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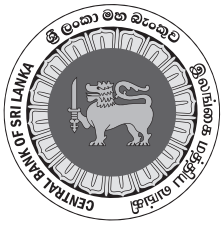

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For all correspondence about the Staff Studies Journal, please contact:
Director of Economic Research
Central Bank of Sri Lanka
30, Janadhipathi Mawatha
Colombo 01
Sri Lanka
Email: directorerd@cbsl.lk

Inflation - Growth Nexus in Sri Lanka: Is there a Threshold Level of Inflation for Sri Lanka?

B.G. Nilupulee De Silva [1] [2]

Abstract

It is of significant economic importance to investigate the relationship of the inflation-growth nexus in Sri Lanka, to identify whether there is a linear or non-linear relationship between the two macro variables. This can lead to the discovery of the threshold level of inflation for Sri Lanka. Accordingly, this research explores the inflation-growth relationship in Sri Lanka, using annual data from 1965 to 2014. The results reveal an inflation rate of 9 per cent, which maximises the per capita GDP growth rate in Sri Lanka. However, the results do not confirm any significant structural break in per capita GDP growth rate when the inflation rate exceeds 9 per cent. Therefore, based on the findings, there is no statistically significant evidence to suggest the existence of a non-linear relationship between per capita GDP growth and inflation in Sri Lanka. Some conjectures, such as errors in data and not including savings and investment data can be made regarding the non-existence of a significant inflation threshold. Furthermore, the findings highlight that there is no negative effect of inflation towards the GDP per capita growth at any rate of inflation in Sri Lanka. This is an indication that any adverse effects of contemporaneous inflation are neutralized due to the significant positive effects from the inflation lag of two years. Furthermore, the results are not in favour of the view of maintaining inflation at low levels and thus, this study is important for policymakers in Sri Lanka, when implementing inflation targeting in Sri Lanka in the future.

Keywords: *Per-capita income growth, Inflation threshold, Structural break, Sri Lanka*

JEL Classification: *C22, E00, O11*

[1] Senior Assistant Director of International Operations Department of the Central Bank of Sri Lanka.
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1. Introduction

Most of the development policy objectives of an emerging economy revolve around achieving rapid and sustainable economic growth. Yet, when rapid growth is achieved, as a result of increasing pressure on inputs utilized by excess demand, prices can increase. Hence, sustaining high growth requires that inflation be kept under control, if a rise in inflation causes negative effects on economic growth. The study of the inflation- growth nexus in developing countries is vital to understand the true nature of the relationship between inflation and growth, as maintaining excessively low inflation can lead to high unemployment and reduced output (Philips curve[3]). This can create inadvertent consequences to economic growth in developing countries. In view of this, Pollin and Zhu identify a positive nexus between Gross Domestic Product (GDP) growth and high inflation up to 15-18 per cent for 80 middle and low income countries, where they argue that targeting inflation at low levels of around 3-4 per cent may not be optional for emerging economies and doing so could harm economic growth (593).

A number of empirical studies, which are discussed in detail under Section Two, have shown that high inflation can be costly and can affect the macroeconomic stability of the country. A study based on data from Latin American countries reveals that there is a negative relationship between inflation and GDP per capita growth (Gregorio 59). Barro shows that when inflation exceeds 10 per cent, the per capita GDP growth rate reduces by 0.2 - 0.3 percentage points (19). A similar inflation threshold is evident in a study by Espinoza et al., where they conclude that for developing countries, a significant structural break in per capita GDP growth is caused by an inflation rate above 10 per cent (100).

A study that was carried out using data from 86 countries including Sri Lanka, found a structural break in per capita GDP growth at 8 per cent of inflation rate for emerging and developed nations and suggests that if such a significant structural break for per capita GDP growth exists for a country, and the failure on the part of policymakers to take into consideration the same will impose a greater bias on the inflation effect towards GDP growth (Sarel 203). Sarel further emphasises that the existence of a structural break provides a numerical policy target for Central Banks to maintain inflation below the structural break (213). He is the first to identify the detrimental effects of high inflation by taking into account the structural break in growth in GDP. He points out that when the inflation rate doubles (for example, an increase in inflation from 20 percent to 40 percent), the growth rate declines by 1.7 percentage points (214).

One of the core objectives of the Central Bank of Sri Lanka is to maintain economic stability by controlling inflation, which may be harmful to the economy. The lack of well-researched

[3] Philips Curve is a historical inverse relationship between rates of unemployment and corresponding rates of inflation that result in an economy.

and published papers regarding the threshold level of inflation for Sri Lanka, which quantifies any significant structural break of GDP per capita growth in Sri Lanka, creates a research gap in this field of studies. Motivated by the identified research gap and also by the findings of Sarel (213), this study attempts to explore whether such a structural break for per capita GDP growth exists in the Sri Lankan context. Accordingly, this research explores the inflation-growth nexus in Sri Lanka, using annual data from 1965 to 2014. Principally, this paper addresses whether there is any inflation threshold that maximises per capita GDP growth for Sri Lanka. If any, is the effect of inflation on growth in per capita GDP significantly different above the threshold level from what it is below the inflation threshold.

This study mainly follows the methodology used by Sarel, (207) and Hayat and Kalirajan (8). The results of this study reject the argument that the inflation rate and per capita GDP growth rate in Sri Lanka has a non-linear relationship. Accordingly, there is no statistically significant evidence to suggest the existence of a non-linear relationship between per capita GDP growth and inflation in Sri Lanka. Nevertheless, the study reveals an inflation rate of 9 per cent, which maximises the per capita GDP growth rate. However, the results do not confirm any statistically significant structural break in per capita GDP growth rate at the 9 per cent of inflation.

The structure of the remainder of the paper is as follows. Section Two reviews the empirical literature on the inflation-growth nexus. Section Three includes data and the methodology used in the study, followed by a summary of the results and an analysis in Section Four. Finally, Section Five discusses the limitations and policy implications, and concludes, suggesting future extensions of this study.

2. Literature review

A survey of the available theoretical and empirical literature is carried out with a view to enlighten policy makers on the on-going debate of the inflation- growth nexus and also to discover the threshold level of inflation, if any, for Sri Lanka. Many previous empirical studies have analysed the inflation growth nexus in developing countries as well as developed countries and there is evidence for both a positive and negative relationship between inflation and growth. More interestingly, the non-linearity of the inflation and growth relationship has been identified in many country specific studies as well as cross country analyses which include both developing and developed countries. Previous studies have been categorized according to the nature of the inflation-growth nexus and salient features are briefly explained.

2.1. Positive relationship

Latin American countries experienced high double-digit inflation along with moderate growth during the 1950s and 1960s, and Bruno and Easterly researched the behaviour of growth in pre, during and post high inflation periods (3). They found that there is no permanent harm

to growth from high inflation rates (25). A short run positive relationship between inflation and growth is recognized by the Keynesian and Neo-Keynesian theories (Hayat & Kalirajan 3), whereas a long - run positive relationship is established by Mallik and Chowdhury (133) using error correction models for four South Asian countries-Bangladesh (1974-97), India (1961-97), Pakistan (1957-97), and Sri Lanka (1966-97), implying that these countries needed inflation for growth. However, these results contrast with the discoveries of Hayat and Kalirajan for Bangladesh for the period 1976-2005 (14).

In the context of developed countries, Feldstein considers a two percent inflation rate as a benchmark of price stability by Feldstein and calculates the perpetual benefit of reducing inflation in the United States from two- percent "true" inflation to zero percent "true" inflation (50). Khan and Senhadji establish a 11 per cent threshold for developing countries and 1 per cent for industrialised countries (12). According to Ghosh and Phillips, the appropriate rate is 2.5 per cent (672), whereas Judson and Orphanides conclude a double-digit inflation threshold (117). Moreover, the aggregate supply equation with imperfect information, sticky wages and sticky prices explains a positive link between prices and output. According to the Phillips curve equation, low inflation is related with lower output or increased unemployment (Cooray 3).

2.2. Negative correlation

Several studies have explored the negative relationship between inflation and growth and according to the conventional neo-classical view, there is a negative relationship between inflation and growth (Barro 423). Fisher suggests that there are two major routes through which uncertainty caused by high inflation affects the growth of a country (485). Accordingly, uncertainty brings macroeconomic instability and in turn reduces the efficiency of the price mechanism and secondly, uncertainty reduces the investments in a country due to the high volatility in prices (Fischer 485).

Another study carried out by Gregorio, on 12 Latin American countries for the period 1950-1985, identifies a negative relationship between inflation and growth (59). Moreover, Barro emphasises the argument that growth is expedited during the periods of low inflation, where he highlights that the growth rate of GDP per capita decreases by 0.2 - 0.3 percentage points when the average inflation rate exceeds by 10 percentage points (19) according to his study of 100 countries during the 1960 to 1990 time period. In addition, Hodge argues that the growth rate declines by 0.25 percentage points for a percentage point increase in the inflation rate in South Africa (163).

Moreover, Jha and Dang examine the effect of economic growth and inflation variability using annual data from both developing and developed countries (1). The said study which included 182 developing countries and 31 developed countries covering the period 1961-2009, suggests

that there is significant evidence that beyond the 10 percent inflation rate, inflation variability has a harmful effect on economic growth for developing countries and there is no such significant evidence in the context of developed countries (10).

2.3. Non-linear relationship of inflation and growth

The above summary of literature gives evidence to both the positive and negative relationship between inflation and growth. As mentioned earlier, many studies highlight the negative relationship beyond a particular level of rate of inflation (Barro 19), (Jha & Dang 10). The study by Fischer, which is regarded as the first research that identified a non-linear relationship between inflation and growth, highlighted that low inflation rates have a positive impact on growth (485). It is further argued that inflation leads to a reduction in investment and productivity growth and hence, beyond a threshold limit, inflation has an adverse effect on economic growth (Sarel 199). Further, Pollin and Zhu reveal a positive relationship between output growth and high inflation up to 15-18 per cent of the inflation threshold level and their estimates for 80 middle and low income countries for the period 1961-2000 (593). These findings suggest that targeting inflation at low levels around 3-4 per cent is not really necessary for emerging economies and doing so might harm economic growth.

The non-linearity of the inflation–growth nexus has been investigated in a research done by Mohanty et al., which takes into consideration the structural changes of the Indian economy (14). They suggest an inflation threshold between 4 - 5.5 per cent for India (14). However, an earlier study by Singh identifies the inflation threshold level for India as 6 per cent (3209). Furthermore, using annual data for the period 1971-1998, Singh and Kalirajan attempt to find the inflation threshold for India (377). Yet, they found that there is no significant structural break or an inflation threshold for India and conclude that any level of rise in inflation will have a negative effect on GDP growth rate for India (377). Similarly, Sepheri and Moshiri adopted the same methodology used by Sarel for four different group of countries that are in various stages of development (191). The results indicated that the inflation-growth nexus is non-linear for all groups except for OECD[4] countries where, the inflation threshold is 21 percent for lower-middle income countries, 15 percent for low-income countries and 4 percent for upper-middle income countries (191).

According to the results of Espinoza et al.'s study, which examined 165 countries over the period 1960–2007, it is evident that for developing countries inflation above a threshold of about 10 percent rapidly becomes unfavourable to growth (12), implying the need to take

[4] OECD -The Organization for Economic Cooperation and Development comprises a group of countries which account for 63 percent of world GDP, three-quarters of world trade, 95 percent of world official development assistance, over half of the world's energy consumption, and 18 percent of the world's population.

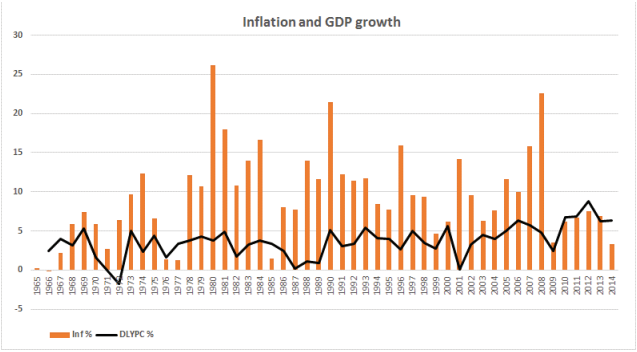
immediate policy actions to maintain inflation at a single digit level. However, in the context of advanced economies, threshold effect has not been proven and hence any level of inflation damages growth (Espinoza et al. 12). Furthermore, by using panel data and the Panel Smooth Transition Regression (PSTR) method on the Southern African Development Community, Seletang et al. reveal an inflation threshold of 18.9 per cent, beyond which, there will be harmful effects on the economic growth (149).

3. Data and Methodology

The rate of inflation in Sri Lanka is measured by the change in the Colombo Consumer Price Index (CCPI). The CCPI is computed to indicate average changes in the prices of goods and services purchased by households in urban areas of the Colombo district, the Capital city of Sri Lanka. The consumer basket includes 373 items that represent the usual urban households' consumption expenditure. The CPI weights are derived from the Household Income and Expenditure Survey (HIES) 2006/2007. The Department of Census and Statistics (DCS) released a new National Consumer Price Index (NCPI) on November 23, 2015, which reflects more recent changes in the patterns of consumption and expenditure, as revealed by the HIES.

During the 1950s and 1960s the inflation rate in Sri Lanka was 0.7 percent and 2.2 percent, respectively (Cooray 7). However, with the introduction of the open economy in 1977, the rate of inflation started to accelerate and the Sri Lankan economy experienced a high inflation rate (on average more than 10 per cent per annum) during the 1980s, 1990s until about 2009. However, inflation was managed at a single digit level for the last five years since then (CBSL 1). According to Table 1 and Figure 2, the average GDP per capita growth in Sri Lanka tends to decline when the rate of annual inflation exceeds 10 per cent. Further, Figure 1 shows that during periods with single digit annual inflation, the GDP per capita growth in Sri Lanka also increased.

Figure 1: Inflation- GDP Per Capita growth relationship in Sri Lanka, 1965-2014



Source: CBSL, DCS

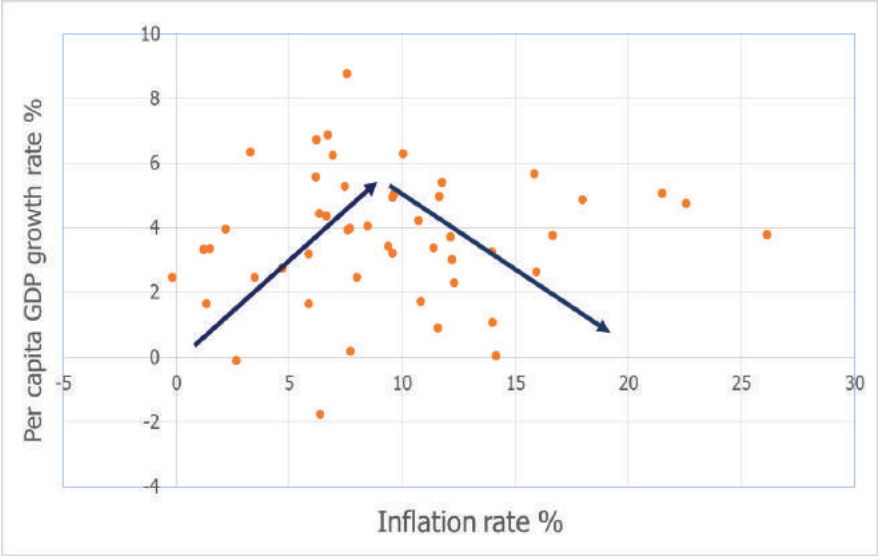
Table1: Inflation- GDP per capita growth relationship in Sri Lanka, 1965-2014

Inflation Range (%)	Average GDP per capita Growth (%)
0-2	2.71
2-4	3.17
4-6	2.54
6-8	4.40
8-10	4.51
10-15	3.11
15-20	4.24

Source: The author's calculations

Hence, a non-linear relationship between inflation and GDP growth is indicated according to Figure 2. As highlighted by Burdekin et al. 2000, the statistical significance of this non-linear relationship and the growth maximising inflation rate need to be examined to recognize a possible structural break in per capita GDP growth rate.

Figure 2: Non-linear relationship between Inflation and per capita GDP growth



Source: The author's findings

Accordingly, the null hypothesis to be tested in this study is that;

H_0: the inflation rate and per capita GDP growth rate has a non- linear relationship and a threshold level of inflation exists for Sri Lanka.

A similar approach to Sarel (207), Singh (377), and Hayat and Kalirajan (18) is used in this study to examine the threshold level of inflation in Sri Lanka and to assess whether that threshold level is statistically significant. The data obtained from the World Bank website and the Central Bank of Sri Lanka (CBSL) for the period 1965-2014 are used in this study. The period of this study is reasonable, given that it covers a variety of inflation episodes in Sri Lanka (as in Figure 1), while at the same time data on most other variables are reliably available beyond 1965.

3.1. Estimating the growth equation

To examine the inflation- growth nexus in Sri Lanka, this study uses the model based on the studies of Barro (423), De Gregorio (59), Levine and Renelt (942), Sala-i-Martin (178), Bruno and Easterly (3), Singh and Kalirajan (377), and Hayat and Kalirajan (8). These empirical studies have emphasized inflation, education and life expectancy variables, capital formation, agriculture value addition, export growth, and money supply (M2) and population growth as the main determinants of growth, among others. Literacy rate is also included in the model since it can affect growth through human capital development. Human capital, education and health are more likely to contribute to GDP by improving productivity. This principle can also be adopted in a single country time series data, ensuring that the variables entering the regression are stationary (Singh & Kalirajan 377).

The present model utilises those potential growth variables suggested in the literature together with a new variable - Foreign Direct Investment (FDI) and Balance of Payments (BOP). The objective is to identify a model with higher explanatory power for analysing the relationship between growth and inflation. Following Hayat and Kalirajan, the estimation begins with two lagged variables for inflation and per capita GDP growth separately (9). Subsequently, other important control variables are included in to the model to test the strength of the inflation coefficient. Accordingly, the following model has been applied to the Sri Lankan context.

$$\mathrm{dl(ypc)}_t = \beta_o + \beta_{1i}\,\mathrm{dl(ypc)}_{t-i} + \beta_{2i}\,(\mathrm{INF})_{t-i} + \beta_{3i}\,\mathrm{dl(Cf)}_t + \beta_{4i}\,\mathrm{dl(M2)}_t + \beta_{5i}\,\mathrm{dl(FDI)}_t + \beta_{6i}\,\mathrm{dl(lit)}_t + \beta_{7i}\,\mathrm{dl(X)}_t + \epsilon_{1t} \quad (1)$$

$\mathrm{dl(ypc)}_t$ -Growth in GDP per capita in period 't';

INF_t -Rate of inflation in period 't';

$\mathrm{dl(Cf)}_t$ -Growth in gross capital formation (% of GDP) in period 't';

$dl(M2)_t$ -Growth in broad money supply in period 't';

$dl(FDI)_t$ -Growth in foreign direct investments (% of GDP) in period 't';

$dllit_t$ -Growth in literacy rate (%) in period 't' ;

$dl(X)_t$ -Growth in exports as percentage of GDP in period 't';

BOP -Balance of payments as a percentage of GDP in period 't';

ϵ_{1t} -the stochastic term.

To start with a reduced form, VAR is used to test whether there is any bi-directional causality between GDP per capita growth (dlypc) and inflation (INF). Due to the relatively small size of the time series data, the order of the VAR is decided on by using the Schwarz Bayesian Criterion (SBC) of model selection. A lag length of two is selected accordingly. This study involves lagged terms of inflation and per capita growth (YPC growth) to find any bidirectional causality. Next, using equation (1), the potential effect of lagged inflation is tested using the Ordinary Least squares (OLS) regression, having taken into consideration all the relevant significant explanatory variables.

3.2. The threshold level of inflation

The threshold level of inflation has been examined by Sarel (203), Singh and Kalirajan (377) for India, Mubarik (35) for Pakistan, and later Hayat and Kalirajan (8) for Bangladesh, by utilizing a well specified functional form. In this study, by following Sarel (1996), and Hayat and Kalirajan (2009) in particular to examine the threshold level of inflation for Sri Lanka, the dummy variables are introduced to the basic model to incorporate the concept of extra inflation that is the effect caused by higher actual inflation above the threshold level. Accordingly equation 2 will be estimated using the Ordinary Least Squares (OLS) regression and is iterated with different PIDE i variables.

First, let INF^* be the rate of inflation at the structural break.

