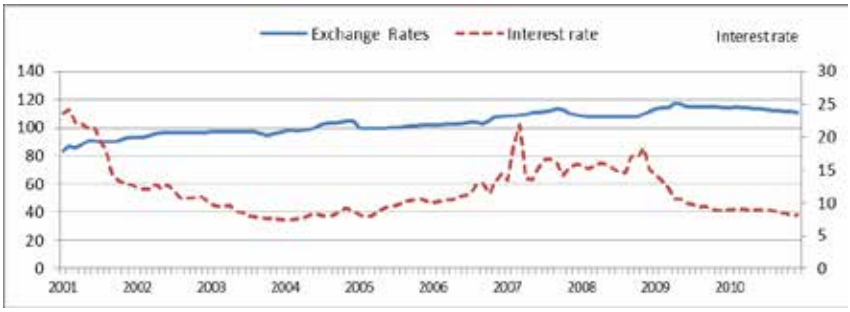
Figure 01: Nominal Exchange Rate (USD/LKR) and Inflation

- **Interest Rates**

Interest rates, inflation and exchange rates are all highly correlated. By manipulating interest rates, central banks exert influence over both inflation and exchange rates, and changing interest rates impact inflation and currency values. Higher interest rates offer lenders in an economy a higher return relative to other countries. Therefore, higher interest rates attract foreign capital and cause the exchange rate to rise. The impact of higher interest rates is mitigated, however, if the inflation in the country is much higher than in others, or if additional factors serve to drive the currency down. The opposite relationship exists for decreasing interest rates - that is, lower interest rates tend to decrease exchange rates.

The chart (Figure 2) below shows a weak negative relationship between exchange rate and monthly interest rate (call money rates) for 2001 to 2010, due to the correlation between exchange rate and interest rate, being **-0.18**.

Figure 02: Nominal Exchange Rate (USD/LKR) and Interest Rate

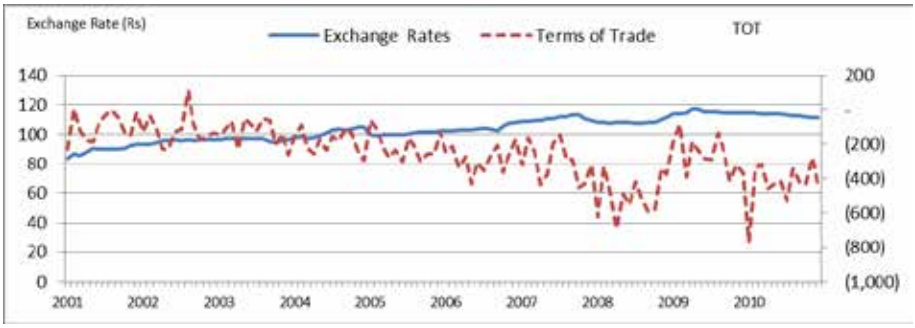


- **Terms of Trade**

A ratio comparing export prices to import prices, the terms of trade is related to current accounts and the balance of payments. If the price of a country's exports rises by a greater rate than that of its imports, its terms of trade have favorably improved. Increasing terms of trade show a greater demand for the country's exports. This, in turn, results in increasing revenues from exports, which provides an increased demand for the country's currency (and an increase in the currency's value). If the price of exports rises by a smaller rate than that of its imports, the currency's value will decrease in relation to its trading partners.

Figure 03 represents the fluctuations of the nominal exchange rate and terms of trade during the past decade, 2001 to 2010. There is a negative relationship between exchange rate and terms of trade where the correlation is **-0.62.**

Figure 03: Nominal Exchange Rate (USD/LKR) and Terms of Trade (USD Mn)