Next, a dummy variable is defined as,

$D2 = 1$ if actual INF in period $t > INF*$, and $D2 = 0$ otherwise,

$(i = 4,5,6 \ldots\ldots\ldots\ldots\ldots\ldots 19,20)$

Thirdly, a new variable for the excess inflation over INF* is termed as,

$PIDEi = D2 * (INF - INF*)$ where i is the value of INF*.

Thus, for example, the coefficient of PIDE 7 represent the effect of excessive inflation beyond the inflation threshold INF* of 7 percent.

$$dl(ypc)_t = \beta_1 + \beta_2\, dl(ypc)_{t-1} + \beta_3\, (dlypc)_{t-2} + \beta_4\, (INF)_t + \beta_5\, (INF)_{t-2} + \beta_6\, dl(Cf)_{t-1} + \beta_7\, dl(M2)_t + \beta_8\, dl(lit)_{t-1} + \beta_9\, dl(FDI)_t + \beta_{10}\, dl(X)_t + \beta_{11}\, BOP_{t-1} + \beta_{12}\, PIDE_i + \epsilon_{1t} \quad (2)$$

The iteration of the regression with PIDE i and INF as the regressors produce a series of regression statistics corresponding to different chosen values of INF*. As suggested by Singh and Kalirajan (377), the applicable estimators for contemporaneous inflation are: When inflation is low (INF < INF*), the PIDE i= 0, and the related estimator for inflation is INF. However when inflation is high (INF > INF*), then the relevant estimator is the sum of the two coefficients: the coefficient of INF and PIDE i.

According to Hayat and Kalirajan, running iterative regressions at different chosen threshold values will result in finding the value at which a significant structural break occurs with the largest R2 and F-value (8). It is also required that the sum of the coefficients of both the INF and PIDEi variables be positive and statistically significant to be considered as the threshold level of inflation. The coefficient of PIDEi will explain the variance in the inflation effect on growth before and after the structural break and the significance of the threshold is determined by its t-statistic value (Sarel 208).

4. Estimation results and analysis

According to Table 2, during the last 50 years, the mean figure of the annual average per capita GDP (YPC) of Sri Lanka is USD 859 and average annual inflation rate is 9.26 percent. The average of the year on year growth in GDP per capita income (DLYPC) is 3.8 percent. The average literacy rate during the last 50 years is approx. 88 percent. Further, an average of approx. 1 per cent growth in population is evidenced.

Table 2: Descriptive Statistics

	YPC	INF	CF	AGRI	BOP	FDI	POP	LIT	M2
Mean	859	9.26	23.28	22.839	-4.394	0.819	16582900	87.921	32.124
Median	693	8.21	24.262	26.328	-3.8	0.925	16920000	86.778	31.714
Maximum	2136	26.15	33.768	33.165	3.5	2.850	20869000	91.181	41.716
Minimum	353	-0.156	12.531	9.860	-16.4	0.030	11164000	86.778	17.946
Std. Dev.	464	5.693	5.237	7.009	3.443	0.673	2968150	1.857	6.311
Skewness	1.082	0.740	-0.387	-0.660	-0.836	0.454	-0.23116	0.997	-0.316
Kurtosis	3.350	3.643	2.24	1.939	4.846	2.919	1.753917	2.020	2.137
Jarque-Bera	10.020	5.429	2.453	5.980	12.928	1.730	3.680	10.286	2.384
Probability	0.007	0.066	0.293	0.050	0.002	0.421	0.159	0.006	0.304
Observations	50	50	50	50	50	50	50	50	50

	DLYPC	DLCF	DLAGRI	DLFDI	DLOPOP	DLM2
Mean	0.038	0.007	-0.026	-0.075	0.011	0.005
Median	0.039	0.014	-0.028	-0.009	0.013	0.014
Maximum	0.088	0.268	0.195	3.252	0.023	0.164
Minimum	-0.017	-0.242	-0.340	-4.907	-0.026	-0.160
Std. Dev.	0.021	0.104	0.076	1.106	0.008	0.071
Skewness	-0.293	-0.057	-0.930	-1.589	-2.910	-0.060
Kurtosis	3.367	4.123	9.936	12.001	12.884	3.427
Sum	1.565	0.302	-1.060	-3.069	0.452	0.214
Sum Sq. Dev.	0.017	0.430	0.232	48.959	0.003	0.201

According to Table 3, the Augmented Dicky-Fuller (ADF) test for the stationarity of the variables shows that all variables used in the regression model are stationary at their levels. The trend graphs for all time-series variables and the appropriate lag difference have been taken into consideration.

Table 3: Unit root test results

Variables	ADF Test Statistic	Critical Value	Stationary
GDP per capita growth (dlypc)	-4.478***	-3.574	I(0)
Inflation (inf)	-4.631***	-3.571	I(0)
Gross capital growth (dlcf)	-6.606***	-3.574	I(0)
M2 growth (dlm2)	-5.575***	-3.574	I(0)
Exports growth (dlx)	-6.647***	-3.574	I(0)
Agriculture V.A. growth (dlagri)	-6.415***	-3.574	I(0)
Literacy rate growth (dllit)	-6.963***	-3.574	I(0)
BOP	-4.387***	-3.571	I(0)
FDI growth (dlfdi)	-3.456**	-2.939	I(0)

Notes: *** significant at the 1% level, ** significant at the 5% level

4.1. Estimating the growth equation

This paper attempts to estimate a well specified model to explain the growth inflation relationship. Thus, at the outset, the estimation started with two lags of inflation and per capita growth. Subsequently, other important controlling variables such as Gross Capital formation, Money supply growth, Export growth, FDI growth, literacy rate growth and BOP have been included to test the robustness of the inflation coefficient (Hayat & Kalirajan 8). Since we can suspect a bi-directional causality between inflation and growth, a bi-variate reduced form VAR can be used or pair-wise Granger causality test can be performed to test such a causality. However, Temple argues that if the inflation variable is I(0), as in this study, a bi-variate reduced form VAR or the Granger causality test between inflation and GDP per capita growth rate is uninformative, hence, the inflation effects on GDP per capita growth should be estimated within a full structural model (410).

According to Model 1, only per capita GDP growth of lag 1 shows a positive significant effect on per capita GDP growth, while inflation lags of one and two show no significant effect on per capita GDP growth. However, the inflation lag of one period shows a significant positive effect on the Inflation variable. According to the SBC lag length criteria, two lags of inflation and per capita GDP growth are chosen and other important variables which may have an effect on per capita GDP growth and inflation are included. Any variable that is economically and statistically insignificant at a 10 percent level of significance has been taken out from the regression model and accordingly, the growth equation has been estimated with important controlled variables only.

Finally, as shown in Table 4 (Appendix A), Model 2 is selected as the best specified model due to the inclusiveness of important determinants of per capita GDP growth and due to the statistical significance of most variables. Further, this model gives the highest adjusted R^2 value of 0.65 for GDP per capita growth. Therefore, this can be the representative model to analyse the inflation- growth nexus in Sri Lanka. It is worth mentioning that in Model 1, an inflation lag of two periods, which showed no significance in explaining the GDP per capita growth, becomes significant when other important control variables are added to the model. This implies its increasing robustness on growth after controlling other explanatory variables.

The important features of the well specified model (Model 2) are summarized as follows. DLYPC(-1) and DLYPC(-2), which represent one period lag and two period lags of GDP per capita growth rates, respectively, show significant positive effects on the GDP per capita growth rate of Sri Lanka. Further, the inflation lag of one period and inflation lag of two periods show a positive effect on GDP per capita growth rate, yet only the inflation lag of two periods is statistically significant at a 5 percent level of significance. The positive relationship of lagged inflation and the GDP per capita growth of Sri Lanka has previously been highlighted by Cooray (2013). Furthermore, Malik and Chowdhary have also emphasised the long run positive relationship between inflation and growth in Sri Lanka, India, Bangladesh and Pakistan (123). One period lag of the growth in gross capital formation has a highly significant positive effect on DLYPC.

It is noteworthy that growth in the current period gross capital formation (DLCF) has no significant impact on GDP per capita growth rate, but the growth in the capital formation lag of one period (DLYPC(-1)) shows a positive relationship with GDP per capita growth rate at the one per cent significant level. It is an indication that the capital formation takes some time to have an effect on growth in Sri Lanka. In favor of this result, Mundel and Tobin (671)[5] cited in Dutta and Mukhopadhyay predict a positive relationship between the rate of inflation and the rate of capital formation (416). They argue that inflation reduces people's wealth due to the decline in the rate of return on individual's real money balances. Thus, households save more by switching to assets, in order to accumulate desired wealth and subsequently, greater savings lead to greater capital accumulation which expedites the output growth. Model 2 also discovers a significant positive contribution of export growth to GDP per capita growth rate, as expected. An unexpected feature in this model is that the growth in money supply (DLM2) has a highly significant negative effect on GDP per capita growth rate.

Next, the potential effect of current inflation has been tested using the OLS regression in the most well specified model, having taken into consideration all the relevant significant

[5] The Tobin and Mundel effect (1965) explains that an increase in inflation increases capital formation in the long run.

explanatory variables. The impact of contemporaneous inflation along with two lags of inflation has been examined in Model 3 (Table 5 Appendix B). Accordingly, it can be seen that the inclusion of contemporaneous inflation along with other significant controlled variables has improved the goodness-of-fit from 64 per cent to 66 per cent without any change in significance or signs of the variables. Furthermore, the unbiasedness of the estimated OLS coefficients has been tested using diagnostic tests such as the Durbin Watson test for Serial Autocorrelation, ARCH (2) test for Heteroscedasticity and residual normality tests (Appendix E, F) for which the results have been reported in the respective tables.

It is noteworthy that the negative effect of contemporaneous inflation on the GDP per capita growth is not statistically significant. The sum of the inflation coefficients is almost zero. According to the Wald test of coefficient restriction, the null hypothesis that the sum of the two coefficients being zero, is not rejected. This means that the significant positive effects of inflation that is realized after a gap of two years is neutralized by the negative effects of the contemporaneous change in inflation.

The statistically significant positive relationship between per capita GDP growth and the inflation lag of two periods suggest that the per cent 1 increase in prices (ie. inflation) has led to an increase in 0.1 per cent GDP per capita growth after a period of two years. It is important to analyze how lagged inflation must have affected the per capita GDP growth positively in Sri Lanka.

Inflation in Sri Lanka is measured by the Colombo Consumer Price Index (CCPI) and more than 53 percent of the CCPI is contributed by food items (CBSL 85). Therefore, price rises in agricultural food such as rice and other cereals should have greatly contributed to the rise in CPI. Ceriani et al. reveal that there has been a greater poverty reduction in Sri Lanka, when compared with other countries in South Asia. According to their findings, the contributory factors for the sharp reduction in monetary poverty which occurred in Sri Lanka over the last decade was mainly due to the growth in labour income (12). Such labour income growth accounted for about 60 per cent of the reduction in poverty in the South Asian countries: Bangladesh, Nepal and Sri Lanka (which is measured by the US$ 1.25 a-day poverty line).

The salient result from Ceriani et al. is that most of the growth in labour incomes of the poor in Sri Lanka is due to the higher income to self-employed farm workers and salaried nonfarm workers, which is a result of the increase in commodity food prices (12). Therefore, it can be argued that although inflation in Sri Lanka has contemporaneous negative effects on per capita GDP growth, the inflation lag of two years bring positive effects on per capita GDP growth for the self-employed agriculture workers.

It is noteworthy that the robustness of the estimated regression results is tested by analysing to what extent the assumptions of the ordinary least squares regression are valid in this study. The estimation of the growth equation has been carried out using the OLS regression and

these estimates have been used to identify the inflation threshold for Sri Lanka. Hence, the study tests whether the OLS assumptions are valid in this context and confirms that the residuals of regressions are normally distributed with mean zero and constant variance (Appendix D, E). The residuals are confirmed to be homogenous and no serial correlation exists (Appendix F) and thus, the regression estimates in this study are considered as unbiased and efficient estimates.

4.2. Estimation of threshold level of inflation for Sri Lanka

In order to examine whether there is any structural break for GDP per capita growth in Sri Lanka, Model 3 has been chosen as the basic model due to its highest explanatory power and also due to the statistical and economical significance of the variables (Hayat & Kalirajan 8). In this model, current inflation, inflation which lagged two years, growth in gross capital formation, growth in broad money supply, export growth, growth in literacy levels, FDI growth, BOP have been included for the analysis of the threshold level of inflation. In fact, 17 values of INF* or threshold inflation from the range between 4 and 20 have been chosen for the iteration as PIDE 4, PIDE 5,…,PIDE 20. The following model is regressed with different PIDE values.

$$\mathrm{dl(ypc)}_t = \beta_1 + \beta_2\,\mathrm{dl(ypc)}_{t-1} + \beta_3\,(\mathrm{dlypc})_{t-2} + \beta_4\,(\mathrm{INF})_t + \beta_5\,(\mathrm{INF})_{t-2} + \beta_6\,\mathrm{dl(Cf)}_{t-1} + \beta_7\,\mathrm{dl(M2)}_t + \beta_8\,\mathrm{dl(lit)}_{t-1} + \beta_9\,\mathrm{dl(FDI)}_t + \beta_{10}\,\mathrm{dl(X)}_t + \beta_{11}\,\mathrm{BOP}_{t-1} + \beta_{12}\,\mathrm{PIDE}_i + \epsilon_{1t} \quad (2)$$

The iteration generating a series of regression statistics corresponding to different chosen values of INF* (threshold inflation) shows that the 9 per cent (corresponds to PIDE 9) threshold inflation level, both R^2 and F-statistics is the maximum (Appendix G). Further, the coefficient of PIDE 9 is also statistically significant at the 5 per cent significance level (Refer Model 5, Table 6 in Appendix C). It should be noted that the coefficients of PIDE 4 to PIDE 20 are all positive but statistically insignificant at any level of significance in the respective regressions, yet, the coefficients of lagged inflation are positive and significant at a 5 per cent level of significance (Appendix D). The contemporaneous inflation has a negative relationship with GDP per capita growth, but it is not statistically significant.

Figure 3 and Figure 4 present the series of R square values and log likelihood values plotted against the different values of chosen inflation threshold. From Figure 3 and Figure 4 it can be said that the structural break occurs at the 9 per cent level of inflation in Sri Lanka (Sarel 203). However, in order to interpret 9 per cent inflation level as the threshold inflation for Sri Lanka, this structural break should be statistically significant. The significance of the threshold level at 9 per cent can be examined by using the Wald test to test whether the sum of the inflation coefficients are significantly different from zero.

Figure 3: R square values of the series of regressions

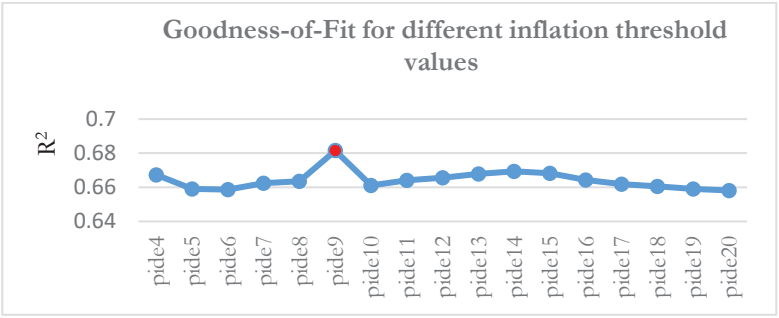
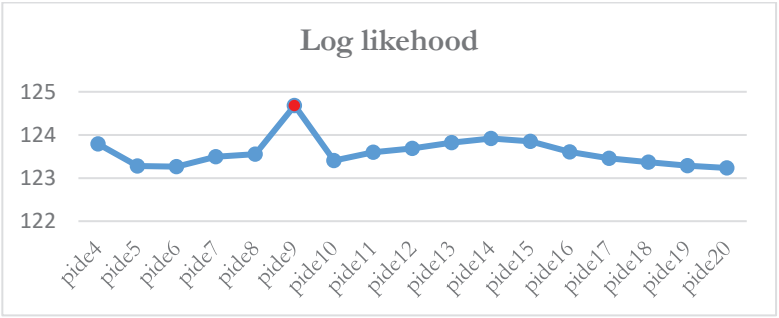


Figure 4: Log likelihood values of the series of regressions



According to Singh and Kalirajan, at some value of INF*, the log likelihood of the regression is maximized (and the sum of the squared residuals is minimized) but the value of INF* at which the sum of the coefficients of INF and PIDE i significantly change signs (positive to negative) may be less than at INF* (385). Therefore, the analysis of the entire set of coefficients is equally important in deciding the target inflation level. To be precise, if the previously identified 9 percent inflation rate is to be a significant threshold, then at a 10 percent inflation rate, the sum of inflation coefficients has to be significantly negative, implying that beyond the single digit inflation, there should be adverse effects for the per capita income growth of Sri Lanka.

The Wald test results in Table 7 highlight that the sum of coefficients of contemporaneous inflation, lagged inflation and PIDE variable are all almost zero at all chosen values of the threshold inflation (Appendix D). Further, the P values of the Wald test indicate that the said positive effect of inflation variables towards the GDP per capita growth rate in Sri Lanka are not statistically significant. This clearly suggests that there is no significant structural break in the inflation-growth nexus in Sri Lanka. Further, as highlighted in Singh and Kalirajan, the

non-existence of a structural break (390) can also be visualized from the observation of the plots of the R square and the plots of the log-likelihood for these models in Figures 3 and 4. These curves are flat and not much of a slope can be seen from either side of these curves. Similar results of the inflation threshold level have been identified by Singh for India (3209) and Hayat and Kalirajan for Bangladesh, and those studies concluded that such inflation thresholds found are not statistically significant (18).

Table 7: Wald Test Results for Inflation variables

Model with Extra Inflation Variable	Sum of the inflation coefficients	Wald Test for Sum of Co-efficient (H0)	F value (P value)
PIDE 8	$\beta_4+ \beta_5+\beta_{12}= 0.000582$	$H_0: \beta_4+ \beta_5+ \beta_{12}= 0$	0.599 (0.445)
PIDE 9	$\beta_4+ \beta_5+ \beta_{12}= 0.000795$	$H_0: \beta_4+ \beta_5+ \beta_{12}= 0$	1.181 (0.286)
PIDE 10	$\beta_4+ \beta_5+ \beta_{12} = 0.000623$	$H_0: \beta_4+ \beta_5+ \beta_{12}= 0$	0.550 (0.464)

Accordingly, it is evident that the inflation threshold at 9 per cent is not statistically significant and moreover, this study suggests that there is no negative effect of inflation towards the GDP per capita growth at any rate of inflation in Sri Lanka. This is an indication that any adverse effects of contemporaneous inflation are neutralized from the significant positive effects from the inflation lag of two periods. Further, it is also can be explained that beyond the 9 per cent inflation rate, there are neither significant positive nor negative cumulative effects from inflation variables towards the GDP per capita growth rate in Sri Lanka.

5. Conclusion

Policymakers throughout the world during the last decade have acted on the understanding that lowering inflation is conducive to higher growth performance. Taking into consideration one of the main objectives of the Central Bank of Sri Lanka, which is to maintain price stability, this study sheds light on important policy actions taken by the Central Bank. As Mohanty et al. emphasise, inflation targeting and the inflation threshold are two different concepts, where under the inflation targeting mechanism, a central bank announces a 'target' and then directs its policy tools towards achieving that target (14). Inflation threshold is a point of inflection for the growth-inflation relationship. Therefore, Mohanty et al. suggest that the inflation threshold need not necessarily be the 'target' of monetary policy in the Central Bank (14). The target level of inflation for monetary policy should be lower than the inflation threshold, considering the existence of significant lags in the transmission of monetary policy measures and the costs of inflation.

In view of the above, this study mainly aimed at identifying a non-linear relationship between inflation and per capita GDP growth in Sri Lanka. The estimated results based on annual data from 1965 to 2014 reject the null hypothesis that the inflation rate and per capita GDP growth rate have a non-linear relationship, and that a threshold level of inflation exists for Sri Lanka. Therefore, there is no statistically significant evidence to suggest that there exists a non-linear relationship between per capita GDP growth and rate of inflation in Sri Lanka. The study reveals an inflation rate of 9 per cent, which maximises the per capita GDP growth rate. However, the results do not confirm any significant structural break in per capita GDP growth rate when the inflation rate exceeds 9 per cent. Interestingly, this level of inflation rate of 9 per cent is closer to the inflation threshold of 8 per cent suggested by Sarel in his study, where Sri Lanka was also included (199). Furthermore, a new series of GDP and CCPI have been released since conducting this research study, which may lead to a change in the results of this study if those new series are used.

Moreover, some conjectures can be made for the statistical insignificance of the inflation threshold such as errors in data, and not including the savings and investments variables. Due to the lack of data, this study could not incorporate the savings and investment variables to test how the inflation will effect growth, through changes in savings and investments in Sri Lanka. As explained by Tobin and Mundell, higher inflation leads to lower real interest rates and in turn lead to portfolio adjustment away from real money balance towards real capital (671). Hence, an increase in real investment will result in faster growth. Another limitation of this study is that the impact on growth from core and headline inflation cannot be distinguished due to the lack of data. Thus, this is an important area for further research. Since core inflation is less volatile and can be anticipated to a greater extent than the headline or the noncore component of inflation, core inflation is likely to have a lower impact on long-term growth.

One of the important findings of this study is the non-existence of an inflation threshold for Sri Lanka. The identified 9 per cent growth maximising inflation threshold is not statistically significant. It can be further highlighted that the total effect from contemporaneous inflation and lagged effect of inflation towards the GDP per capita growth in Sri Lanka is not negative, as expected. Further, testing for the cumulative effect of inflation variables indicate that there is neither a significant positive effect nor a significant negative effect of inflation that exists for the per capita GDP growth rate of Sri Lanka. The results however are not in favour of the view for maintaining inflation at very low levels, since the per capita GDP growth is maximised at the inflation rate of 9 per cent. Since, Sri Lanka is an emerging economy, it is important to maintain inflation at a moderate level and prevent adverse effects to the economy either through very low inflation rates or through very high inflation rates. Thus, it suggests that maintaining inflation at single digital levels is prudent and in line with the Central Bank's objective of maintaining economic and price stability.

References

Barro, RJ., "Inflation and economic growth", Annals of Economic and Finance, vol. 1, no. 14, 2013, pp. 85-109.

Barro, R., *Inflation and growth*, Handbook of Monetary and Fiscal Policy, 2001, pp. 423–442.

Burdekin, RCK, Denzau, AT, Manfred WK, Sitthiyot, T, & Willett, TD., *Working Papers in Economics*, Claremont Colleges, 2000

Bruno, M & Easterly, W. "Inflation crises and long-run growth", *Journal of Monetary Economics*, vol. 1, no. 41, 1998, pp. 3-26.

Barro, RJ., "Inflation and economic growth", *NBER Working Paper Series*, no. 5326, National Bureau of Economic Research, USA, 1995

Barro, RJ., "Economic growth in a cross section of countries", *The Quarterly Journal of Economics*, vol. 2, no. 106, 1991, pp. 407-443.

Ceriani, L, Inchauste, G & Olivieri, S., "Understanding poverty reduction in Sri Lanka, Evidence from 2002 to 2012/13", *Policy Research Working paper*, no. 7446, Poverty Global Practice Group, World Bank Group, USA, 2015

Cooray, NS., "An empirical analysis of inflation-growth nexus in developing countries: the case of Sri Lanka", International University of Japan, Japan, 2013

Central Bank of Sri Lanka, *Objectives, functions and organization*, Central Bank of Sri Lanka, Colombo, 2005

Datta, K & Mukhopadhyay, CK., "Relationship between inflation and economic growth in Malaysia - An econometric review", *International Conference on Economics and Finance Research*, Singapore, 2011

De Gregorio, J. "Economic growth in Latin America", *Journal of Development Economics,* vol. 39, 1992, pp. 59-84.

Espinoza, R, Leon, H & Prasad, A., "When should we worry about inflation?", *The World Bank Economic Review*, vol. 26, no. 1, 2012, pp. 100–127.

Feldstein, M. "The costs of going from low inflation to price stability", *NBER Working Paper series*, No. 5469, National Bureau of Economic Research, Cambridge, 1996

Fischer, S., "The role of macroeconomic factors in growth", *Journal of Monetary Economics*, vol. 32, no. 3, 1993, pp. 485-512

Ghosh, A & Phillips, S., "Warning: Inflation may be harmful to your growth", *IMF Staff Papers*, vol. 45, no. 4, 1998, pp. 672-710.

Hayat, CZ & Kalirajan, K., "Is there a threshold level of inflation for Bangladesh?", *The Journal of Applied Economic Research,* vol. 3, 2009, pp. 1-20.

Hodge, D., "Inflation and growth in South Africa", *Cambridge Journal of Economics*, vol. 30, 2005, pp. 163-180.

Jha, R & Dang, N., "Inflation variability and the relationship between inflation and growth", *Macroeconomics and Finance in Emerging Market Economies*, vol. Online 14 Dec 2011, pp. 1-15.

Judson, R & Orphanides, A., "Inflation, volatility and growth", *International Finance,* vol. 2, no. 1, 1999, pp. 117–138.

Khan, MS & Senhadji, AS., 2001, "Threshold effects in the relationship between inflation and growth", Technical Report, *IMF Staff paper*, no. 48, 2001

Levine, R & Renelt, D., "A sensitivity analysis of cross-country growth regressions", *The American Economic Review,* vol. 82, no. 4, 1992, pp. 942–963.

Mohanty, D, Chakraborty, AT, Das, A & John, J., "Inflation threshold in India: an empirical investigation", Department of Economic and Policy Research, Reserve Bank of India, 2011

Mubarik, YA., "Inflation and growth: an estimate of the threshold level of inflation in Pakistan", *State Bank of Pakistan Research Bulletin,* vol. 1, 2005, pp. 35-44.

Mallik, G & Chowdhury, A., "Inflation and economic growth: evidence from four south Asian countries", *Asia-Pacific Development Journal*, vol. 8, no. 1, 2001, pp. 123-135.

Pollin, R & Zhu, A., "Inflation and economic growth: A cross-country nonlinear analysis", *Journal of Post Keynesian Economics,* vol. 28, no. 4, 2006, pp. 593-614.

Phillips, AW., "Employment, inflation and growth", *Economica*, New Series, vol. 29, no. 113, 1962, pp. 1-16.

Seleteng, M., Bittencourt, M. and van Eyden, R., "Non-linearities in Inflation-Growth Nexus in the SADC Region: Panel Smooth Transition Regression Approach", *Economic Modelling*, vol. 30, 2013, pp. 149-156.

Singh, P., "Searching threshold inflation for India", *Economics Bulletin*, vol. 30, no .4, 2010, pp. 3209-3220.

Sepehri, A & Moshiri, S., "Inflation-growth profiles across countries: evidence from developing and developed countries", *International Review of Applied Economics*, vol. 18, no. 2, 2004, pp. 191–207.

Singh, K & Kalirajan, K., "The inflation-growth nexus in India: an empirical analysis", *Journal of Policy Modeling,* vol. 25, 2003, pp. 377–396.

Sala-i-Martin, XX., "I just ran two million regressions", *The American Economic Review,* vol. 87, no. 2, 1997, pp. 178–183.

Sarel, M., "Nonlinear effects of inflation on economic growth", *IMF Staff Papers*, 43(1), 1996, 199-215.

Temple, J., "Inflation and growth: Stories short and tall", *Journal of Economic Surveys*, vol. 14, no. 4, 2000, pp. 395 – 432.

Tobin, J., "Money and economic Growth", *Econometrica*, vol. 33, 1965, pp. 671-684.

Appendices

A. Table 4: Growth Equation

	Model 1	Model 2
	DLYPC	**DLYPC**
DLYPC(-1)	0.300**	0.385***
	(0.152)	(0.129)
DLYPC(-2)	0.243	0.435***
	(0.155)	(0.142)
INF(-1)	0.000	0.0005
	(0.001)	(0.001)
INF(-2)	0.000	0.002**
	(0.001)	(0.001)
C	0.018	0.004
	(0.009)	(0.008)
DLCF(-1)		0.082***
		(0.025)
DLM2		-0.110***
		(0.034)
DLLIT(-1)		0.444
		(0.407)
DLFDI		0.003
		(0.002)
DLX		0.118**
		(0.038)
BOP(-1)		0.003*
		(0.001)
R-squared	0.189	0.641
Adj. R-squared	0.111	0.521
Log likelihood	121.32	122.22
Akaike AIC	-4.95	-5.43

Notes: *Values in parenthesis are standard errors. ***significant at 1% level, ** significant at 5% level, *significant at 10% level.*

B. Table 5: Growth Equation with Current year Inflation

	Model 3
Variable	**DLYPC**
C	0.015
	(0.009)
DLYPC(-1)	0.405***
	(0.125)
DLYPC(-2)	0.337**
	(0.139)
INF	-0.001
	(0.001)
INF(-2)	0.002**
	(0.001)
DLCF(-1)	0.099***
	(0.026)
DLM2	-0.142***
	(0.039)
DLLIT(-1)	0.654
	(0.392)
DLFDI	0.004*
	(0.002)
DLX	0.102***
	(0.035)
BOP(-1)	0.002**
	(0.001)
R-squared	0.66
Adjusted R-squared	0.54
DW Stat	2.177
LM (2) Serial Correlation	0.174 (0.841)
Heteroscedasticity Test: ARCH	0.774 (0.469)

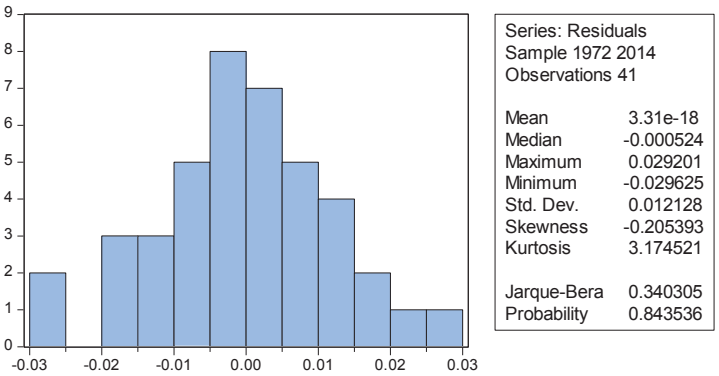
Notes: *Values in parenthesis are standard errors. ***significant at 1% level, ** significant at 5% level, *significant at 10% level.*

C. Table 6: Threshold Level of Inflation for Sri Lanka

	Model 4	Model 5	Model 6
Variable	DLYPC	DLYPC	DLYPC
C	0.022	0.027	0.020
	(0.014)	(0.012)	(0.013)
DLYPC(-1)	0.410***	0.424***	0.407***
	(0.127)	(0.124)	(0.127)
DLYPC(-2)	0.321**	0.291**	0.319**
	(0.142)	(0.140)	(0.145)
INF	-0.002	-0.003**	-0.002
	(0.002)	(0.001)	(0.002)
INF(-2)	0.002**	0.002**	0.002**
	(0.001)	(0.001)	(0.001)
DLCF(-1)	0.100***	0.098***	0.099***
	(0.026)	(0.025)	(0.026)
DLM2	-0.146***	-0.145***	-0.144***
	(0.040)	(0.039)	(0.040)
DLLIT(-1)	0.761*	0.772*	0.708*
	(0.426)	(0.393)	(0.412)
DLFDI	0.005**	0.005**	0.005*
	(0.002)	(0.002)	(0.003)
DLX	0.107***	0.108***	0.105***
	(0.037)	(0.035)	(0.036)
BOP(-1)	0.002*	0.001*	0.002*
	(0.001)	(0.001)	(0.001)
PIDE 8	0.001	-	-
	(0.002)		
PIDE 9	-	0.002	-
		(0.002)	
PIDE 10	-	-	0.001
			(0.002)
R-squared	0.663	0.682	0.661
Adjusted R-squared	0.536	0.561	0.532
DW Stat	2.155	2.178	2.163
LM (2) Serial Correlation	0.153 (0.859)	0.230 (0.796)	0.163 (0.851)
Heteroscedasticity Test: ARCH	0.719 (0.494)	0.486 (0.619)	0.671 (0.518)

Notes: *Values in parenthesis are standard errors. ***significant at 1% level, ** significant at 5% level, *significant at 10% level.*

D. Residual Test – Histogram Normality Test of Model 3 (Table 5)



E. Residual Test - Hetroskedasticity ARCH Test of Model 3 (Table 5)

Heteroskedasticity Test: ARCH

F-statistic	0.773733	Prob. F(2,34)	0.4692
Obs*R-squared	1.610698	Prob. Chi-Square(2)	0.4469

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 11/13/15 Time: 09:25
Sample (adjusted): 1974 2014
Included observations: 37 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.000171	5.53E-05	3.098538	0.0039
RESID^2(-1)	-0.192785	0.172165	-1.119769	0.2707
RESID^2(-2)	0.051750	0.172783	0.299509	0.7664

R-squared	0.043532	Mean dependent var	0.000149
Adjusted R-squared	-0.012730	S.D. dependent var	0.000223
S.E. of regression	0.000224	Akaike info criterion	-13.88826
Sum squared resid	1.71E-06	Schwarz criterion	-13.75765
Log likelihood	259.9329	Hannan-Quinn criter.	-13.84221
F-statistic	0.773733	Durbin-Watson stat	2.033046
Prob(F-statistic)	0.469240		

F. Residual Test – Serial Correlation Test of Model 3 (Table 5)

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.174073	Prob. F(2,28)	0.8411
Obs*R-squared	0.503526	Prob. Chi-Square(2)	0.7774

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 11/13/15 Time: 09:32
Sample: 1972 2014
Included observations: 41
Presample and interior missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.001334	0.009736	-0.137038	0.8920
DLYPC(-1)	0.066565	0.173372	0.383944	0.7039
DLYPC(-2)	-0.026705	0.208206	-0.128261	0.8989
INF	-6.53E-05	0.000610	-0.107064	0.9155
INF(-2)	5.95E-05	0.000527	0.113003	0.9108
DLCF(-1)	-0.001596	0.026943	-0.059244	0.9532
DLM2	-0.007485	0.042696	-0.175308	0.8621
DLLIT(-1)	-0.047782	0.428782	-0.111436	0.9121
DLFDI	0.000467	0.002394	0.195189	0.8467
DLX	-0.005284	0.038518	-0.137193	0.8919
BOP(-1)	4.37E-06	0.000872	0.005010	0.9960
RESID(-1)	-0.171813	0.291260	-0.589894	0.5600
RESID(-2)	-0.000935	0.283093	-0.003301	0.9974

R-squared	0.012281	Mean dependent var	3.31E-18
Adjusted R-squared	-0.411027	S.D. dependent var	0.012128
S.E. of regression	0.014406	Akaike info criterion	-5.389508
Sum squared resid	0.005811	Schwarz criterion	-4.846180
Log likelihood	123.4849	Hannan-Quinn criter.	-5.191658
F-statistic	0.029012	Durbin-Watson stat	1.992748
Prob(F-statistic)	1.000000		

G. Table 7: Regression results and sum of inflation coefficients of the iterations done using PIDE 4 to PIDE 9

Model with	R square	log like	β_4	β_5	β_{12}	$\beta_4+\beta_5+\beta_{12}$
pide4	0.667	123.790	-0.00548	0.00130**	0.00467	0.00048
pide5	0.659	123.283	-0.00015	0.00130**	-0.00074	0.00041
pide6	0.659	123.262	-0.00011	0.00126**	-0.00078	0.00037
pide7	0.662	123.494	-0.00226	0.00129**	0.00144	0.00046
pide8	0.664	123.556	-0.00202	0.00130**	0.00130	0.00058
pide9	0.681	124.682	-0.00259**	0.00120**	0.00219	0.00080
pide10	0.661	123.406	-0.00154	0.00129**	0.00088	0.00062
pide11	0.664	123.597	-0.00170	0.00129**	0.00120	0.00080
pide12	0.666	123.688	-0.00168	0.00128**	0.00131	0.00091
pide13	0.668	123.821	-0.00171	0.00127**	0.00153	0.00108
pide14	0.669	123.918	-0.00167	0.00125**	0.00166	0.00124
pide15	0.668	123.852	-0.00155	0.00123**	0.00165	0.00132
pide16	0.664	123.606	-0.00138	0.00124**	0.00139	0.00125
pide17	0.662	123.457	-0.00129	0.00125**	0.00123	0.00120
pide18	0.660	123.372	-0.00120	0.00126**	0.00112	0.00118
pide19	0.659	123.288	-0.00108	0.00127**	0.00083	0.00102
pide20	0.658	123.234	-0.00092	0.00128**	0.00019	0.00054

*Notes: ** significant at 5% level, *significant at 10% level.*

A Measurement of Financial Inclusion - Index Development and its Relationships

Vathsalya Weligama [1] [2]

Abstract

The aim of this study is to develop a composite index for financial inclusion. It is a multi-dimensional index as financial inclusion is based on many different aspects of financial systems. This study is an effort to develop a more appropriate, significant and accurate index using more indicators of financial inclusion. The index is developed using indicators on bank accounts, bank branches, number of ATMs, number of POS terminals, number of credit cards, number of debit cards, borrowings, savings, credit purchases, deposits, withdrawals, credit card usage, debit card usage, internet usage and mobile usage for transactions. This study is carried out with the objective of improving the number of variables and assigning weights for the variables methodologically. Accordingly, the composite index for financial inclusion is developed by using the correlation matrix of the variables to derive the weights and then taking the arithmetic mean of the dimensions. The results of the index developed are compared with the countries' income classification, literacy rate, Gini coefficient and the OECD country representation. The analysis shows that the index is developed with more relevant indicators or that the variables well represent the countries' financial inclusion. This index can be used as an indication of the country's financial inclusion and will give a better representation of the financial inclusion ranking of the country and hence, can be used to measure the development of financial inclusion of a country.

***Key Words**: Financial Inclusion, Financial Instruments*

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[1] Senior Assistant Director of the Payments and Settlements Department of the Central Bank of Sri Lanka. vathsalya@cbsl.lk

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1. Introduction

Financial Inclusion (FI) has become a subject of considerable interest developed in the last decade, among many stakeholders of economies, mainly researchers and policy makers. It is fast becoming an important aspect in financial systems developments and thereby in economic development, at a rapid rate.

FI is derived from financial exclusion, an alternative to financial inclusion, which was the subject in discussion previously. Financial exclusion is defined broadly as the inability of some societal groups to access the financial system, by Carbo et al.

Financial exclusion can be either voluntary, due to not having an interest or need, or because of cultural or religious reasons. Or, it can be involuntary, due to insufficient income, high risk profile, discrimination, market failures and imperfections. The development of an economy needs, first to minimize involuntary financial exclusion. It cannot ignore voluntary exclusion as well. Therefore, policy initiatives must first focus on involuntary exclusion as it can be addressed by appropriate economic programs and activities, which can be designed to increase income levels and correct market failures and imperfections. Then, it is required to take initiatives to improve the interest of people towards financial activities (which improves financial intermediation) and to consider cultural and religious aspects in financial activities (well-known example is Sharia law in financial intermediation).

FI is a broad concept. In simple, for the purpose of this paper, FI can be defined as the 'depth and spread of the possibilities of formal financial activities among and throughout the population of an economy.

Improving FI or better FI means higher possibilities for financial activities. This can be achieved by lowering barriers such as geographical and legal difficulties, tight regulations, costs, market failures or imperfections and improve knowledge/knowhow (literacy and information). Having considered these, policy developers have been taking many initiatives to improve FI.

In addition to Central Banks' (policy developers') initiatives, the IMF, G20, International Finance Corporation (IFC), the Alliance for Financial Inclusion (AFI), and the Consultative Group to Assist the Poor (CGAP) are assuming an increasingly active role at the international level in collecting the data and setting standards to improve FI.

Higher FI allows broader access to financial services, brings in more people into formal financial channels, especially the low-income people or disadvantaged groups. It stimulates those disadvantaged groups or the low-income people to be active in financial environments and make benefits for the betterment of them. Further, the availability of appropriate and promising financial services has a direct positive impact on the welfare of the poor. This leads to both social and economic growth (by allowing a greater number of people to support

aggregate demand) of the country, while reducing the inequality or improving the wealth distribution. On the other hand, better FI helps poverty alleviation and overcomes the forms of social exclusion in employment, housing, education and health services.

With the development of technology which improves FI and vise-versa, financial activities have become more efficient and less costly, and thus created avenues for new and innovative financial products and services. These developments in the financial sector lead to make peoples' lives better, allowing people to buy goods and services anytime anywhere, instantaneously. Improved FI allows all stakeholders to see a better picture of the economy's financial strength. Ultimately, FI supports financial stability and restores confidence that has been affected by domestic shocks and global crises.