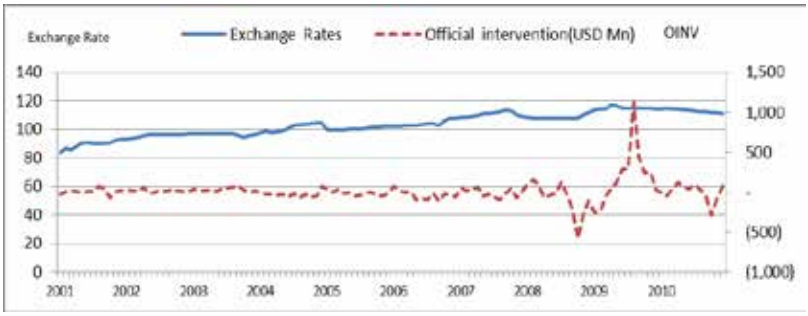


• Net official intervention

The Central Bank of Sri Lanka intervenes in the market to smoothen the USD/LKR excessive volatility. Though Sri Lanka adopted the free exchange rate system from 2001, practically, the Central Bank always determines the range of the buying and selling band on daily basis. When market forces violate the bands, the Central Bank intervenes to keep the exchange rate at the desired level. On the other hand, it is a signal to the market to follow the desired band, escaping market forces. The principal purpose of official intervention in exchange markets is to reduce short-run exchange rate fluctuations, or "smooth" medium- term movements in exchange rates, through the purchase of foreign exchange when the home currency tends to appreciate and the sale of foreign exchange when the home currency tends to depreciate.

The following chart (Figure 04) shows a positive relationship between the nominal exchange rate (USD/LKR) and official intervention (US Dollar Mn) from 2001 to 2010 and the correlation value is 0.12.

Figure 04: Nominal Exchange Rate (USD/LKR) and Official Intervention (US Dollar Mn

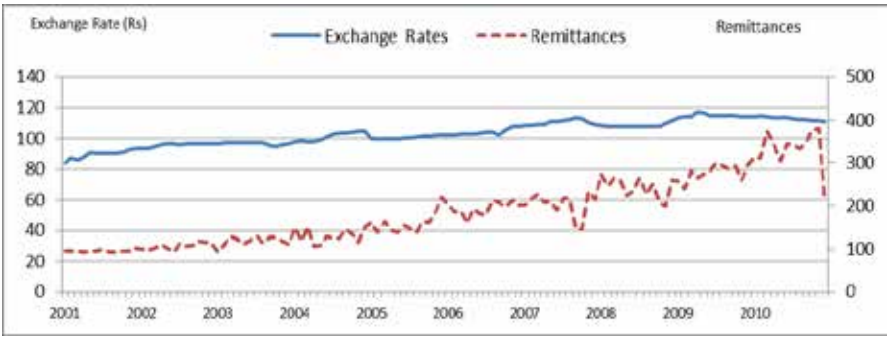


• Remittances

Remittances are money transfers by migrants to their home countries. In recent years, remittances have played an increasingly significant role in the growth of many developing countries. Workers' remittances have become the second largest source of net financial flows to developing countries. Remittances can affect long-term growth through several channels, one of which is the exchange rate. Changes in the nominal exchange rate affect the distributional impact of remittance inflows, both by altering the returns to factors related to the traded and non-traded goods sectors and by affecting the relative price of traded and non-traded consumption goods.

It is evident from the graph (Figure 05) below that there is a strong positive relationship between the nominal exchange rate (USD/LKR) and monthly worker remittances (US Dollar Millions) from 2001 to 2010 where the correlation is 0.87.

Figure 05: Nominal Exchange Rate (USD/LKR) and Monthly Worker Remittances (US Dollar Mn)

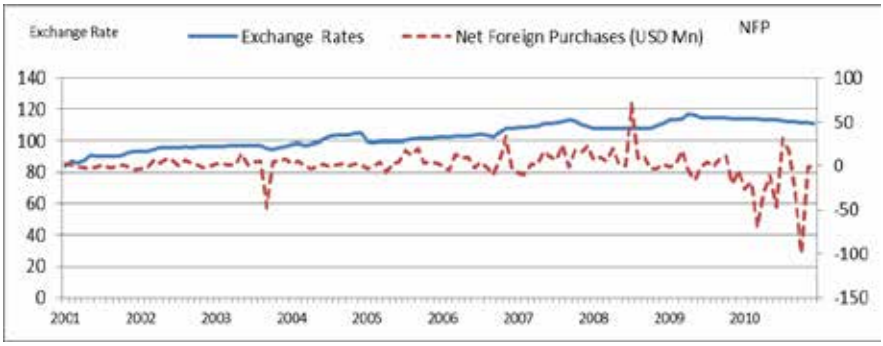


- **Net Foreign Purchases**

Net foreign purchases are measured by the difference between sales and purchases of the foreigners. The relationship between net foreign purchases and the nominal exchange rate has long been understood in the theoretical literature. In a simple Keynesian setting, countries with large external liabilities need to run trade surpluses in order to service them, and achieving trade surpluses requires a relatively depreciated currency. In particular, it is recognized that while in the steady state a positive NFP position supports a more appreciated exchange rate, in transition, the exchange rate movements may be a means of reaching a desired level of net foreign Purchases.