As mentioned above, there are several policy initiatives already taken in different economies, which are country initiatives, regional initiatives, initiatives by economic cooperation and international initiatives. FI can be mainly driven by policy initiatives and therefore, the regulatory framework needs to support FI though there are conflicts in promoting FI and tightening regulations in order to maintain financial system stability.

To understand the FI state of an economy (a region, a country or a state/ province) and to compare its FI with other economies or peer economies, or to compare its own development through time, or to see development opportunities and generate development insights, it is important have a measurement. But there are several factors that affect FI in an economy and many of them are substantially important. Since there is no dominant factor, FI cannot be measured simply or easily. These factors include, an account in a financial institution, frequency and proximity to access the account, easiness and the quality of the access and financial products, financial literacy, individuals needs and wants, technology developments, availability, access and developments in financial products and services, etc. etc.

The aim of this study is to develop a composite index to measure FI, which will be a multi-dimensional index. In the literature there are a few studies that developed indices of financial inclusion. This study is an effort to develop a more appropriate, significant and accurate index using more indicators of financial inclusion as opposed to literature. The study focuses on combining the important aspects of methodologies that have been used in the past studies to overcome the drawbacks of the methodologies used in those individual studies. Therefore, this study is carried out with the objective of improving the usage of variables and assigning weights for the variables methodologically. The developed FI index can be used as an indication or measurement of a country's FI and its ranking. The FI index relationship to income classifications, literacy rate, Gini coefficient and the OECD countries' representation will be tested in order to examine the relevance of the results.

The rest of the paper is structured as follows. Section Two discusses the literature on FI index developments. Section Three discusses the data and the methodology adopted in this study.

Then given the focus of this study, Section Four is devoted to results and the analysis of the results by testing the relationships. Section Five concludes the study and provides recommendations for further study.

2. Literature Review

2.1 Index for Financial Inclusion

Though it is evident that FI is an important topic in the current context, and as mentioned above many policy initiatives have been taken to improve FI, comparatively, the literature on FI is insufficient. Most studies have looked at the appropriate measures of financial inclusion at the levels of a country or an economy. Some studies focused on the role of financial access in lowering poverty and income inequality. Further, some research are on varying levels of financial inclusion, comparing economies to provide key policy insights for sustainable development.

Burgess and Pande, noticed that the expansion of bank branches in rural India had a significant impact on poverty alleviation. Since the increased interest on FI, it was a time to explore this emerging aspect by measuring the current state within and across countries and following up with the developments. Different approaches have been proposed in the literature including the use of a variety of FI dimensions to econometric estimation. One of the first efforts at measuring financial sector outreach across countries were by Beck et al.. The indicators of banking sector outreach were three dimensional; physical access, affordability, and eligibility. The considered banking services were deposits, loans, and payments.

Honohan constructed a financial access indicator that captures the fraction of adult population in a given economy with access to formal financial intermediaries. The composite financial access indicator was constructed using household survey data for economies with available data on financial access. For those without household survey on financial access, the indicator was derived using information on bank account numbers and GDP per capita. The dataset was constructed as a cross-section series using the most recent data as the reference year, which varies across economies. The measure provided a snapshot of financial inclusion and might not be applicable for understanding changes over time and across economies.

Rojas-Suarez used the same indicator constructed by Honohan to test the significance of various macroeconomic and country characteristics for a group of emerging economies, including some from developing Asia. The results show that economic volatility, weak rule of law, higher income inequality, and social underdevelopment and regulatory constraints significantly lower financial access. In addition, various country groupings were also found to be significant, especially for large emerging economies. However, unlike the estimation of Honohan, Rojas-Suarez used weighted least squares estimation.

Brune et al. conducted field experiments in rural Malawi analyzing venues through which access to formal financial services improve the lives of the poor, with respect to savings products helping them in their farming agriculture activities. Allen et al. explore determinants of financial development and inclusion among African countries and found that by tapping underprivileged households, commercial banks can help improve financial access of the poor in Kenya.

Sarma (measure of financial sector inclusiveness) follows an approach similar to that, which was used by the United Nations Development Programme (UNDP) for the computation of some well-known development indexes such as HDI, HPI and GDI, to construct the indicator (this index has been evolved from Sarma's previous publications in 2008 and 2010).

Sarma first computed a dimension index for each dimension of financial inclusion, assigning weight indicating the relative importance of the dimension in quantifying the inclusiveness of a financial system. He then computes the normalized Euclidean distance of the country's achievement in the n-dimensional space between the worst point and the ideal/best point in the same n-dimensional space. (Normalization done by the distance between the worst point and the ideal/best point to make the value of X lie between 0 and 1). Sarma assigns weightage to each dimension using intuition and then develops the final Index of Financial Inclusion (IFI) by taking the geometric average (normalized inverse Euclidean distance from ideal points).

The three (3) dimensions that Sarma used in his computation of the IFI are;

i. Banking Penetration
   Indicator - Number of deposit bank accounts (per 1000 adult population)

ii. Availability of banking services
   Indicators - Number of bank outlets (per 1000 population)
   Number of ATM (per 1000 population)

iii. Usage
   Indicators - Volume of credit to the private sector / country's GDP
   Volume of deposit mobilized from the private/ country's GDP

The main data source of Sarma's analysis is the Financial Access Survey (FAS) database of the International Monetary Fund (IMF), which disseminates annual data of geographic and demographic outreach on financial services indicators of more than 140 countries from year 2004 to 2010. He enriches his database with data from Central Banks around the world, Bank for International Settlement's 'payment and settlement statistics', International Financial Statistics (IFS) database of the IMF and World Bank's World Development Indicators (WDI). The main limitation he found in developing the index was the insufficiency of data. However, he has come up with an IFI for 94 countries from 2004 to 2010.

Sarma in his study in 2010 compares the computed indices with the European Commission's study on financial exclusion in the EU (25 countries) in 2008, and claims that the index fairly represents the EU study.

Although it is a significant study, Sarma's use of intuition rather than a logic based development of dimension weights/ sub- dimension weights is a significant limitation.

Massara et al. derive a composite index by aggregating intermediate sub-indices of different dimensions. Similar to the indices discussed above, this is also a multidimensional index by aggregating dimensional sub-indices determined after normalizing the variables. This index also follows the same basic sequence of development of HDI, HPI, and GDI similar to the studies discussed above. Massara et al. distinguished or improved their study by proving that the statistical identification of financial inclusion dimensions obtained from a factor analysis are the same as the theoretical dimensions. Further, it assigns various weights for each dimension, different for years, which implies the importance of one measure versus another. The aggregation technique follows a weighted geometric mean. The two dimensions used in this study are;

i. Availability of banking services
   Indicators - Number of bank branches (per 1000 km^2)
   Number of ATM (per 1000 km^2)
ii. Usage
   Indicators - Total resident household depositors with ODCs per 1,000 adults
   Total resident household borrowers with ODCs per 1,000 adults

The data sources of Massara et al. are also the FAS of the IMF with World Bank database. Massara et al. claim that the index they developed for financial inclusion addresses many criticisms made against the similar indices previously developed, namely the lack of an adequate weighting scheme for variables and dimensions and the inability of certain aggregators to capture imperfect substitutability between dimensions. The use of the factor analysis method made the identification of financial inclusion dimensions less arbitrary. They propose improvements in the index by adding SME indices, and also considering other financial institutions (ex: insurance corporations).

The study by Massara et al. also has limitations with regard to data availability. Moreover, they used only two (2) dimensions for the index and excluded account penetration which is as an important dimension. Massara et al. stated that they excluded the variable 'Account' because in the FAS database, data is available as the 'No of accounts per 1000 adults', and therefore they believe that it could potentially introduce a bias in the dataset. Further they stated that in cases where an individual has multiple accounts, the use of formal financial services in a country would be overstated.

Nevertheless, Bank for International Settlements (BIS), '*Payment Aspects of FI'* discusses that having a transaction account as an important factor in FI (p.12). Further, account penetration can be considered as the base factor and the sustainable factor in making people carry out formal financial activities.

2.2 Sustainable Inclusion

The BIS consultative report on payment aspects of FI analyses the basis of setting guiding principles to assist countries that seek to advance financial inclusion in their markets through payments. It briefly discusses transaction accounts and the barriers to the access and usage of such accounts and gives an overview of the retail payments landscape from a financial inclusion perspective. Further, it outlines a framework for enabling access and usage of payment services for the financially excluded. It also discusses on some key policy objectives, suggestions and key actions for consideration in improving FI. The focus should be more on developing solutions to cater to the needs (payment, store value with safely, gateway to other financial services) of individuals and SMEs. The report premises that efficient, accessible, and safe retail payment systems and services are critical for greater financial inclusion while highlighting that a transaction account is an essential financial service that provides the facility to store value safely and serve as a gateway to other financial services.

Financial inclusion measurement is a key, not only for financial sector developments but also for economic and social sector developments in the current context. Yet, there is hardly any research done on developing a measurement instrument for FI. There is no commonly accepted and widely used world standard for a FI index. However, it needs to be a sophisticated and composite index due to the fact that FI is an outcome of several micro economic variables and as a result, the literature shows that there is a huge research gap in the area of FI and IFI, specially because of the unavailability of data. Further, comprehensive aggregating methodologies need to be developed to serve a composite index.

3. Methodology

3.1 Sample and Data Collection

Sources of data

The main source of data for this study is data banks of the World Bank (WB) and IMF. A vast amount of indicators are tabulated for series of years in these data banks and are used to compute several databases such as World Development Indicators, Poverty and Equity Database, Health Nutrition and Population Statistics, G20 Financial Inclusion Indicators and Global Findex (Global Financial Inclusion Database) in the WB 'DataBank' and, Consumer

Price Index, National Accounts, Balance of Payments and International Investment Position, (BOP&IIP) and FAS in the IMF database.

'Global Findex' is a comprehensive user-side survey-based database. It has more than a hundred indicator availability of financial instruments detailed in gender, age group, and household income. The indicators are based on interviews with about 150,000 nationally representative and randomly selected adults in more than 140 economies. This survey is done only for 2011 and 2014 since it is costly and time consuming, needing reasonable amount of effort. It is a joint effort with Gallup World Poll and Bill & Melinda Gates Foundation.

'Financial Access Survey' of the IMF is a database covering Geographical Outreach financial services in a number of financial institution branches, ATMS, mobile money outlets and the Use of financial services in a number of depositors, deposit accounts, borrowers, loan accounts, outstanding loans, and deposits, and mobile money, across 160 countries for the years starting 2006.

Both the sources were accessed to gather data for this study. Data from Global Findex from the World Bank and the FAS from the IMF have been extracted since Findex provides many important indicators but is available only for two years, whereas FAS data is available for a reasonable period of time but with limited indicators to compute IFI. Further, to study the relationships of literacy, wealth distribution and income category to computed IFI, the WDI, 'Poverty and Equity Database' of the WB and UNESCO database have been accessed.

Firstly, the data extracted for the following indicators of the Findex Database for the years 2011 and 2014 for 143 countries are as follows:

1) Account / Transaction Account (% age 15+)[3]
   Respondents who report having an account (by themselves or together with someone else) at a bank, at a financial institution or a mobile account.
2) Commercial bank branches (per 100,000 adults)[4]
3) Automated teller machines (ATMs) (per 100,000 adults)
4) Point-of-sale terminals (POS) (per 100,000 adults)
5) No of credit card holders (% age 15+)
6) No of debit card holders (% age 15+)
7) Borrowed from a financial institution (% age 15+)
   Respondents who report borrowing any money from a bank or another type of financial institution in the past 12 months

[3] (% age 15+) *Denotes the percentage of adult respondents,*
[4] (per 100,000 adults) *Denotes the total number divided by adult population and multiplied by 100,000*

8) Purchased on credit (% age 15+)
Denotes the percentage of respondents who made credit purchases in the past 12 months

9) Saved at a financial institution (% age 15+)
Denotes the percentage of respondents who report saving or setting aside any money at a bank or a of financial institution in the past 12 months

10) Credit card used in the past year (% age 15+)

11) Debit card used in the past year, female (% age 15+)

12) Deposit in the past year (% with an account, age 15+)
Denotes the percentage of respondents with an account who report one or more deposits into the account in the past 12 months. This includes cash or electronic deposits or fund transfers to the account (Ex: Salary receipt)

13) Withdrawal in the past year (% with an account, age 15+)

14) Used the internet to pay bills or buy things in the last year (% age 15+)

15) Used the mobile phone to pay bills or buy things in the last year (% age 15+)

Descriptive Statistics of the data are given in Annexure IV.

In order to expand the study, data for the years from 2010 to 2014 is extracted from the FAS for 123 countries, in the following indicators to represent the above indicators.

1) No of deposit accounts with commercial banks and credit unions per 1000 adults

2) Number of ATMs per 100,000 adults

3) Number of commercial bank & credit unions branches per 100,000 adults

4) Borrowers from commercial banks & credit unions per 1000 adults

5) Depositors with commercial banks & credit unions per 1000 adults

The Findex Database provides micro level data gathered from a sample of individual respondents representing the country, whereas the FAS provides macro level data of a country by getting the country totals against the adult population. Both surveys provide indicators with pros and cons. Sample selection is crucial in Findex, and, if not done effectively, the country representation is misinterpreted, although it provides more accurate and appropriate indicators for FI due to the individual respondents. In the FAS, as country aggregates are taken, the country is well represented, but the accuracy at an individual level is not represented. For the

computation of IFI, Findex data is more relevant. But the availability of data with a reasonable frequency is a matter of concern.

To study the relationships with the computed IFI, data for the following indicators are also tabulated for the period 2010 to 2014 for the countries considered above;

1) Literacy Rate
2) Gini Coefficient
3) Income Classification of Countries

3.2 Variable Selection

15 variables are considered for the computation of IFI, in 3 dimensions. The assignment of variables under the dimensions are as follows.

1. ACCOUNT
   Hold of a deposit account at a financial institution. This is the basic requirement to be financially inclusive, sustainably.
   Proxy : Number of Accounts per Adults

2. ACCESS
   The availability of financial infrastructure and instruments for people's easy access. Improvement in access develops the spread of financial activities.
   The 5 variables (variable 2 to 6) from the Findex database are considered as proxies to develop the dimension.
   Proxies : Number of bank branches, No of ATMs, No of POSs, No of credit cards and No of debit cards available

3. USAGE
   This refers to the use of the above instruments and infrastructure to make financial transactions in a formal channel (with a significant frequency). The objectives of financial inclusion cannot be achieved by simply having access to financial transactions. It is necessary to make the financial transactions through the available channels, in order to improve financial inclusion.
   The 9 variables (variable 7 to 15) from Findex database are considered as proxies to develop the dimension.
   Proxies: Number of adults who borrowed, purchased on credit, saved, used credit card, used debit card, withdrew, deposited, made an internet transaction and made a mobile transaction within the last 12 months

3.3 Computation of the Index

The development of the IFI is the determination of coefficients (XYZ) of dimensions and sub dimensions or assigning weights are carried out following a three-step sequence:

(i) normalization of variables

(ii) determination of coefficients (YZ) of sub dimensions

(iii) determination of coefficients (X) of dimensions

The most popular composite indices of well-being, constructed by the UNDP, such as the Human Development Index (HDI), Human Poverty Index (HPI), and Gender- related Development Index (GDI) follow this basic sequence in developing multidimensional indices.

Similarly, other indices of FI, such as those proposed by Sarma and Massara et al., are based on this three-step sequence.

As discussed previously Sarma computed the index by taking the Euclidean Distance Geometric Mean of the dimensions in his papers 2008 and 2012, which is a similar method used in the global indices above. However, the assignment of weights to the dimensions and sub dimensions is done arbitrarily in these studies of Sarma. Thereafter, he developed the computation to an Euclidian geometric mean in his study in 2012.

Massara et al. developed a comprehensive composite index by running a Factor Analysis, a statistical identification to assign the weights to dimensions and sub dimensions, and develop the Index by aggregating them by taking the simple geometric mean.

In this study the simple arithmetic mean is taken to compute the IFI, as in the case of HDI and GDI[5].

Variable Normalization

There are various normalization approaches in use, however, the most common practical methods are the standardization, the min-max, and the distance to a reference. In this study the distance to a reference method is used. The distance to a reference measures the relative position of a given variable with respect to its reference point. This reference point is named as Optimal Value and values of the variable can be moved in a range of zero to Optimal Value ($0 - O_i$), where O_i is the Optimal Value of i the variable.

The optimal value for the variables are taken from the indicators that are directly related to an individual's performance, such as 'Accounts', 'Credit Cards', 'Debit Cards', 'Credit Card Usage', 'Debit Cards Usage', 'Borrowings', 'Savings', 'Deposits' etc., is one (1) per adult (i.e.

5 HPI is computed using simple geometric mean

100 %)[6]. Then the optimal value for the variables taken from the indicators that are not directly related to an individual's performance, such as bank branches, ATMs and POS terminals need be set, considering its own values. This optimal value is set to the value at 3 Standard Deviations to the right tail from the mean in order to exclude the impact of outliers that can harm the development of a generalized index. This optimal value selection is different to the values taken for variable normalization in the studies of Sarma and Massara et al. Sarma has used set values for the upper bound or the maximum value and Massara et al. used the maximum value of the variable itself, when computing the variable normalization.

$$O_i = \mu_i + 3\,\sigma_i \quad (1)$$

μ_i - mean of ith variable
σ_i - standard deviation of ith variable

In the normalized variable, the score of 1 is the optimum value position, and the normalized value of a country represents its position against the optimal value. The variable normalization formula is;

$$n_{ic} = \frac{x_{ic}}{O_i} \quad (2)$$

x_{ic} - value of ith variable in cth country,
n_{ic} - normalized value of ith variable in cth country

Determination of coefficients for sub dimensions

When determining the coefficients for sub dimensions, the method used in this study defines values by analyzing the correlation matrix for all the variables. Since only the year 2014 has data for all the variables in consideration, it gives the full correlation matrix. For the year 2011, data for five variables, 'Credit Card Usage', 'Debit Card Usage', 'Withdrawals', 'Deposits' and 'Internet Usage' are not available. Therefore, the correlation matrix gives the correlation coefficients for the rest of the variables. It is interesting to see that the correlation matrices for both the years give similar values with a few exceptions.

The methodology adopted to compute the coefficient is to take the average correlation of one variable to the other variables within one dimension. This figure gives the general correlation of that variable with other variables within that dimension. From the two data sets for the years 2011 and 2014, final average correlation coefficient for each of the 15 variables. This

generalized correlation coefficient will be more accurate with availability of more data sets annually.

Considering the attribute of correlation, if two variables are perfectly correlated, it is adequate to take one variable to analyze the characteristics or to calculate the composite index. Conversely, if two variables are perfectly uncorrelated, the two variables need to be analyzed separately and should be considered to calculate a composite according to the importance. Whereas, if the two variables are moderately correlated, the characteristics analysis and composite calculation of the two variables can be considered as equally important. This is the basis to compute the coefficients for the variables using the correlation matrix. The logic is the relevance of selected variable to the composite index is higher when it has low generalized correlation to the other variables and vise-versa. Therefore, it was decided to use the difference between generalized correlation value and one (1.0), and compute the Generalized Variable Coefficient (GVC) as it adds up to one (1.0) in one dimension. Formula (5) calculates the GVC for the variables, which is the sub dimension coefficient.

$$\mathrm{ACV}_i = \frac{\sum_{i=1}^{n} \mathrm{CC}_{ij}}{n-1} \tag{3}$$

CC_{ij} - Correlation Coefficient if *i*th variable and *j*th variable (where $i \neq j$)
ACV_i - Average Correlation of *i*th variable

$$\mathrm{VC}_i = \frac{\sum_{y=1}^{m} (1-\mathrm{ACV}_{iy})}{m} \tag{4}$$

ACV_{iy} - Average Correlation of *i* th variable of year *y*
VC_i - *i*th Variable Coefficient

$$\mathrm{GVC}_i = \frac{\mathrm{VC}_i}{\sum_{i=1}^{n} \mathrm{VC}_i} \tag{5}$$

GVC_i - Generalized Variable Coefficient of *i*th Variable

Determination of coefficients for dimensions (Coefficients of the Composite index)

Dimension Values (DV) are then computed using the formula (6) for the years.

$$\mathrm{DV}_x = \sum_{i=1}^{n} \mathrm{GVC}_i \times \mathrm{VV}_i \tag{6}$$

After generating the DVs for all the countries in the respective years of the data set, IFI, the composite index is then developed computing the simple arithmetic mean[7]. The Final Index is presented as a per cent value, which means the value for 100 adults[8].

$$\mathrm{IFI}_c = \frac{\mathbf{100}}{\mathbf{3}} \sum_{x=1}^{3} \mathrm{DV}_x \tag{7}$$

4. Results and analysis

4.1 Development of IFI

The development of IFI starts with analyzing the correlation matrix for all the variables (Annexure I and II) to define the values for the sub dimensions and the results are tabulated below.

ACCESS

Table 1: GVC for ACCESS variables

Variables	Average Correlation of Variable (ACV)		Variable Coefficient (VC)	Generalized Variable Coefficient (GVC)	
	2014	2011			
Bank Branches	0.49	0.27	0.62	GVC_1	0.3
ATMs	0.64	0.54	0.41	GVC_2	0.2
POS s	0.62	0.55	0.42	GVC_3	0.2
Credit Cards	0.66	0.59	0.37	GVC_4	0.15
Debit Cards	0.63	0.61	0.38	GVC_5	0.15
			2.2		**1.0**

The formula derived for the dimension 'ACCESS' is;

DV access = (0.3 * Branches) + (0.2 * ATM) + (0.2 * POS) + (0.15 * CC) + (0.15* DC)

[7] Global composite indices such as HDI and GDI also adopt the simple arithmetic mean.
[8] From all 15 variables, only 3 variables could not be taken as optimal values per person, but optimal values per 100,000 adults. Since the 12 other variables can be considered as per person values, the overall index is considered as a percentage of per adult value.

USAGE

Table 2: GVC for USAGE variables

Variables	Average Correlation of Variable (ACV)		Variable Coefficient (VC)	Generalized Variable Coefficient (GVC)	
	2014	2011			
Borrowings	0.1	0.1	0.9	GVC6	0.2
Credit Purchases	0.1	0.1	0.9	GVC7	0.2
Savings	0.03	0.55	0.58	GVC8	0.1
CC Usage		0.55		GVC9	
DC Usage		0.58		GVC10	
Deposits		0.52	0.5	GVC11	0.1
Withdrawals		0.51	0.5	GVC12	0.1
Internet Usage		0.6	0.4	GVC13	0.1
Mobile Usage	-0.04	-0.04	1.4	GVC14	0.2
			5.18		**1.0**

Variables 'Credit Card Usage' and the 'Debit Card Usage' is omitted from the computation of the 'USAGE' since those two variables show the perfect correlation to the 'Credit Cards' and 'Debit Cards' respectively. This is discussed in detail in the next section (4.3).

The formula derived for the dimension 'USAGE' is;

$$DVUsage = (0.2 * Borrow) + (0.2 * Cr.Purchase) + (0.1 * Save) + (0.1 * Withdraw) + (0.1 * Deposit) + (0.1 * Internet\ Usage) + (0.2 * Mobile\ Usage)$$

Finally, the composite index formula is;

$$IFI = \frac{100}{3}(Account + Access + Usage)$$

4.2 Results and Discussion

It was noteworthy to find some important points regarding Correlation Matrices. Those are;

- Variable 'Account' is highly correlated with the variables 'Debit card' and 'Savings' with a value of 0.9 and 0.8, respectively. Vis-a-vis 'Withdrawal' and 'Deposits' also show a moderate correlation of 0.6 with the 'Account'. This is common for both

years and emphasizes the common practice, understanding and the commonly accepted logic that possessing a deposit account leads people to save and also to possess a debit card.

- Variables 'Credit Card Usage' and the 'Debit Card Usage' are perfectly correlated to the variables 'Credit Card' and 'Debit Card' respectively in the year 2014 (there is no data for the 'Credit Card Usage' in year 2011). This finding confirms that the usage of card transactions increase, as the number of cards issued increase. Therefore, it is reasonable to consider that possessing a card will lead to card transactions. Considering the perfect correlation, it was decided to drop the variables of 'Credit Card Usage' and the 'Debit Card Usage'.
- 'Internet Usage' for financial transactions is having a strong correlation with a coefficient of 0.9 with 'Credit Card Usage', 'Credit Card' and 'Debit Card', which indicates that improvement in internet transactions is based on the improvement of 'Credit Card Usage' 'Credit Card' and 'Debit Card' or vise-versa (Since there is no data for the 'Credit Card Usage' in year 2011, this correlation is shown in year 2014 only).
- A slightly moderate correlation of value 0.6 is shown for the variables 'ATMs' and 'Debit Cards' for both the years. A strong correlation is expected between these, as higher the debit cards higher the ATMs that are required for cash withdrawals and vise-versa. Also, debit cards are used more at present, for purchasing, reducing the requirement for cash withdrawals. This might have caused the correlation to be moderate.
- It is confusing to see the weak relationship between the variables 'Credit Purchases' against the 'Credit Cards' and the 'Credit Card Usage' with a coefficient of 0.2, as the most common instrument for credit purchases is the credit card.

IFIs are calculated for 143 countries for the years 2014 and 2011.[9] Due to the inadequacy of data, which is available only for the years 2014 and 2011, data for more years are extracted from the FAS in order to analyze the relevance of the composite index. A five-year span of consecutive years, from year 2010 to 2014 is taken, but with a reduction of variables only up to five variables. These variables are 'Account', 'Branches', 'ATMs', 'Borrowers' and 'Depositors'. Due to the availability of data in FAS, and in order to improve the significance, the above variables are taken for institutions, commercial banks and credit unions together for 124 countries. However, it is necessary to mention that the countries considered in the FAS dataset are not a subset of the countries considered in the Findex dataset.

[9] The accuracy of the IFIs calculated for the year 2011 deviates as the data for the variables 'Deposit', 'Withdrawal' and 'Internet Usage' is not available. Hence the values on the dimension 'USAGE' is affected.

Since the variables that can be taken for the years 2010 to 2014 in the FAS database are limited, the above formulae were re-formed as follows[10] to generate the IFIs for the respective years. Sub-dimensions were reduced to 2 for each of the dimensions 'Usage' and 'Access'.

ACCESS

Table 3: GVC re-formed for ACCESS variables (FAS Data)

Variables	Generalized Variable Coefficient (GVC)		GVC re-formed For FAS Data
Bank Branches	GVC1	0.3	0.6
ATMs	GVC2	0.2	0.4
POS s	GVC3	0.2	No Data
Credit Cards	GVC4	0.15	No Data
Debit Cards	GVC5	0.15	No Data
		1.0	1.0

USAGE

Table 4: GVC re-formed for USAGE variables (FAS Data)

Variables	Generalized Variable Coefficient (GVC)		GVC re-formed For FAS Data
Borrowings	GVC6	0.2	0.66
Credit Purchases	GVC7	0.2	No Data
Savings	GVC8	0.1	0.33
Deposits	GVC11	0.1	No Data
Withdrawals	GVC12	0.1	No Data
Internet Usage	GVC13	0.1	No Data
Mobile Usage	GVC14	0.2	No Data
		1.0	1.0

Then the new formulae for the dimensions are:

DV access = (0.6 * Branches) + (0.4 * ATM)

DVUsage = (0.66 * Borrow) + (0.33 * Save)

[10] The new GVCs are calculated according the ratios of weightages derived in the formulae developed above.

4.3 Analysis

For the year 2014 the Findex database has provided appropriate data and detailed indicators for the computation of IFI. Even though the indicators are the same, a lesser amount of data is available for the year 2011. Thus, the Financial Inclusion Index is developed for 143 countries using data for the years 2011 and 2014. The IFI values and the respective ranks are given in Annexure III for 38 selected countries in the order of the 2014 ranking for easy reference, and Annexure V gives the full list of countries in the order of the 2014 ranking. The ten top ranked countries are Spain, Austria, Canada, New Zealand, Australia, Luxembourg, United Kingdom, Norway, Switzerland, and Denmark. In comparison to the OECD countries, the 26 countries with the heist IFI in 2014 represent the OECD countries[11] except Singapore. Again, in the year 2011 Singapore, Norway and Switzerland are the exceptions for the first 24 countries ranked as having the highest FI. Norway and Switzerland, along with Bhutan, Belize, and Nambia show a sharp increase in IFI and improvement in the rank from 2011 to 2014. The reason could be the unavailability of the data on the indicator 'Account' for the year 2011. Therefore, Singapore can be considered as the only exception to the high ranked countries. This is a good indication that the index developed fits well, because, out of the 34 OECD countries, 25 are ranked as the highest financially inclusive countries.

Therefore, the results of the IFI are analyzed against the income category of the countries for each year. The IFI was categorized as 'High IFI', 'Moderate IFI' and 'Low IFI' according the values for each year for the countries. High IFI countries represent the values above the 3rd Quartile of the respective year, while the low IFI Countries are countries blow the 1st Quartile. On average 25% of the high IFI countries represent the high-income countries in both the years. The majority of moderate IFI represent middle-income countries, while moderate IFI countries marginally represent the high and low-income countries. Low IFI countries, which are supposed to be represent the low-income countries majorly represent the middle-income countries as well. Figure 1 below explains this graphically.

The improvement in the literacy rate of a country, and the inequality or wealth distribution of a country influences the improvement in the FI. Therefore, this phenomenon is tested on the results of the developed IFI. The WDI database of the World Bank data provides the Gini Index indicator. The literacy rates of the countries were extracted from the UNESCO data bank. The data was not available for the full range of countries in this study, and for the year 2014, the most recent values for the literacy rates were considered.

[11] Out of 34 OECD countries

Figure 1: IFI Categories Vs. Income categories (IFI 2011 & 2014)

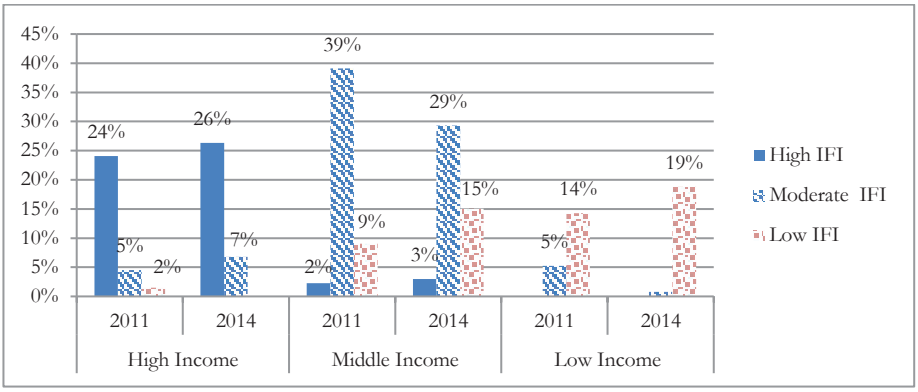


Table 5: IFI Categories Vs. Income categories (IFI 2011 & 2014)

		Countries with High FI	Countries with Moderate FI	Countries with Low FI
2011	High	32	6	2
	Upper Middle	2	33	2
	Lower Middle	1	19	10
	Low	0	7	19
2014	High	35	9	0
	Upper Middle	3	27	6
	Lower Middle	1	12	14
	Low	0	1	25

The correlation coefficients of the literacy rate and the IFI are 0.56 and 0.65 for the years 2011 and 2014, respectively. Although a high correlation between the literacy rate and the IFI is expected, the empirical results of this study show only a moderate correlation for the year 2011 and a correlation of 0.65 in the year 2014, which is a nearly strong correlation. Considering the data availability for the year 2014, which is richer compared to 2011, it is reasonable to conclude that the IFI composite index developed in this study is a better representation of FI.

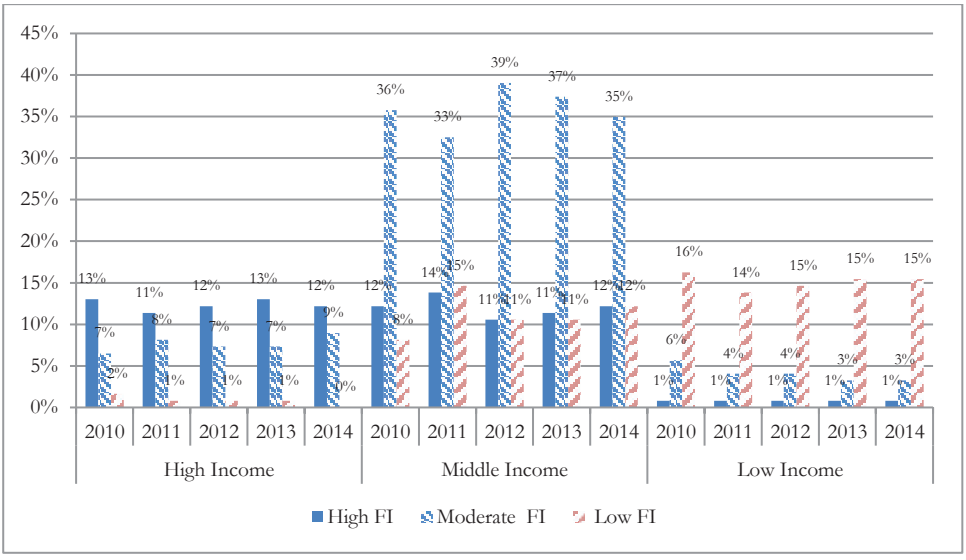
Gini coefficient and the IFI are also expected to be strongly correlated[12]. But the results show a weak correlation between these two indicators as 0.4 and 0.2. Therefore, this is an area of development in the study to examine the reasons for this deviation in empirical results.

With the objective of improving or enhancing the study, IFI_R (using re-formed formulae for ACCESS and USAGE) is calculated for the span of 5 years, from the year 2010, using the FAS data and the re-formed formulae generated in the previous chapter.

A comparison of the OECD countries in the top ranked FI countries gives only 10-12 OECD countries in the first 25 countries with high FI. This explains the importance of the original formulae aggregating more factors or indicators that are relevant and required to compute a comprehensive index. This observation is further elaborated in the analysis done subsequently.

Figure 2 below shows that unlike in previous IFI results, the IFI_R results do not clearly distinguish the high, low and middle-income categories in the high low and moderate FI. The middle-income category substantially blends the high FI and low FI countries. In addition, more moderate FI countries are in the category of the high-income countries.

Figure 2: IFI Categories Vs. Income categories (IFI_R 2010 to 2014)



[12] FI values and Gini coefficient are inversely correlated because higher inequality or the lower wealth distribution gives higher Gini Coefficient and vice versa. Further, better wealth distributions results in higher FI values.

Table 6: IFI Categories Vs. Income categories (IFI, IFI_R2011 & 2014)

		IFI with Original Formulae			IFI with re-formed Formulae		
		High IFI	Moderate IFI	Low IFI	High IFI	Moderate IFI	Low IFI
2011	High	32	6	2	14	10	1
	Upper	2	33	2	15	14	3
	Lower	1	19	10	2	26	15
	Low	0	7	19	1	5	17
2014	High	35	9	0	15	11	0
	Upper	3	27	6	13	19	3
	Lower	1	12	14	2	24	12
	Low	0	1	25	1	4	19

A comparison[13] is further done for the years 2011 and 2014 for the results obtained using the original formulae and the re-formed formulae for the dimension value calculation. Table 6 clearly shows that the IFI results obtained using the re-formed formulae deviates from the accuracy of categorization.

The movement of IFI_R results computed using fewer variables and the re-formed formulae against the literacy rate and the Gini coefficient. For all the 5 years considered in the study, the IFI calculation in the FAS data gives moderate correlation for both the literacy rate and the Gini coefficient. But it can be noticed that the IFI calculations from the Findex database gives improved correlation coefficients (Table 7).

Table 7: Relationship to Literacy and Gini Coefficient (IFI, IFI_R)

	IFI		IFI_R	
	Correlation Coefficeint_ IFI – Literacy	Correlation Coefficeint_ IFI – Gini	Correlation Coefficeint_ IFI – Literacy	Correlation Coefficeint_ IFI – Gini
2010			0.54	-0.38
2011	**0.53**	**-0.42**	**0.52**	**-0.41**
2012			0.54	-0.43
2013			0.57	-0.30
2014	**0.68**	**-0.44**	**0.60**	**-0.34**

[13] The comparison is made for the sub set of countries common to both the data sets.

5. Conclusion and Recommendations

5.1 Conclusion

Many definitions for financial inclusion are discussed in the literature, but for the purpose of this paper FI is defined as the 'depth and spread of the possibilities of formal financial activities among and throughout the population of an economy'.

Therefore, many aspects need to be taken into consideration when measuring FI. In the literature, there are different indices that have been developed to measure FI. As discussed throughout this paper, the limited data availability has influenced the accuracy or the significance of those indices.

With the availability of data in the Findex database, for the recent years, this study attempted to develop a more appropriate, significant and accurate index using more indicators. The index was developed using 13 indicators, such as 'Account', 'Bank Branches', 'Credit Cards', 'Borrowings', 'Deposits', 'Withdrawals', 'Mobile Usage' for transactions, etc.

Previous studies were only restricted to 4 – 6 variables due to the limitation of data. Massara et al. used Factor Analysis to derive the weights for the dimensions and sub dimensions, but excluded the 'Transaction Account' variable in the study, which is an important indicator in FI. Among other studies, Sarma assigned weights for the variables in sub-indices, arbitrarily. This study is carried out with the objective of developing an index, overcoming the major drawbacks in the previous two studies, as discussed above. Therefore, this study improved the usage of important and relevant variables of FI and derived the weights for the variables using the correlation matrix of the variables and then developed the composite index by taking the arithmetic mean of the dimensions.

Sri Lanka is ranked 59th in the year 2014, with an IFI of 34 out of 143 countries in the sample considered. This shows a decline in rank from 53 in the year 2011, but with an increase in the IFI from 28. Sri Lanka is in a better position when the variables of 'Account', 'No of 'Bank branches' and the 'Savings' are compared with the other countries, in both the years considered, that have ranks between 30 to 60 out of 143 (Annexure VI &VII). Therefore, these variables could impact mostly for Sri Lanka to obtain a comparatively higher rank in the Financial Inclusion Index. Also, these ranking are improved in the year 2014 compared to the year 2011 and that could have impacted the development in the IFI in the year 2014. The emerging trends in FI are electronic payments (credit cards, debit cards, internet payments and mobile payments). In comparison to the other countries in the data set, Sri Lanka is in a state that needs improvement in those areas. However, it can be considered that Sri Lanka is in a better state in FI compared to the other countries in the region and also due to its position as a developing country.

In order to measure the accuracy or the relevance of the developed index, the results of IFI were analyzed against the countries income classification, literacy rate, Gini coefficient and a comparison was made with the OECD countries.

The IFI and the literacy rate show a moderate to nearly strong correlation, but surprisingly the Gini index shows a weak relationship to the IFI developed. When the index results are compared according to the income classification of the countries the high, middle and low-income countries are well represented in high, medium and low IFI countries. Almost 75% of the OECD countries are ranked the highest IFI countries.

Therefore, the index developed with more relevant indicators or variables, well represents the Countries' FI. With the expectation that the Global Findex database will be updated with a reasonable frequency (annually) that this index can be used as an accurate indication of the country's FI and will give a better representation of the FI ranking of a country where, it can be used to measure the development of financial inclusion state of a country.

5.2 Limitations of the study and future research areas

Internet banking and mobile banking are emerging trend in the world. Therefore, this study can be developed by including those areas in to the development of the index. Further, facilities like prepaid cards can also be included when improving the index.

The major limitation of the study is the unavailability of data for a reasonable period for all the indicators. In the future, the Global Findex database will be updated with a reasonable frequency (annually) and therefore the IFI can be expected to be more accurate.

Empirical results of this study deviated from the expected results for the correlation between the IFI and Gini index and thus can be proposed as a lead for further research.

References

Allen, Franklin, et al. "The African financial development and financial inclusion gaps." *Journal of African economies* 23.5 (2014): 614-642.

Massara, Mr Alexander, and André Mialou. "*Assessing countries' financial inclusion standing-A new composite index"*. No. 14-36. International Monetary Fund, 2014.

Beck, Thorsten, Asli Demirguc-Kunt, and Maria Soledad Martinez Peria. "Reaching out: Access to and use of banking services across countries." *Journal of Financial Economics* 85.1 (2007): 234-266.

Carbó, Santiago, Edward PM Gardener, and Philip Molyneux. "Financial Exclusion in Developing Countries." *Financial Exclusion*. Palgrave Macmillan UK, 2005. 145-168.