The graph (Figure 06) below depicts a weak negative relationship between the nominal exchange rate (USD/LKR) and monthly net foreign purchases (US Dollar Mns) from 2001 to 2010. The correlation between the exchange rate and net foreign purchases is **-0.10**.

Figure 06: Nominal Exchange Rate (USD/LKR) and Monthly Net Foreign Purchases (US Dollar Mn)



Unit Root Test

Many macroeconomic data are non- stationary data. Therefore, we have to convert those non-stationary data to stationary data. The unit Root test is carried out to test whether the series are level stationary (I (0)) or first difference stationary (I (1)). The Augmented Dickey Fuller Test was used to check the stationary of variables. There are five variables in DLOG form (Growth rate), namely; exchange rate, inflation, interest rate, remittances and terms of trade. The results of the unit root test for all variables are given in Table 01 below. Results of the Augmented-Dickey Fuller tests confirm that three variables (Exchange Rate, Inflation and Remittances) are non-stationary at the level. The variables became stationary only after taking the first difference.

Table 01: ADF Test Result

Variable	Level (P Value)	1st Difference (P value)
ER	0.3821	0.0000
INF	0.2457	0.0000
IR	0.0551	*
REMI	0.8030	0.0000
OINTV	0.0000	*
NFP	0.0000	*
GRTOT	0.0001	*

* Already significant at Level

Table 02: Intermediate ADF Test Results

Untitled

Series	Prob.	Lag	Max Lag	Obs
DLOG(ER)	0.0000	0	12	118
DLOG(INF)	0.0000	0	12	118
DLOG(IR)	0.0000	1	12	117
DLOG(REMI)	0.0000	1	12	117
OINTV	0.0000	0	12	119
NFP	0.0000	0	12	119
GRTOT	0.0000	0	12	118

If the Augmented Dickey – Fuller test statistic value is smaller than the critical values, the null hypotheses of all variables are rejected. Alternatively, the probability value can be used. According to Table 02, the unit root test for all five variables confirm that they are stationary in the level at the 1 per cent level of significance.

Lag selection criteria

The determination of lag length is a trade-off between the curses of dimensionality and abbreviates models, which are not appropriate to indicate the dynamic adjustment. If the lag length is too short, autocorrelation of the error terms could lead to apparently significant and inefficient estimators. Therefore, one would receive wrong results. On the other hand, with increasing number of parameters, the degrees of freedom decrease, which could possibly result in significant of inefficient estimators.

The idea of information criteria is similar to the trade-off discussed above. On one hand, the model should be able to reflect the observed process as precisely as possible (error terms should be as small as possible) and on the other hand, too many variables lead to inefficient estimators. Therefore, the information criteria are combined out of the squared sum of residuals and a penalty term for the number of lags. In detail, for 'T' observations I chose the lag length 'P' in a way that the reduction of the squared residuals after augmenting lag 'P+1', is smaller than the according boost in the penalty term. Hence, I have selected the 1st lag based on the AIC (refer Table 03).

Table 03: Lag selection criteria

Endogenous variables: DLOG(ER) DLOG (INF) DLOG (IR) DLOG (REMI) OINTV NFP GRTOT

Exogenous variables: C

Lag	Log L	LR	FPE	AIC	SC	HQ
0	-2835.54	NA	6.58e+13	51.68254	51.85439*	51.75224*
1	-2778.201	106.3375	5.66e+13*	51.53092*	52.90571	52.08855
2	-2732.603	78.76024	6.09e+13	51.59278	54.17051	52.63832
3	-2704.746	44.57023	9.18e+13	51.97721	55.75788	53.51067
4	-2652.731	76.60391*	9.14e+13	51.92239	56.90600	53.94377
5	-2612.79	53.73878	1.17e+14	52.08710	58.27365	54.59640
6	-2566.965	55.82345	1.42e+14	52.14482	59.53432	55.14204
7	-2511.004	61.04855	1.52e+14	52.01825	60.61069	55.50339
8	-2453.308	55.59811	1.71e+14	51.86014	61.65552	55.83320

* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information Criterion

Mean root graph

Further, Auto regressive Roots graph (Figure 07) for Vector Auto Regression model confirms that all the variables used in this analysis are stationary as a system.

Figure 07: Inverse Roots of AR Characteristic Polynomial

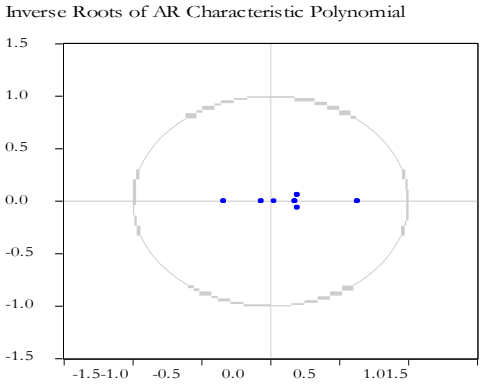


Table 4: Variance Decomposition

Period	S.E.	DLOG(ER)	DLOG (INF)	DLOG (IR)	DLOG (REMI)	OINTV	NFP	GRTOT
1	0.009541	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.009991	95.70883	0.230313	0.310263	0.482713	2.342029	0.279075	0.646782
3	0.010102	93.81899	0.289129	0.306257	0.496123	4.035239	0.399681	0.654577
4	0.010148	93.01329	0.287160	0.305514	0.494788	4.818153	0.430207	0.650884
5	0.010166	92.67542	0.287292	0.310291	0.493369	5.140369	0.444248	0.649008
6	0.010174	92.53962	0.288162	0.312393	0.492668	5.268898	0.450018	0.648236
7	0.010177	92.48544	0.288465	0.313439	0.492381	5.319813	0.452537	0.647927
8	0.010178	92.46397	0.288610	0.313836	0.492265	5.339961	0.453552	0.647804
9	0.010179	92.45546	0.288662	0.313999	0.492219	5.347937	0.453964	0.647756
10	0.010179	92.45209	0.288684	0.314063	0.492201	5.351095	0.454127	0.647736

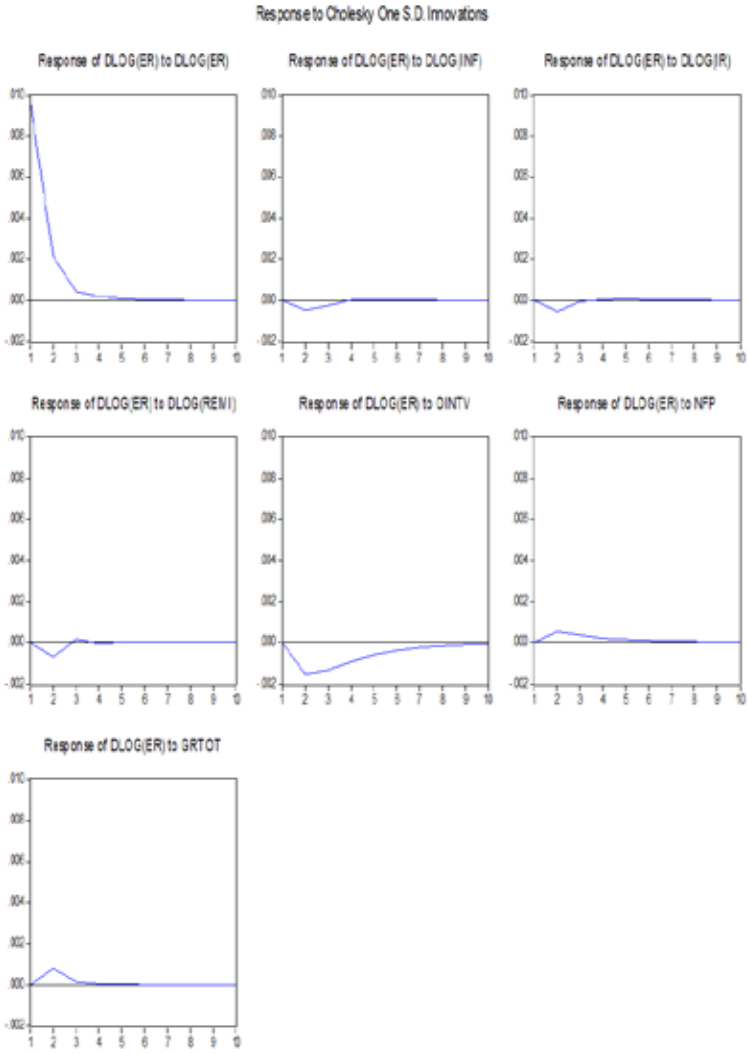
It is necessary that all the variables in the model are stationary for analysis in terms of variance decomposition. Variance decomposition of the growth in the exchange rate (DLOGER) gives the changes in the variable DLOGER attributable to each of the other variables.