Brune, Lasse, et al. "Commitments to save: A field experiment in rural Malawi." World Bank, 2011.

Committee on Payments and Market Infrastructures and World Bank Group. "Consultative report, Payment aspects of financial inclusion September". Bank for International Settlements, World Bank, 2015.

Demirgüç-Kunt, Asli, and Leora F. Klapper. "Measuring financial inclusion: The global findex database." World Bank, 2012.

Demirgüç-Kunt, Asli, and Leora Klapper. "Measuring financial inclusion: Explaining variation in use of financial services across and within countries." Brookings Papers on Economic Activity 2013.1 (2013): 279-340.

Demirgüç-Kunt, Asli, et al. "The global findex database 2014: Measuring financial inclusion around the world." World Bank, 2015.

Honohan, Patrick. "Cross-country variation in household access to financial services." *Journal of Banking & Finance* 32.11 (2008): 2493-2500.

Burgess, Robin, and Rohini Pande. "Do rural banks matter? Evidence from the Indian social banking experiment." *The American economic review* 95.3 (2005): 780-795.

Rojas-Suarez, Liliana. "Access to Financial Services in Emerging Powers: Facts, Obstacles and Recommendations." (2010).

Sarma, Mandira. *Index of Financial Inclusion, Indian Council for Research on International Economic Relations (ICRIER)*. Working Paper 215, 2008.

Sarma, M. "Index of financial inclusion (CITD Discussion Paper No 10-05)." *New Delhi: Centre for International Trade and Development, Jawaharlal Nehru University* (2010).

Sarma, Mandira. "Index of Financial Inclusion–A measure of financial sector inclusiveness." *Berlin (GE): Berlin Working Papers on Money, Finance, Trade and development* (2012)

Annexures

Annexure I: Correlation matrix for all the 15 variables for the year 2014

	Acc	CB Br	ATM	POS	Crd Card	Dbt Card	Borrow	Crd Purch	Save	CC Usage	DC Usage	Deposit	Withdrawal	Internet	Mobile
Acc	1	0.3	0.6	0.7	0.8	**0.9**	0	0.1	**0.8**	0.8	0.9	*0.6*	*0.6*	0.8	0.1
CB Br	0.3	1	0.3	0.3	0.2	0.3	-0.1	0	0.2	0.2	0.2	0.2	0.2	0.2	0
ATM	0.6	0.3	1	0.6	0.6	0.6	0.1	0.1	0.5	0.6	0.6	0.5	0.5	0.5	-0.1
POS	0.7	0.3	0.6	1	0.7	0.7	0.1	0.1	0.6	0.7	0.7	0.5	0.5	0.7	0
			0.6												
Crd	0.8	0.2		0.7	1	0.8	0	*0.2*	0.8	**1**	0.8	0.6	0.6	**0.9**	0
Dbt	0.9	0.3	*0.6*	0.7	0.8	1	0.1	0.1	0.8	0.8	**1**	0.7	0.7	**0.9**	0.1
Borrow	0	-	0.1	0.1	0	0.1	1	0	0.1	0.1	0.1	0.2	0.1	0.1	-0.2
Crd Pur	0.1	0	0.1	0.1	0.2	0.1	0	1	0.1	0.2	0.1	0.1	0.1	0.1	0
Save	0.8	0.2	0.5	0.6	0.8	0.8	0.1	0.1	1	0.8	0.8	0.6	0.6	0.9	0
CC U	0.8	0.2	0.6	0.7	1	0.8	0.1	*0.2*	0.8	1	0.8	0.6	0.6	**0.9**	0
DC U	0.9	0.2	0.6	0.7	0.8	1	0.1	0.1	0.8	0.8	1	0.7	0.7	0.9	0
Deposit	0.6	0.2	0.5	0.5	0.6	0.7	0.2	0.1	0.6	0.6	0.7	1	0.9	0.6	-0.1
Wtdwl	0.6	0.2	0.5	0.5	0.6	0.7	0.1	0.1	0.6	0.6	0.7	0.9	1	0.6	-0.1
Internet	0.8	0.2	0.5	0.7	0.9	0.9	0.1	0.1	0.9	0.9	0.9	0.6	0.6	1	0
		0	-0.1	0	0	0.1									
Mobile	0.1						-0.2	0	0	0	0	-0.1	-0.1	0	1

Annexure II: Correlation matrix for all the 15 variables for the year 2011

	Acc	CB Br	ATM	POS	Crd Card	Dbt Card	Borrow	Crd Purch	Save	CC Usage	DC Usage	Deposit	Withdrawal	Internet	Mobile
Acc	1	0.6	0.7	0.7	0.8	**0.9**	0	0	**0.8**						0.1
CB Br	0.6	1	0.5	0.5	0.5	0.5	0	0	0.3						0
ATM	0.7	0.5	1	0.7	0.7	0.6	-0.1	-0.1	0.5						-0.1
POS	0.7	0.5	0.7	1	0.7	0.6	0.1	0.1	0.6						0
Crd Card	0.8	0.5	0.7	0.7	1	0.8	0	*-0.1*	0.8						0.1
Dbt Card	0.9	0.5	*0.6*	0.6	0.8	1	0.1	0	0.8						0.1
Borrow	0	0	-0.1	0.1	0	0.1	1	0.3	0						-0.1
Crd Pur	0	0	-0.1	0.1	-0.1	0	0.3	1	0						0
Save	0.8	0.3	0.5	0.6	0.8	0.8	0	0	1						0
CC U															
DC U															
Deposit															
Wtdwl															
Internet															
Mobile	0.1	0	-0.1	0	0.1	0.1	-0.1	0	0						1.0

Annexure III

Country	Rank		IFI	
	2014	2011	2014	2011
Spain	1	1	68	61
Australia	2	2	67	59
Canada	3	6	67	56
New Zealand	4	4	65	56
Austria	5	5	63	56
Luxembourg	6	3	62	57
United Kingdom	7	7	62	54
Norway	8	108	61	9
Switzerland	9	79	60	16
Denmark	10	9	59	53
Netherlands	11	8	59	53
Belgium	12	15	59	51
Japan	13	21	59	47
France	14	10	59	52
Sweden	18	22	57	47
Italy	19	27	56	44
United States	20	24	56	46
Singapore	25	25	54	46
Germany	26	17	53	49
Iran, Islamic Rep.	29	35	51	38
Hong Kong, China	30	29	51	43
Korea, Rep.	33	13	50	51
United Arab Emirates	37	50	47	30
Brazil	40	39	47	36
Thailand	46	46	42	33
China	51	54	41	27
South Africa	56	56	38	26
Sri Lanka	59	53	37	28
Kenya	73	68	31	21
India	84	82	26	15
Indonesia	86	89	25	14
Bhutan	92	131	22	4
Philippines	98	94	20	13
Ethiopia	115	139	13	2
Iraq	131	114	8	6
Pakistan	132	115	8	6
Somalia	136	142	5	1
Niger	143	140	2	1

Annexure IV

Descriptive Statistics

2014	ACC		ATM__ADULTS	POS__ADULTS	CREDIT_CARD_	
Mean	53.21	22.51	51.55	1039	17.96	39.37
Median	50.34	15.26	48.81	597.99	10.71	32.94
Maximum	100	256.26	222.27	4889.6	77.07	98.63
Minimum	1.79	0.76	0.8	1.03	0.12	0.49
Std. Dev.	31.91	28.43	42.63	1162.54	19.99	30.77
Skewness	0.07	5.15	1.3	1.29	1.26	0.45
Kurtosis	1.57	39.8	5.17	4.04	3.56	1.89
Jarque-Bera	12.38	7425.43	55.3	23.94	39.18	12.24
Probability	0	-	-	0	-	0
Sum	7661.65	2745.96	5979.91	76886.13	2550.02	5669.32
Sum Sq. Dev.	145646.4	97789.21	209033	98659684	56340.62	135369.6
Observations	144	122	116	74	142	144

2014	BORROW __FI	SAVE__ _FI	CREDIT_P URCHAES	DEPOSIT _12M	WITHDRAWA L_12M	CC_USA GE_12M	DC_USAG E_12M	INTERNE T_12M	MOBIL E_ 12M
Mean	12.05	22.55	10.55	77.79	79.03	15.3	28.56	17.4	3.04
Median	11.78	15.3	8.7	80.02	80.76	8.12	17.67	5.81	1.68
Maximum	40.51	78.41	44.76	98.74	99.01	75.11	95.92	78.98	26.93
Minimum	1.28	0.65	0.59	38.01	41.03	0.03	0.04	0.07	0.06
Std. Dev.	7.47	18.8	8.2	13.04	13.27	18.07	28.78	21.83	4.53
Skewness	1	1.03	1.75	-0.61	-0.78	1.4	0.89	1.37	3.41
Kurtosis	4.46	3.13	6.6	2.99	3.24	4.11	2.53	3.62	15.92
Jarque-Bera	33.84	25.74	149.61	7.99	13.65	52.86	20.21	46.41	765.53
Probability	-	0	-	0.02	0	-	0	-	-
Sum	1590.14	3247.58	1497.46	10112.68	10274	2141.77	4055.41	2471.21	261.12
Sum Sq. Dev.	7319.37	50561.11	9482.23	21926.45	22700.23	45384.58	116771.7	67214.96	1743.62
Observations	132	144	142	130	130	140	142	142	86

2011	ACC	CB_BR_ _ADULTS	ATM__ ADULTS	POS__ADULTS	CREDIT_CARD_	DEBIT_CARD	BORROW__FI	SAVE_ __FI	CREDIT_ PURCHAES	MOBILE _12M
Mean	47.5	19.82	47.49	1039	18.01	32.72	9.92	19	8.41	2.9
Median	40.46	15.07	39.54	597.99	10.19	22.48	8.56	13.45	6.57	1.57
Maximum	99.74	102.19	282.49	4889.6	79.66	97.61	30.65	63.58	42.81	25.65
Minimum	0.4	0.63	0.32	1.03	0.14	0.27	0.84	0.12	0.33	0.06
Std. Dev.	32.59	18.97	47	1162.54	20.33	29.03	6.03	17.36	7.4	4.34
Skewness	0.28	1.75	1.85	1.29	1.25	0.73	0.94	1.05	1.85	3.39
Kurtosis	1.63	6.75	7.96	4.04	3.43	2.27	3.72	2.95	7.32	15.73
Jarque-Bera	12.01	145.1	206.36	23.94	34.7	14.77	22.51	24.45	177.72	736.45
Probability	0	-	-	0	-	0	0	0	-	-
Sum	6269.46	2616.34	6126.31	76886.13	2341.41	4319.32	1328.7	2507.63	1110.43	246.25
Sum Sq. Dev.	139135.7	47166.49	282692.5	98659684	53317.16	110387.4	4840.57	39476.04	7166.39	1581.31
Observations	132	132	129	74	130	132	134	132	132	85

Annexure V

Country	IFI Rank		Country	IFI Rank		Country	IFI Rank	
	2014	2011		2014	2011		2014	2011
Spain	1	1	Germany	26	17	China	51	54
Australia	2	2	Mongolia	27	30	Hungary	52	41
Canada	3	6	Malta	28	19	Kuwait	53	26
New Zealand	4	4	Iran, Islamic Rep.	29	35	Turkey	54	40
Austria	5	5	Hong Kong China	30	29	Jamaica	55	48
Luxembourg	6	3	Greece	31	28	South Africa	56	56
United	7	7	Latvia	32	31	Costa Rica	57	58
Norway	8	108	Korea, Rep.	33	13	Chile	58	61
Switzerland	9	79	Czech Republic	34	34	Sri Lanka	59	53
Denmark	10	9	Cyprus	35	14	Montenegro	60	55
Netherlands	11	8	Taiwan, China	36	37	Saudi Arabia	61	63
Belgium	12	15	United Arab	37	50	Romania	62	59
Japan	13	21	Slovak Republic	38	33	Puerto Rico	63	132
France	14	10	Colombia	39	77	Belarus	64	57
Portugal	15	11	Brazil	40	39	Venezuela, RB	65	60
Finland	16	20	Serbia	41	45	Ukraine	66	66
Slovenia	17	12	Poland	42	42	Namibia	67	123
Sweden	18	22	Mauritius	43	36	Bosnia and	68	52
Italy	19	27	Russian Federation	44	49	Peru	69	70
United States	20	24	Lithuania	45	43	Argentina	70	69
Ireland	21	18	Thailand	46	46	Lebanon	71	64
Estonia	22	23	Macedonia, FYR	47	38	Ecuador	72	65
Croatia	23	16	Malaysia	48	47	Kenya	73	68
Israel	24	32	Bulgaria	49	44	Kazakhstan	74	67
Singapore	25	25	Bahrain	50	51	Uruguay	75	88

Country	IFI Rank		Country	IFI Rank		Country	IFI Rank	
	2014	2011		2014	2011		2014	2011
Dominican	76	73	Vietnam	101	97	Haiti	126	101
Botswana	77	83	Jordan	102	84	Burkina Faso	127	117
Kosovo	78	62	Moldova	103	96	Togo	128	126
Georgia	79	72	Gabon	104	104	Mali	129	122
Belize	80	120	Uganda	105	105	Cambodia	130	136
Panama	81	76	Bangladesh	106	85	Iraq	131	114
Nigeria	82	93	Zambia	107	99	Pakistan	132	115
Guatemala	83	80	WB and Gaza	108	100	Tajikistan	133	125
India	84	82	Tunisia	109	113	Burundi	134	119
Mexico	85	78	Mauritania	110	106	Yemen, Rep.	135	135
Indonesia	86	89	Zimbabwe	111	75	Somalia	136	142
Bolivia	87	87	Myanmar	112	143	Congo, D. Rep.	137	138
Algeria	88	86	Nicaragua	113	112	Afghanistan	138	127
Uzbekistan	89	81	Tanzania	114	107	Chad	139	118
Albania	90	74	Ethiopia	115	139	Guinea	140	137
El Salvador	91	102	Malawi	116	111	Turkmenistan	141	141
Bhutan	92	131	Congo, Rep.	117	116	Madagascar	142	133
Azerbaijan	93	103	Kyrgyz Republic	118	130	Niger	143	140
Rwanda	94	90	Egypt, Arab Rep.	119	121			
Angola	95	71	Côte d'Ivoire	120	134			
Nepal	96	98	Cameroon	121	109			
Honduras	97	92	Sierra Leone	122	110			
Philippines	98	94	Senegal	123	129			
Ghana	99	95	Sudan	124	124			
Armenia	100	91	Benin	125	128			

Annexure VI

Ranking of the Countries by each Variable 2014

No	Country	Acc	CB Br	ATM	POS	Credit	Debit	Borrow	Credit	Save	Deposit	Withdr	Internet	Mobile
1	Afghanistan	134	114	115		118	138	75	124	130			135	86
2	Albania	89	45	73	55	88	88	123	78	109	122	116	93	2
3	Algeria	72	102	100	68	85	90	119	127	84	96	117	72	6
4	Angola	99	70	84	64	93	91	87	138	75	40	56	125	3
5	Argentina	73	67	35		38	60	16	82	126	52	23	63	55
6	Armenia	117	44	41	58	90	114	9	13	139	78	83	76	61
7	Australia	9	30	4	2	11	14	53	62	6	11	5	7	
8	Austria	16	64	10	1	22	21	19	79	8	17	15	19	
9	Azerbaijan	100	82	72	57	77	101	13	55	118	45	39	85	85
10	Bahrain	41				36	27	77	14	31	85	89	35	
11	Bangladesh	101	91	94		137	122	44	7	111	118	124	139	41
12	Belarus	51	122	116	54	60	63	31	17	74	34	61	40	16
13	Belgium	11	13	18	28	20	8	48	119	13	31	29	18	
14	Belize	75	38	65		71	84	94	91	58	109	125	78	
15	Benin	121	108	105		117	123	111	126	113	120	108	103	80
16	Bhutan	94	61	85		139	98	17	92	57	54	115	129	
17	Bolivia	83	62	74	63	83	85	46	123	54	67	65	126	43
18	Bosnia and	71	25	62	39	76	69	57	106	102	43	43	95	63
19	Botswana	74	85	79		74	67	64	35	46	58	77	69	32
20	Brazil	56	10	6	20	32	42	52	107	91	35	33	62	49
21	Bulgaria	60	7	20	33	62	45	105	95	81	59	40	49	67
22	Burkina Faso	126	122	116		101	125	129	90	104	81	84	113	79
23	Burundi	138	112	112	75	138	140	6	40	127			140	65
24	Cambodia	128	99	92	62	100	120	128	71	129	130	127	134	83
25	Cameroon	131	116	108		132	117	7	97	108	70	76	131	70

No	Country	Acc	CB Br	ATM	POS	Credit	Debit	Borrow	Credit	Save	Deposit	Withdr	Internet	Mobile
26	Canada	7	40	1	11	1	10		38	5	3	6	9	
27	Chad	137	119	114		119	133	34	105	124			105	22
28	Chile	59	57	44	42	35	49	79	43	73	91	88	50	57
29	China	43	92	47		53	56	36	131	26	46	73	43	47
30	Colombia	87	1	66		58	75		72	93	94	80	68	37
31	Congo, Dem.	133	120	113		106	129	108	129	123			101	84
32	Congo, Rep.	119	122	116		107	111	59	137	97	69	100	130	46
33	Costa Rica	58	46	22	75	56	50	121	44	53	55	60	57	86
34	Côte d'Ivoire	123	122	116		122	119	11	134	101	83	102	114	
35	Croatia	35	21	11	15	24	28	78	3	43	9	12	42	
36	Cyprus	30	15	51		39	54	58	114	59	53	47	34	
37	Czech	40	37	56	35	41	38	12	51	29	12	18	21	
38	Denmark	1	33	49	16	26	6		76	4	1	1	4	
39	Dominican	67	79	75		70	86	70	54	48	84	85	86	25
40	Ecuador	78	4	116		89	80	100	133	82	44	46	107	50
41	Egypt, Arab	125	104	90		109	113	28	57	125	116	109	119	72
42	El Salvador	91	78	76	49	79	89	42	61	83	79	68	88	86
43	Estonia	13	73	24	21	33	9	95	41	38	2	10	11	
44	Ethiopia	109	122	116		135	142	32	56	86	121	130	138	
45	Finland	1	76	70	59	7	4	39	12	12	25	2	2	
46	France	18	14	13	14	19	22	109	87	19	57	36	22	
47	Gabon	97	122	116		87	96	47	135	65	71	98	89	11
48	Georgia	85	35	40	53	49	76	21	80	141	29	28	75	69
49	Germany	10	66	116	32	17	11	91	66	11	41	25	13	
50	Ghana	92	97	97	69	125	112	76	112	64	104	107	99	59
51	Greece	32	31	37	4	66	46	61	103	89	62	52	54	
52	Guatemala	82	19	71	40	82	99	127	70	72	115	104	84	86
53	Guinea	140	118	110		105	130	107	88	135			108	51
54	Haiti	116				95	127	27	122	98	129	129	100	56

No	Country	Acc	CB Br	ATM	POS	Credit	Debit	Borrow	Credit	Save	Deposit	Withdr	Internet	Mobile
55	Honduras	98	41	81		84	102	90	117	78	102	92	96	53
56	Hong Kong	22	43	116		6	32	85	68	20	39	37	27	
57	Hungary	50	60	42	38	63	41	99	50	63	23	24	39	
58	India	69	68	87		94	87	56	118	80	127	128	120	31
59	Indonesia	90	80	57	56	113	79	4	83	47	65	74	74	82
60	Iran, Islamic	26	34	43	24	69	26	112	2	60	105	81	46	
61	Iraq	132	96	116		103	131	23	5	131			77	38
62	Ireland	23	47	21		16	16	1	98	21	16	22	15	
63	Israel	31	53	8		2	73	51	1	16	8	8	31	
64	Italy	34	8	19	9	27	37	69	28	32	76	51	24	
65	Jamaica	44	101	77	34	57	58	92	102	41	106	106	56	21
66	Japan	17	20	7		5	15	49	52	7	19	19	28	
67	Jordan	106	51	78		104	94	30	116	128	107	64	102	86
68	Kazakhstan	68	107	26	51	68	74	40	96	106	89	95	66	14
69	Kenya	66	98	93		92	68	24	19	40	82	96	79	4
70	Korea, Rep.	24	55	116		12	33	82	42	17	37	34	17	
71	Kosovo	76	49	68		59	70	45	59	112	125	31	73	7
72	Kuwait	49	56	116	31	40	31	50	22	50	87	87	37	
73	Kyrgyz	113	93	80		98	116		108	122	128	121	90	54
74	Latvia	29	50	32		43	18	35	67	51	5	9	20	26
75	Lebanon	77	28	61	26	72	72		31	66	30	78	80	77
76	Lithuania	46	122	54	22	73	36	83	34	42	24	20	33	36
77	Luxembourg	21	3	14		3	17	54	110	9	26	21	14	
78	Macedonia,	52	36	48	25	45	51	125	20	85	56	55	55	5
79	Madagascar	141	117	109	72	141	139	102	75	133			143	86
80	Malawi	120	109	104	71	114	105	18	63	114	119	119	121	64
81	Malaysia	42	83	53	30	47	62	120	47	33	88	93	44	29
82	Mali	127	122	116		128	128	80	141	134	114	111	136	75
83	Malta	20	16	45		21	23	93	136	25	73	41	25	

No	Country	Acc	CB Br	ATM	POS	Credit	Debit	Borrow	Credit	Save	Deposit	Withdr	Internet	Mobile
84	Mauritania	110	95	98		91	108	29	100	95	86	79	87	8
85	Mauritius	39	39	60	36	50	40	73	30	30	68	62	83	35
86	Mexico	86	63	58		48	77	103	36	79	101	67	71	17
87	Moldova	114	74	69		81	100	2	89	115	47	66	58	58
88	Mongolia	27	5	39	43	123	35	8	39	34	99	49	67	18
89	Montenegro	62	12	27		54	71		11	119	33	45	65	34
90	Myanmar	108	110	111		142	137	96	93	88	123	105	141	
91	Namibia	63	71	50	50	78	55	65	85	45	77	94	92	
92	Nepal	93	90	95		133	115	60	6	69	92	120	137	78
93	Netherlands	6	65	55	10	30	2	3	140	10	15	14	8	
94	New Zealand	5	29	28	3	9	7	41	26	3	10	3	6	
95	Nicaragua	112	94	91		97	107	130	77	105	124	113	106	62
96	Niger	142	122	116		115	143	104	125	137			124	74
97	Nigeria	80	100	89		102	66	5	113	44	74	82	94	45
98	Norway	1	89	59	7	4	1		73	1	6	4	1	
99	Pakistan	135	59	99	60	140	132	67	9	132			110	44
100	Panama	81	42	34	44	75	81		101	62	108	101	70	86
101	Peru	102	2	46	61	64	92	66	120	92	50	44	98	42
102	Philippines	103	88	82		99	93	20	24	76	103	112	91	33
103	Poland	47	22	31	48	52	53	81	48	61	20	27	23	
104	Portugal	33	9	3	8	34	34	68	64	52	32	35	38	
105	Puerto Rico	53			23	42	43		84	55	93	75	41	
106	Romania	61	26	30	41	65	57	74	69	87	80	72	53	60
107	Russian	57	18	2	46	46	59	89	74	71	51	69	47	40
108	Rwanda	88	105	103	74	120	124	62	81	49	28	58	111	52
109	Saudi Arabia	54	87	25		67	39	118	27	70	110	126	48	
110	Senegal	129	122	116		124	118	84	37	117	42	38	122	81
111	Serbia	37	27	63	29	55	44	115	58	103	22	32	60	27
112	Sierra Leone	124	122	116		129	121	43	132	94	66	57	109	68

No	Country	Acc	CB Br	ATM	POS	Credit	Debit	Borrow	Credit	Save	Deposit	Withdr	Internet	Mobile
113	Singapore	19	86	36	19	28	13	26	86	23	36	48	36	
114	Slovak	48	32	38	37	51	30	55	49	24	4	7	26	
115	Slovenia	15	24	16	18	29	12	124	23	36	21	103	30	
116	Somalia	136				130	134	63	18	136			97	
117	South Africa	55	81	29		61	47	98	15	35	64	86	64	12
118	Spain	14	6	9	5	14	20	25	16	22	38	17	12	
119	Sri Lanka	38	54	88		96	82	101	115	39	126	122	116	30
120	Sudan	122	111	106		134	110			110	98	91	123	15
121	Sweden	4	48	67		18	3	86	25	2	7	11	3	
122	Switzerland	12	11	15	17	15	19		111	14	18	30	16	
123	Taiwan,	28			27	13	29	116	65	28	75	59	29	
124	Tajikistan	130	122	116	73	126	126	97	104	140			127	1
125	Tanzania	111	115	101	67	127	106	38	142	100	117	123	118	9
126	Thailand	45	72	12		86	48	117	130	27	27	26	82	71
127	Togo	115	122	116		131	135		128	116	113	114	128	73
128	Tunisia	105	122	116	52	80	104	15	53	96	112	118	81	
129	Turkey	65	52	23	6	31	61	122	45	99	97	99	45	13
130	Turkmenistan	143				142	141	33	8	143			142	86
131	Uganda	104	113	107	70	112	97	88	32	68	72	70	112	20
132	Ukraine	70	121	17	45	37	64	37	60	107	49	54	52	39
133	United Arab	36	77	33		25	24	14	33	37	63	53	32	
134	United	8	122	5	12	8	5	10	46	18	14	13	5	
135	United States	25	23	116	13	10	25	72	29	15	13	16	10	
136	Uruguay	79	75	52	47	23	65	131	21	90	100	42	51	76
137	Uzbekistan	84	17	96		116	83	126	109	138	48	71	133	10
138	Venezuela,	64	58	64		44	52	22	121	56	60	50	59	48
139	Vietnam	96	106	83		108	78	110	139	77	90	97	61	19
140	West Bank	107	84	86		121	109	71	10	121	111	110	115	23
141	Yemen, Rep.	139	122	116	65	136	136	106	4	142			132	66

No	Country	Acc	CB Br	ATM	POS	Credit	Debit	Borrow	Credit	Save	Deposit	Withdr	Internet	Mobile
142	Zambia	95	103	116	66	110	95	113	99	67	95	90	104	28
143	Zimbabwe	118	69	102		111	103	113	94	120	61	63	117	24

Annexure VII

Ranking of the Countries by each Variable 2011

No	Country	Acc @ a FI	CB Br /adults	ATM /adults	POS /adults	Credit Card	Debit Card	Borrow - FI	Credit Purchase	Save - FI	Mobile 12M
1	Afghanistan	118	120	124		116	108	90	108	117	86
2	Albania	82	44	70	55	62	71	130	101	83	2
3	Algeria	73	103	104	68	113	83	77	80	107	6
4	Angola	68	80	90	64	48	59	94	93	60	3
5	Argentina	74	71	51		39	58	13	6	109	55
6	Armenia	102	53	58	58	98	106	19	7	128	61
7	Australia	4	30	4	2	5	14	73	69	2	
8	Austria	11	67	11	1	23	11	18	10	11	
9	Azerbaijan	107	83	76	57	95	96	6	99	119	85
10	Bahrain	46				43	26	5	23	57	
11	Bangladesh	77	90	115		115	117	24	25	54	41
12	Belarus	50	121	62	54	73	36	52	107	93	16
13	Belgium	15	12	20	28	13	12			22	
14	Belize		36	64				113	131		
15	Benin	113	112			127	131			91	80
16	Bhutan		64	93				21	122		
17	Bolivia	83	84	84	63	85	87	32	71	53	43
18	Bosnia and Herz.	52	29	67	39	57	53	101	77	98	63
19	Botswana	79	88	83		60	79	95	95	55	32
20	Brazil	53	11	10	20	33	44	83	66	76	49
21	Bulgaria	55	7	19	33	63	38	121	117	105	67
22	Burkina Faso	111				117	121	129	74	88	79

No	Country	Acc @ a FI	CB Br /adults	ATM /adults	POS /adults	Credit Card	Debit Card	Borrow - FI	Credit Purchase	Save - FI	Mobile 12M
23	Burundi	121	118	123	75	122	129	11	32	115	65
24	Cambodia	129	109	105	62	130	114	110	111	129	83
25	Cameroon	108	128	120		102	120	9	19	78	70
26	Canada	16	39	2	11	3	9	133	114	9	
27	Chad	119	131	126		80	104	84	48	92	22
28	Chile	64	59	30	42	37	64	91	115	70	57
29	China	47		75		72	46	39	56	28	47
30	Colombia	78	68	71		65	66	92	60	80	37
31	Congo, Dem. Rep.	126	132	125		107	125	120	132	120	84
32	Congo, Rep.	116	116	119		82	109	53	89	99	46
33	Costa Rica	57	42	46	75	55	40			42	86
34	Côte d'Ivoire		106	107				26	14		
35	Croatia	25	23	13	15	28	17	2	61	71	
36	Cyprus	29	1	26		17	37	59	54	30	
37	Czech Republic	31	43	57	35	35	29	14	75	25	
38	Denmark	1	19	32	16	20	6	108	98	6	
39	Dominican Republic	69	79	78		54	70	67	90	59	25
40	Ecuador	71	13	60		66	75	118	106	64	50
41	Egypt, Arab Rep.	117	105	98		108	107	115	121	130	72
42	El Salvador	110	75	74	49	79	92	87	31	68	86
43	Estonia	13	58	22	21	30	4			32	
44	Ethiopia		122	129				41	59		
45	Finland	2	66	68	59	6	7	15	87	7	
46	France	12	15	14	14	25	22	124	127	15	

No	Country	Acc @ a FI	CB Br /adults	ATM /adults	POS /adults	Credit Card	Debit Card	Borrow - FI	Credit Purchase	Save - FI	Mobile 12M
47	Gabon	100	99	96		94	99	47	84	82	11
48	Georgia	75	54	61	53	69	73	37	34	125	69
49	Germany	8	65	9	32	27	8	100	76	8	
50	Ghana	81	101	111	69	99	89	78	67	58	59
51	Greece	34	18	27	4	45	54	28	94	43	
52	Guatemala	91	22	81	40	76	85	123	91	77	86
53	Guinea	127	129			110	118	71	112	118	51
54	Haiti	92	117	127		104	116	29	37	46	56
55	Honduras	95	49	85		81	91	79	18	85	53
56	Hong Kong SAR, China	24	40	50		9	16	60	105	21	
57	Hungary	39	63	39	38	49	25	85	64	50	
58	India	72	77	100		103	100	68	96	74	31
59	Indonesia	98	85	89	56	126	94	1	2	62	82
60	Iran, Islamic Rep.	38	33	69	24	36	31	76	8	44	
61	Iraq	112	104	121		105	112	25	53	102	38
62	Ireland	19	34	21		12	21	20	12	13	
63	Israel	22	51	12		1	102	106	116	36	
64	Italy	41	4	17	9	29	51	80	86	61	
65	Jamaica	42	97	82	34	75	45	98	40	31	21
66	Japan	14	25	7		4	86	109	104	12	
67	Jordan	86	52	77		90	80	31	46	86	86
68	Kazakhstan	65	113	29	51	70	56	57	39	94	14
69	Kenya	63	102	99		78	57	22	30	38	4
70	Korea, Rep.	21	56	1		11	32	99	97	16	

No	Country	Acc @ a FI	CB Br /adults	ATM /adults	POS /adults	Credit Card	Debit Card	Borrow - FI	Credit Purchase	Save - FI	Mobile 12M
71	Kosovo	61	48	73		71	60	8	124	104	7
72	Kuwait	28	55	35	31	10	13	44	130	23	
73	Kyrgyz Republic	125	94	94		120	126	16	133	126	54
74	Latvia	23	31	31		41	15	45	73	67	26
75	Lebanon	70	32	66	26	59	69	122	88	52	77
76	Lithuania	36		52	22	52	28	75	65	41	36
77	Luxembourg	18	3	15		2	18	50	70	10	
78	Macedonia, FYR	37	38	48	25	47	50	125	15	89	5
79	Madagascar	124	127	122	72	131	128	61	100	122	86
80	Malawi	105	130	112	71	109	98	46	62	87	64
81	Malaysia	45	50	45	30	56	65	117	102	26	29
82	Mali	120	110	117		123	122	54	50	106	75
83	Malta	17	14	41		15	20	82	58	18	
84	Mauritania	103	107			84	103	27	24	97	8
85	Mauritius	32	47	59	36	50	35	89	44	29	35
86	Mexico	84	69	56		53	67	111	35	95	17
87	Moldova	101	74	80		97	77	4	22	112	58
88	Mongolia	35	5	72	43	101	30	7	20	39	18
89	Montenegro	56	16	28		51	68	112	113	114	34
90	Myanmar		125	130							
91	Namibia		91	49	50			49	17		
92	Nepal	87	92	102		124	111	35	109	79	78
93	Netherlands	6	46	40	10	22	1	3	9	5	
94	New Zealand	3	26	25	3	8	3	88	118	3	
95	Nicaragua	109	93	97		96	101	132	103	96	62

No	Country	Acc @ a FI	CB Br /adults	ATM /adults	POS /adults	Credit Card	Debit Card	Borrow - FI	Credit Purchase	Save - FI	Mobile 12M
96	Niger	131				128	130	127	38	123	74
97	Nigeria	80	98	95		119	74			37	45
98	Norway		76	42	7			62	43		
99	Pakistan	114	87	106	60	121	115	56	85	121	44
100	Panama	88	41	54	44	61	90	33	92	69	86
101	Peru	97	8	79	61	67	82	51	5	84	42
102	Philippines	85	89	88		92	84	58	72	63	33
103	Poland	43	28	44	48	44	47	72	110	47	
104	Portugal	30	6	3	8	32	24			35	
105	Puerto Rico				23			36	28		
106	Romania	60	27	34	41	58	63	86	82	81	60
107	Russian Federation	58	21	5	46	68	49	70	128	75	40
108	Rwanda	76	100	118	74	93	105	126	41	48	52
109	Saudi Arabia	59	86	33		46	43	119	119	51	
110	Senegal	123				118	124	38	13	110	81
111	Serbia	48	17	53	29	38	41	96	120	116	27
112	Sierra Leone	106	114	128		100	110	55	29	65	68
113	Singapore	7	81	38	19	26	61	43	26	4	
114	Slovak Republic	33	35	47	37	40	23	34	21	24	
115	Slovenia	10	20	16	18	24	5			33	
116	Somalia							65	36		
117	South Africa	54	78	36		74	39	66	49	40	12
118	Spain	20	2	6	5	21	27	17	52	27	
119	Sri Lanka	44	61	92		89	97	104	47	34	30
120	Sudan	122	115	116		125	113	42	45	113	15

No	Country	Acc @ a FI	CB Br /adults	ATM /adults	POS /adults	Credit Card	Debit Card	Borrow - FI	Credit Purchase	Save - FI	Mobile 12M
121	Sweden	5	45	55		14	2			1	
122	Switzerland		9	18	17	131		30	4		
123	Taiwan, China	27			27	18	48	105	81	17	
124	Tajikistan	130	95	101	73	112	123	93	68	131	1
125	Tanzania	104	123	108	67	88	88	12	123	72	9
126	Thailand	40	73	24		83	42	116	125	20	71
127	Togo	115				114	127	69	79	111	73
128	Tunisia		60	86	52	131		107	1		
129	Turkey	51	57	37	6	19	33	134	11	108	13
130	Turkmenistan	132				131	132	64	42	132	86
131	Uganda	96	119	113	70	106	95	74	78	56	20
132	Ukraine	66	126	23	45	42	55	48	57	103	39
133	United Arab Emirates	49	72	43		31	34	40	51	45	
134	United Kingdom	9	37	8	12	16	10	10	16	19	
135	United States	26	24		13	7	19	81	83	14	
136	Uruguay	89	70	65	47	34	76	131	129	100	76
137	Uzbekistan	90	10	109		91	72	128	126	127	10
138	Venezuela, RB	62	62	63		64	52	23	27	66	48
139	Vietnam	93	111	87		111	81	114	3	90	19
140	West Bank and Gaza	99	82	91		87	93	63	55	101	23
141	Yemen, Rep.	128	124	114	65	129	119	97	63	124	66
142	Zambia	94	108	103	66	86	78	102	33	73	28
143	Zimbabwe	67	96	110		77	62	102	133	49	24

Real Effective Exchange Rate and Export Performance: The Case of Sri Lanka

S. D. Nilanka Chamindani [1] [2]

Abstract

*This study examines the determinants of manufacturing exports of Sri Lanka with specific emphasis on the impact of the real effective exchange rate (*REER*). The hypothesis that persistent appreciation of the* REER *has negative implications on exports, when other determinants of manufacturing exports remain constant, is tested using the reduced form of the export equation with annual data for the period 1970-2014.The export equation is estimated using the Autoregressive Distributed Lag (ARDL) method. The results suggest that the* REER *is a key determinant of export performance of Sri Lanka. The world demand is also a contributory factor. If Sri Lanka takes corrective macroeconomic policy measures to maintain the* REER *at a realistic (market consistent) level and to cater to the upper income markets by improving the quality of products and linking with global supply chain networks, it would enable Sri Lanka to secure international competitiveness.*

Key Words*: Real Exchange Rate, Export Growth, Trade, Macro Economic Policy, Autoregressive Distributed Lags (ARDL) model*

JEL Classification: *C32, E58, F31, F41*

[1] Senior Assistant Director of the Regional Development Department of the Central Bank of Sri Lanka.
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1. Introduction

The purpose of this study is to examine the determinants of manufacturing exports from Sri Lanka for the period 1970-2014. The study emphasizes on the impact of the Real Effective Exchange Rate (REER) on manufacturing exports. The REER is one of the prime determinants that are considered in designing policies to promote exports. It is computed by adjusting the trade weighted nominal exchange rate with relative prices between the exporting country and destination countries, and used to measure the relative profitability and competitiveness of exports. Exchange rate misalignment, that is, persistent appreciation of the real exchange rate relative to the equilibrium level, when other factors remain constant, has negative implications on exports (Edwards 1988).

Sri Lanka is an ideal case to examine the relationship between the REER and the performance of manufacturing exports, particularly for two reasons: First, due to the continuous drop in its share in the international market in recent years. Second, in the ongoing policy debate, the real exchange rate appreciation over the past 10 years has been highlighted as one of the key determinants for the reverse pattern of export diversification, which has been underpinned by inappropriate macroeconomic policies (Athukorala & Jayasuriya 2015). However, this hypothesis has not yet been tested empirically and the main objective of this study is to fill this gap by testing this hypothesis.

There is substantial empirical literature on the relationship between the REER and the export performance in developing countries (Bilquees et al. 2010, Fang et al. 2006, Grobar 1993, Haddad & Pancaro 2010, Hinkle & Monteil 1999, Krugman 1989, Nkwelle 2007). The misalignment of the REER has been a source of serious economic distress for many developing countries (Edwards 1988, Shatz & Tarr 2000). Notwithstanding the policy emphasis on export promotion, the only previous study relating to the export performance of Sri Lanka (Ekanayake et al. 1999) has taken the nominal exchange as the determinant of the expansion of exports. Moreover, there have been changes in the structure of the export sector performance over the last two decades, which require renewed research on the sector with a more realistic approach.

The current policy debate and decisive macroeconomic policy changes over the last decades provide ample space to analyse the impact of the REER on manufacturing exports. The purpose of this study is to examine the determinants of manufacturing exports from Sri Lanka, with specific focus on the REER. Accordingly, the study tests the hypothesis of whether persistent appreciation of the REER has an impact on the performance of manufacturing exports.

In order to test the hypothesis, this study employs a fully specified reduced form export equation to identify the determinants of the performance of manufacturing exports. The study analyses the manufacturing exports (excluding petroleum products) and disaggregates the total

manufacturing exports to garment exports and other exports. Though the main focus is to examine the impact of the REER on the performance of exports, a bivariate model is not sufficient as many other factors, which cannot be captured by the REER variable, influence exports. Therefore, the REER variable is incorporated as the key explanatory variable, while other variables are included as controlled variables. In addition to the REER, this study takes into account the world demand for manufacturing exports, the impact of foreign direct investments, improvements in the production capacity overtime, the changes in trade related policy regimes and quota facility under the Multi Fiber Agreement (MFA) offered to garment exports.

The paper is organized as follows: Section Two gives a brief overview of the manufacturing sector, macroeconomic policy and changes in the real exchange rate relating to the performance of exports in Sri Lanka. Section Three presents the specification of the model. Data and sources are given in Section Four. Section Five describes the methodology, while the results and findings are discussed in Section Six, followed by the conclusion.