The results of the variance decomposition with respect to DLOGER are given in Table 4 (Variance decomposition). The variance decomposition of the exchange rate gives the changes in the growth in ER, attributable to each of the other variables included in the model, as well as itself.

Within this period (120 Months), about 0.45 of the variance in the growth in ER is from net foreign purchases, about 0.30 of the variance is from the growth in the inflation, about 0.31

of the variance is from the monthly increase in the weighted average call money rate, while about 0.45 of the variance is from the growth of net official interventions and about 0.49 of the variance is from monthly remittances, whereas 0.65 of the variance is from the terms of trade.

Figure 08: Impulse Response Function



The impulse response function indicates the effect of a one standard deviation shock to one of the innovations on current and future values of the endogenous variables. The results of impulse response functions (except response of NER to NER) are given in Figure 08 (Impulse response function) which shows that an increase in the official interventions has a negative impact on the nominal exchange rate. On the other hand, an increase in interbank call money market rates has some impact to the nominal exchange rate from 1 to 3 months and persists 3 to 6 months after it dies. The response of inflation rate to exchange rate has a negative impact during the first 4 months, thereafter it dies out. We can see a positive response of net foreign purchases to exchange rate from 1 to 6 and afterwards it dies out. The response of terms of trade has a positive impact to the exchange rate from 1 to 3 months, subsequently it dies out. On the other hand, the response of monthly remittances has a negative effect from 1 to 3 months, is slightly positive during 3 to 4 months and thereafter dies out.

According to the estimation results of Vector Auto Regression, net official intervention, net foreign purchases and call money rate affect the fluctuations of the exchange rate. However, when compared to the pass-through process of inflation rate to exchange rate, it is not very significant.

7. Results

This section explains the empirical findings with regard to factors that determine the exchange rate. Firstly, a brief explanation with regard to descriptive statistics is mentioned below. Secondly, I have estimated the Multiple Regression Model and discussed the correlation between the exchange rate and other independent variables, as well as its coefficients. Finally, results are discussed by means of impulse response functions of a VAR Model.

Table 05: Results of Descriptive Statistics

	ER	INF	IR	NFP	OINTV	REMI	TOT
Mean	**103.4162**	**11.27228**	**11.92420**	**0.500000**	**6.744305**	**185.9546**	**-252.1145**
Median	102.8732	10.75624	10.59000	2.000000	0.000000	163.5683	-233.4756
Maximum	117.3699	28.23584	24.23000	90.00000	1130.750	381.4847	110.2653
Minimum	83.66220	0.517117	7.470000	-479	-587.7	92.65000	-765.9135
Std. Dev.	**8.086121**	**6.394444**	**3.961933**	**53.97556**	**151.6359**	**78.01695**	**155.6924**
Skewness	-0.177604	0.456558	1.168569	-6.150496	3.084103	0.657211	-0.672948
Kurtosis	2.083628	2.657085	3.805913	54.32179	28.87417	2.427789	3.482043
Jarque-Bera	**4.829547**	**4.756854**	**30.55853**	**13926.20**	**3537.596**	**10.27566**	**10.21900**
Probability	0.089388	0.092696	0.000000	0.000000	0.000000	0.005870	0.006039
Sum	12409.94	1352.674	1430.904	60.00000	809.3165	22314.55	-30253.74
Sum Sq. Dev.	7780.858	4865.780	1867.933	346690.0	2736220.	724310.8	2884574.
Observations	120	120	120	120	120	120	120

Table 05 depicts the average nominal exchange rate to be 103.4162, the average inflation rate is around 11.27 per cent and interest rate to be 11.92 per cent. A higher volatility can be observed in official intervention and terms of trade. According to the Jarque – Bera values, this data distribution is not a normal distribution.

The data analysis method used in this paper is to identify the determinants of the exchange rate. The results were estimated using the Vector Auto Regression (VAR) method.

Multiple Regression Results: Dependent Variables NER

Table 06: OLS Results of Multiple Regression Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.002534	0.000909	2.789256	0.0062
DLOG(INF)	-0.002654	0.002713	-0.977981	0.3302
DLOG(IR)	-0.000745	0.011377	-0.065493	0.9479
DLOG(REMI)	-0.013351	0.007269	-1.836642	0.0689
OINTV	-1.11E-05	5.97E-06	-1.853063	0.0665
NFP	6.31E-11	5.14E-11	1.228412	0.2219
GRTOT	-7.68E-06	1.95E-06	-3.944056	0.0001

R-squared	0.179901	Mean dependent var	0.002440
Adjusted R- squared	0.135572	S.D. dependent var	0.010478
S.E. of regression	0.009742	Akaike info criterion	-6.367348
Sum squared resid	0.010534	Schwarz criterion	-6.202985
Log likelihood	382.6735	Hannan-Quinn criter.	-6.300611
F-statistic	4.05826	**Durbin-Watson stat**	**1.591854**
Prob(F-statistic)	0.001023		

The empirical studies by Fry (1976), Bilson (1978), Messe and Rogoff (1983), Sebastian (1983), Woo (1985), and Oloyede (1997), to mention a few, have shown that the CAM model can be used to explain the stylized facts of the behavior of the inflation rate and the nominal exchange rate in many small open economies. For example, countries with relatively high rates of

monetary growth are expected to have high rates of inflation and depreciating exchange rates. However, using the OLS model, I found that my result shows a negative relationship between the exchange rate and inflation as the coefficient is negative, when inflation increases by 1 per cent rupee appreciates by 0.002 per cent. This may be due to the effects of some high volatile periods of inflation. However, the estimated coefficient is statistically insignificant.

According to my output, when inflation increases call money rates will also increase; as a result, exchange rate will appreciate. When interest rate increases by 1 per cent, exchange rate will appreciate by 0.0007 per cent. Hence the results indicate a negative relationship between call money rates and the nominal exchange rates. This can be empirically supported by Bjrnland (2009) who identifies a similar relationship to our research by imposing a long-run neutrality restriction on the exchange rate, thereby allowing for contemporaneous interaction between the interest rate and the exchange rate. In particular, a contractionary monetary policy shock has a strong effect on the exchange rate, which appreciates on impact.

If worker remittances increase, exchange rate should appreciate. Therefore, I have found a negative relationship between exchange rate and remittances: 1 per cent in remittances leads to appreciation of the exchange rate on 0.01 per cent. In contrast, Lin's (2001) paper analyzes the determinants of remittances to Tonga. The results indicate that macroeconomic conditions in remitting countries and exchange rate fluctuations influence remittances. In particular, remittances growth falls when the Tongan currency appreciates, but increases with higher real GDP growth and lower unemployment in remitting countries. The analysis also found that the influence of these determinants varies with the recipients of remittances, with remittances to non-profit organizations being more sensitive to an appreciation of the Tongan currency.

As per my results, there is a negative relationship between exchange rates and net official interventions because when the Central Bank injects dollars to the market, the rupee will appreciate against the dollar. Behera et al.'s (2000) paper empirically explores the relationship between central bank intervention and exchange rate behavior in the Indian foreign exchange market. Specifically, the paper investigates the effects of RBI intervention on exchange rate level and volatility. The results using the GARCH model confirms that the intervention of RBI is effective in reducing volatility in the Indian foreign exchange market. Canales et.'s(2003) paper in contrast, offers guidance on the operational aspects of official intervention in the foreign exchange market, particularly in developing countries with flexible exchange rate regimes. The analysis highlights the difficulty of detecting exchange rate misalignments and disorderly markets, and argues in favor of parsimony in official intervention.

According to the analytical result, there is a positive relationship between net foreign purchases and the exchange rates. When net foreign purchases decrease (net sales increase) it will lead to an outflow of more Dollars from the country. Therefore, nominal exchange rate will appreciate. Thus, my result can be empirically supported by Peng et al.'s (2003) paper, which

assesses the equilibrium value of the yen within a VECM framework by considering a number of fundamental factors, in particular net foreign purchases holdings. Based on an established co integrating relationship between the exchange rate and economic fundamentals, the trend value of the Yen is estimated to have remained broadly stable since the early 1990s. The continuous accumulation of net foreign purchase has underpinned the strength of the yen, as its positive impact offset the downward pressure arising from the deterioration of the terms of trade and slower relative productivity growth.

There is a negative relationship between exchange rate and terms of trade. When our terms of trade worsens, the exchange rate will depreciate. Wimalasuriya's (2007) findings from the model suggest that changes in the exchange rate could have significant implications for the trade balance. More precisely, the most important variable affecting the exchange rate equilibrium level is the terms of trade. Although, Drine et al. (2003) show that an improvement in terms of trade entails a long-run appreciation of the exchange rate. On the other hand, an increase of domestic investment and degree of openness the economy entails an exchange rate depreciation; the effect of public spending increase being ambiguous.

8. Concluding Remarks

This paper examines the factors that affect exchange rate fluctuations in Sri Lanka. According to the empirical results, there is a positive relationship between net foreign purchases and the exchange rate. This study finds that the terms of trade is a determinant of the nominal exchange rate in Sri Lanka. A negative relationship exists between the exchange rate and terms of trade. There is a negative relationship between exchange rate and inflation because the coefficient is negative, when inflation increases, the exchange rate will appreciate against the dollar. In addition, there is a link between inflation and call money rates whereas when inflation increases call money rates will also increase, as a result the rupee will appreciate against the dollar. Therefore, there is a negative relationship between call money rates and the nominal exchange rates. If worker remittances increase the exchange rate should appreciate. Therefore, the results show a negative relationship between exchange rate and remittances. Most variables have a significant impact on exchange rate, peak effect within a two month lag. The Durbin-Watson Statistic was found to be 1.60, suggesting that the model specification was somewhat appropriate; this means that relevant variables have been included.

However, the size of the coefficient that relates monetary policy to the exchange rate was found to be relatively small. This points out the need for further research to analyse the impact of determinants on the exchange rate.

On the other hand, this study has several limitations, some of which are related to data availability. One such limitation is that proper net capital inflows do not exist for the entire sample period. Hence, I tend to use a proxy variable (Net Foreign Purchases) instead of Net

Capital Inflows, as there is no monthly data available for capital inflows. Further in this paper, I have considered only six dependent variables even though there are many influential factors that determine the exchange rate. One other limitation is the control over the capital account of Sri Lanka. The REPO market, initiated in 1996, and foreign participants involvement was limited to five per cent of total securities issued, though currently it has expanded to ten per cent. Therefore, the relationship between the exchange rate and interest rate cannot be implemented freely because of capital controls. Further this ten per cent foreign participant involvement limit was introduced in October 2010, hence the impact from this limit change will not be effectively shown in our results due to the time period constraint, i.e., using data from 2001: 01 January -2010 : 12 December.

Moreover, in this paper more emphasis is placed on determinants of nominal exchange rate under the managed floating exchange rate regime. However, it can be extended to account for the effects of real exchange rate shocks and costs of exchange rate fluctuations with regard to the exchange rate determinants. Furthermore, it compels us to explore future work as to whether there is any economic value to the predictive power of economic fundamentals for nominal exchange rates. Overall, more research may be needed to identify the determinants of real exchange rate.

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Appendix 01

Main Variables

The main variables considered in this analysis are given below. The analysis consists of mainly six variables. All monthly variables are from the period of 2001 to 2010.

Variable	Description
NEXRATE	Nominal Exchange Rate (USD/LKR)
	Central Bank Annual Reports
CCPI	Colombo Consumer Price Index
	Consumer and Statistics Department
NFP	Net Foreign Purchases (US Dollar Million)
	Colombo Stock Exchange Monthly Reports
REM	Remittances (US Dollar Million)
	Central Bank Monthly Bulletins
INTCALLMMRATE	Average Inter- bank call money market rate
	Central Bank Annual Reports
NEOINTERVENTION	Net Official Intervention (USD Million)
	Central Bank Annual Reports

Appendix 02

Unit root test

Individual variable unit root test

Null Hypothesis: Unit root (individual unit root process)

Series: DLOG(ER), DLOG (INF), DLOG (IR), DLOG (REMI), OINTV, NFP,

Method	Statistic	Prob.**
ADF - Fisher Chi-square	390.939	0.0000
ADF - Choi Z-stat	-18.4395	0.0000

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality

Appendix 03

Correlation	Coefficients	Correlation
Exchange rate	Inflation Rate	-0.03
Exchange rate	Interest Rate	-0.18
Exchange rate	Net Foreign Purchases	-0.10
Exchange rate	Remittances	0.87
Exchange rate	Net Official Intervention	0.12
Exchange rate	Terms of Trade	-0.62