2. Sri Lankan context

Having identified the importance of promoting the export sector with increased private sector participation as the engine of growth, Sri Lanka introduced export- oriented policy reforms in 1977, marking a turning point in its economic history (Athukorala & Rajapatirana 2000). This policy shift was subsequent to disastrous experiences that the nation encountered due to inward looking policies in a controlled regime with public sector dominance in economic activities. With the policy shift, the theme of the development strategy was to promote free trade with more industrial exports. An incentive package with infrastructure development and tax incentives was given to drive the private sector in line with the government development strategy.

Following the reforms, the export structure of Sri Lanka changed significantly, with manufactured goods becoming the most vibrant element. The country was able to achieve higher economic growth compared to the other developing countries in the region due to the fast expansion of the manufacturing exports. The rapidly growing manufacturing export sector also helped increase employment and reduce poverty in the country.

The degree of enthusiasm to promote manufacturing exports and sustain the pace of its performance changed from time to time, mainly with changes in the political regimes. Despite, such changes, overall manufacturing exports have contributed significantly in fostering the growth and generation of employment during the post liberalization period. However, the nation failed to maintain the high growth momentum that was achieved during the early stages of the new development strategy. The pace of growth started to taper off and reached the stage of near stagnation. This situation is more evident during the last 10 years.

Additionally, it can be argued that the patterns of performance of exports are highly correlated with the changes in economic polices over the years.

Colonial Sri Lanka was an open economy with a few commercial crops, among which tea dominated as the main source of foreign exchange earnings and generation of employment, albeit with high concentration in the upcountry. Even after independence from British rule in 1948, the same economic structure continued until 1956. The post-independence era experienced changes in the structure of the economy with different development strategies adopted in line with the thinking of the political regimes in power. Influenced by the popular development strategy of government intervention in economic activities that was embraced by many developing nations at the time, Sri Lanka also experienced a shift in the development strategy, where the colonial economic structure with an open economy was transformed into a state dominated industrial economy. The period of 1956 -1977 is identified as an era of close economy, where priority was given towards saving foreign exchange against the policy of foreign exchange earnings during the period of colonial economic policies. Many state-owned industries were started under this inward-looking development strategy.

However, the importance of manufacturing exports as a source of foreign exchange was not neglected totally. As a result, partial liberalization efforts were undertaken during 1968-70. As an incentive to promote nontraditional industrial exports, a dual exchange rate system with devaluation was maintained so that export industries can have access to imported inputs for their export industries (Cuthbertson & Athukorala 1991). This strategy has paid off with manufacturing output recording its highest contribution up to that time. These partial liberalizations ended in 1970, when the new government focused on extending the role of public corporation in economic activities. Private manufacturing firms were absorbed by the government and State Owned Enterprises (SOE's) were set up, with the objectives of increasing output growth, employment and national savings. Like in many developing countries, which followed state dominated inward looking development strategies, Sri Lanka also experienced the same fate of utter failure of its development strategy. Due to the moral hazard associated with state protection and political interference in managing SOEs, they failed to foster innovation, efficiency and productivity, which could have helped them to have strong cash flows. Instead, most of the SOEs became burdens to the government treasury.

Sri Lanka experienced a new era in development strategy starting from late 1977 with a new political regime coming into power with a land slide victory, due mostly to the economic hardships that the nation was engulfed in, with the failure of the previous regime. The new era saw revolutionary changes with the opening up of the economy with drastic liberalisation measures and impressive incentives for private sector economic activities, which were considered as the engines of growth. Trade reforms were the significant element of the new policy package of the first round, from 1977 to 1980. Under the Free Trade Zones (FTZs)

system, the tariff scheme was revised, restrictions on foreign investments were reduced, and a pack of incentives was provided for domestic and foreign investors to operate in FTZs. The macroeconomic policies were oriented to support the emerging private industrial sector including financial reforms and monetary policy reforms; adjusting interest rates to keep it above inflation, facilitating foreign banks to get established in the country, allowing credit markets to determine interest rates. Exchange rate adjustment is one of the key attributes in policy changes; in nominal terms, the domestic currency was devaluated more than 100 percent. These policies embedded with massive incentives to the private sector strongly affected structural changes. Rapidly growing export oriented manufacturing industries stimulated the economy to grow at a rapid pace with fast expansion in manufacturing exports.

However, the new reforms lost momentum since 1980, as the policy priorities shifted towards huge investment projects that were politically appeasing. The new investment projects affected export-oriented industrialization reforms, particularly the export sector, since massive government expenditure and capital inflows caused the real exchange rate to appreciate significantly. The high domestic inflation due to excessive public-sector expenditure added more fuel to the issue. Further, the prolonged ethnic conflicts that exhausted most of the resources and efforts that could have been utilized for development programmes further deviated the policy focus from the export oriented agenda.

In 1989, a new package of policy reforms was introduced to intensify the export orientation in the country, which is considered as 'The second wave of liberalization'. New reforms included more privatization attempts, of which one of the goals was to maintain a more flexible exchange rate to support investment and exports. Export oriented manufacturing industries grew further and the ratio of manufacturing exports to output increased dramatically in the 1990s. Within manufacturing exports, garments became the dominant segment since early 1990s and overtook the place that tea had enjoyed for decades, as the major export. More than half of the employment growth during 1980- 1990 was generated through the export oriented manufacturing sector. All in all, export expansion, particularly the manufacturing exports, was the vital source of growth and generation of employment opportunities.

Since 2005, policy priorities were shifted to infrastructure development with the massive construction drive funded mainly with public funds, while conspicuously avoiding any reference to further trade liberalization. Inconsistent macroeconomic policies and improper fiscal policy management, and arbitrary intervention of the monetary authority to prevent the required adjustments in the nominal exchange, in line with other macroeconomic fundamentals, resulted in an appreciation of the real exchange and consequent erosion of the competitiveness of export-oriented production in the economy. Meanwhile, the non-tradable sector was stimulated by the public-sector infrastructure development projects. The manufacturing sector grew at moderate rate, poorly compared to many other sectors of the economy, which resulted in declining its share in the GDP. In contrast, the services sector was booming. More than two third of incremental GDP came predominantly from non-tradable

sectors such as – construction, transport, utilities, trade and other services – propelled largely by public sector investment (Athukorala 2010). The prominence of the industrial sector started to disappear with drastic policy changes, initiating structural adjustments in the economy. The services sector started to boom, while the manufacturing sector recorded much slower growth compared to the previous two decades of post liberalization. The reverse pattern of the manufacturing export performances, compared to the early two decades of the post liberalization era, is consistent with the changes in policy strategy preferences followed by policy makers in the country.

The persistent erosion of export performance resulted in the ballooning of the trade deficit and consequent deterioration of the overall balance of payment situation of the country. The continuation of policy intervention in the foreign exchange market to prevent required adjustments in the nominal exchange rate, in order to preserve international competitiveness, exacerbated the situation, as it consumed the limited reserves to defend the currency. These developments have culminated in debates as to what factors could promote exports on a sustainable basis. Therefore, it is worth to examine this situation to identify the factors that determine the export performance in Sri Lanka in order to design the most appropriate policies to promote the sector.

2.1 Macroeconomic Policy and the Real Effective Exchange Rate (REER)

The REER is a decisive factor in a country's degree of competitiveness in the world market. Any appreciation of the REER signals that the cost of producing tradable goods has increased, while relative prices in the rest of the world are held constant. So, the production has become less cost efficient. Therefore, appreciation of the REER reflects a deterioration of the level of international competitiveness. On the contrary, a depreciation of the REER helps improve the country's degree of international competitiveness. Therefore, when the REER deviates from the optimal level consistent with long equilibrium, it affects the performance of the export sector. Such a disequilibrium in the REER for a longer period of time, leads to economic instability (Willet 1986).

The REER is a function of a number of variables, other than the nominal exchange rate and reflects the significance of each currency in trade as well as relative inflation rates of related nations. Therefore, the changes in the prices of tradable goods, i.e. import tariff, export taxes or the variables that can be influenced the price levels of non-tradable goods i.e. real interest rate, capital controls etc., are all fundamentals of the REER. The basic macroeconomic requirements for sustainable export oriented growth are favorable investment climates and the maintenance of a realistic, competitive real exchange rate (Athukorala & Rajapairana 2000).

The objective of liberalization policy reforms in Sri Lanka was to deliver such a consistent macroeconomic policy environment to boost the economic growth. The new policy reforms over the past three decades generated significant changes in the macroeconomic policy framework in the country. In new export oriented policy agendas, the REER was given special

recognition as one of the important macroeconomic variables associated strongly with the external sector balances and consequently with the overall macroeconomic equilibrium.

At the time, there was a dual exchange rate system that had been in operation since 1968. It was replaced by the new unified and managed flowing exchange rate system, under the liberalization policy, to improve international competitiveness. It caused huge initial devaluation within a single year. The rupee was depreciated by 85 percent, from 8.41 to 15.61 (rupees per dollar) in 1978 (Annual Report, Central Bank of Sri Lanka). Under the new system, the exchange rate was allowed to adjust daily with foreign exchange market conditions. In addition to the exchange rate policy, new policy reforms were contained with some prudent macroeconomic policies. Measures were taken to reduce the budget deficit and significant interest rate reforms were introduced to reduce domestic inflation.

However, the eminence of fiscal policy management was despaired without taking long time and started to deliver high inflation. One of the reasons was the government policy to sell some public enterprises that were making losses. The most significant reason was the government's massive public-sector investments, which included irrigation projects, and housing and urban development programmes. The situation was further exacerbated since 1979, as the Central Bank started to use the nominal exchange rate as an "anchor" to control inflation (Athukorala & Jayasuriya 1994). The level of intervention of the Central Bank in the exchange rate market was gradually increased and the practice of daily determination of the exchange rate was ultimately withdrawn.

Since the early 80s, the exchange rate policy in the country seemingly failed in supporting the export sector and alternative measures were introduced to stimulate exports. The Export Development Bank was established to provide various incentives to the export sector. Weak institutional and financial constraints were caused as a result of attempting to achieve the expected outcomes through these indirect approaches.

During the 1989-1990 period, several steps were taken to bring macroeconomic stability back by controlling the fiscal deficit and maintaining the real exchange rate at realistic levels, under the cradling-peg system (Athukorala & Rajapatirana 2000). However, the macroeconomic stability was arrested by huge government expenditure, particularly due to military and defense expenses during this decade.

In 2005, with a new government, the country's policy focus completely deviated from a market-oriented policy attitude to more populist economic policies. The role of the state was reflected as "guiding the markets" (Athukorala & Rajapatirana 2000). In the macroeconomic policy front, drastic inconsistencies between the exchange rate policy, fiscal policy and monetary policy were shown. Since the nominal exchange rate has multiple effects on key macroeconomic variables that are used to gauge the health of the economy, the Central Bank, in recent times intervened in the foreign exchange market to stabilize the nominal exchange rate, despite it was not being consistent with the prevailing macroeconomic developments.

With relatively higher inflation compared to competitors and trading partners of the nation, the relatively stable nominal exchange rate which has been created artificially the real exchange rate continued to appreciate.

Subsequent to the end of the civil war that severely affected the political stability in the country for about 30 years, in 2009, the government gave policy priority to infrastructure development projects. Large scale construction and reconstruction were started with massive public sector investments. The widening fiscal deficit was a key attribute in this period that affected macroeconomic stability further.

In addition, a new set of rules and regulations were introduced by enacting the Strategic Development Projects (SDP) Act of 2008 to facilitate the development projects around the country. The objective was to bring multiple benefits to the country through the generation of employment, technology transfer and foreign exchange earnings. The act empowered the minister of economic development and investment promotion to make investment decisions including investment promotion, approving, managing and offering tax concessions, and supervising such projects from beginning to the end (Government of Sri Lanka 2008). This approach reduced the transparency in the investment programmes to a greater extent. Further, the abolition of the GSP-Plus scheme in 2010 also had a significant impact on export oriented manufacturing firms, since they lost duty free access to the European Union for 7200 products. Many foreign investment firms in the manufacturing sector left the country due to the above reasons, during this period (Wickramarachchi 2015). Despite a new set of strategies to attract FDI, there were no significant improvements in manufacturing sector investments or in the setup of the manufacturing sector in the country over the past few years (Athukorala 2012). Thus, in the post war period, there has been notable policy uncertainty relating to the external sector.

Overall, manufactured export performance is positively related to an outward-oriented trade regime during the first two decades of post liberalization reforms (Wignaraja 1998). However, the economy failed to maintain macroeconomic stability overtime. Particularly, during the past ten years, development strategy has not given due priority to promote the export sector. As a result, the composition of the GDP has changed with more prominence of the services sector, while reducing the significance of the manufacturing sector. Sri Lanka's export performance since 2000 has not been a satisfactory one. The expanding trade deficit in 2011 and 2012 is partly explained by the weak performance of the export sector. Further, the global economic downturn is not the only reason for the low export growth in Sri Lanka (Kelegama 2013).

In summary and more importantly, during the past ten years the development strategy has not given due priority to promote the export sector in Sri Lanka. As a result, the composition of the GDP has changed where the services sector has become more prominent, while the significance of the manufacturing sector has faded away gradually.

3. The Model

Most of the previous empirical studies for the determinants of the performance of export sector have concentrated on the formulation of the reduced form of the export equation. Following the traditional way to estimate the sensitivity of exports to the real exchange rate, derived by solving export demand and export supply equations assuming an equilibrium between demand and supply functions of exports ($X^d_t = X^s_t = EX_t$) (Goldstein & Khan 1978, 1985; Cerra 1999), this study employs a fully specified reduced form of the export equation to identify the determinants of the performance of manufacturing exports.

Accordingly, the model can accommodate factors of both the demand and supply side. The advantage of the reduced form of the export equation is to avoid simultaneous equation bias, which may arise when estimating a demand or a supply function solely (Goldstein & Khan 1978).

In the model, total manufacturing exports (excluding petroleum products), which accounted for around 60 percent of total exports in the country, is the dependent variable. The total manufacturing exports are disaggregated into garment and other manufacturing exports. Garment exports from Sri Lanka account for around 70 percent of total manufacturing exports. This has heavy concentration around garments, which is a highly labor-intensive manufacturing good, and justifies the approach of taking that sector separately for the analysis. Accordingly, the study estimates three different models for total manufacturing exports, garment exports and other manufacturing exports, to ascertain whether the degree of the impact of the REER varies among different categories of exports.

The REER, which measures the country's competitiveness in international markets, is the key determinant variable in the study. The real exchange rate (RER) is defined as 'the relative price of tradable with respect to non-tradable goods' (Edwards 1988).

$$RER = \text{Price of Tradable Goods} / \text{Price of non tradable goods}$$

Since prices of tradable and non-tradable goods are not readily available, the above equation is not usually used in studies. Therefore, the study uses the proximate measure based on the method proposed by Edwards (1988), which is as follows;

$$REER_t = [\sum S_i * NER_{it} * Pw_{it}] / Pd_t$$

In the given equation, the REER is measured using available domestic and world price indices and the nominal exchange rate. The S_i is the export share corresponding to partner i. The NER denotes the nominal exchange rate (units of domestic currency per one unit of the currency of country i), Pw is an index of world prices, which is represented by producer price index of corresponding partner i. Pd is an index of domestic prices. NER and P_w are weighted averages of the share of trading partners. The measures used for P_w and P_d in previous studies are

different to each other. The proxy for P_w is usually the whole sale price index. The consumer price index (CPI) has been used in many studies as a proxy for P_d.

A decrease (increase) in the REER index denotes appreciation (depreciation) of the domestic currency with respect to the currencies of trading partners, which impact export performance negatively (positively).

The first controlled variable is the world demand approximated by the real income of importing countries. Manufacturing exports of Sri Lanka are heavily concentrated on the garment exports demand, which is heavily concentrated on a few advanced countries. However, garments of Sri Lanka are competitive in the international markets due to high quality and established brand names. Therefore, it is important to examine whether manufacturing export performance is influenced by the income level of importing nations. Further, any impact due to external shocks on export performance is also indirectly captured by the world demand variable, as the demand of developed countries are more sensitive to such changes and tend to adjust their preferences fast.

The second controlled variable is Foreign Direct Investment (FDI). The FDI has played an important role in establishing and promoting the manufacturing industries in Sri Lanka since the 1980s. The FDI not only contributes to domestic capital formation, but also brings technology, managerial knowhow and marketing channels. Following the market oriented policy reforms, many steps have been taken to attract export-oriented investors. The Board of investment (BOI) is the unique institution that promotes export-oriented investments and also has the power to establish and operate Export Processing Zones (EPZ) in the country, where majority of export oriented manufacturing industries are located. Further, 'several incentive packages were offered to investors in EPZs, allowing complete foreign ownership of investment projects' (Athukorala & Jayasuriya 2004). In that context, it is worthy to examine the impact of FDI on manufacturing exports.

The third controlled variable is production capacity. In practice, even if all other variables remain unchanged, exports would shift due to the increase in the production capacity of the country. It is important to have a direct measure to capture the production effect of manufacturing on exports, but the data is not available for a long time span. Value added manufacturing is not a good proxy, as export is a small component of total manufacturing. Therefore, the study uses the time trend variable in the model to capture the improvement in the production capacity overtime.

In addition, trade related policy reforms also play a decisive role in exports performance. The empirical evidence proved that manufactured export performance in Sri Lanka is positively related with outward-oriented policy reforms since 1977 (Wignaraja 1998). The policy measures taken during the post liberalization period under different regimes are not limited to the exchange rate policy or relative price adjustments. There have been many institutional changes embedded with various incentive packages for the private sector, in terms of financial

and non-financial, such as a more secure investment climate, business friendly environment etc. Thus, these policies have contributed to improving export performance by stimulating the private sector to invest in manufacturing exports. The dummy variables REG 1, REG 2, and REG 3 are considered to capture the impact of such policy regime shifts.

The final explanatory (dummy) variable is the MFA that represents the impact of the Multi Fiber Agreement (MFA) that provided quota restrictions on the garment exports. Sri Lanka's garment exports had been largely depended on the MFA Quota facility since 1978. '…the quota system covers more than 52 per cent of the country's garment exports (Dheerasinghe 2009). In the existing literature, the MFA is considered as an important determinant of Sri Lanka manufacturing exports, as garments became Sri Lanka's largest single item of exports since the late 80s, utilizing the quota facility. Though it is believed that the fast expansion of manufacturing exports is due to the MFA quota system, garment exports continued to maintain its position even after the abolition of the MFA in 2005.

Based on the above discussion, the empirical model used in the study can be specified as follows;

$$REXP_t = \beta_0 + \beta_1 REER_t + \beta_2 WD_t + \beta_3 FDI_t + \beta_4 TIME_t + \beta_5 REG2_t + \beta_6 REG3_t + \beta_7 MFA_t + U_t \quad \textbf{(1)}$$

Where,

REXP	: Manufacturing exports
REER	: Real Effective Exchange Rate
WD	: World demand
FDI	: Foreign Direct Investments (FDI)
TIME	: Time trend to capture changes in production capacity overtime
REG2 and REG3	: Binary dummy variables to capture the changes of policy regime related to trade where 1970-1976 (REG1), 1977-2001 (REG2) and 2002-2014 (REG3)
MFA	: Quota facility under Multi Fiber Agreement

Sign of coefficient of the REER β_1 would depend on the way exports respond to REER appreciation and depreciation. If the REER depreciates (increases), exports increase and if the REER appreciates (decreases), exports decrease. Since there is a positive relationship between the REER and export performance, β_1 will be positive. β_2 will also be positive, as the levels of income of importing countries increase, demand for exports increase. However, if the partners

are highly focused on export substitution policies though their income increases, they would not increase the demand for exports. This would lead to the yielding of a negative coefficient. FDI and production capacity would generally impact exports positively. Therefore, β_3 and β_4 are expected to be positive. β_5 and β_6 are expected to be positive as it assumes that policy regime shifts help the export sector to operate in a more business friendly environment. The contribution of the quota restriction provided under the MFA agreement to perform manufacturing exports is obvious. Then, the abolition of the MFA in 2005 would have a negative impact on manufacturing export performance, hence β_7 will be positive or negative.

The model is estimated separately for total manufacturing goods exports (EXP), garment exports (GAR) and other (non- garments) manufacturing exports (OTH) due to the reason discussed above. The MFA dummy variable is included only in the total exports and garment export equations, but not in the other export equation.

4. Data and Sources

Data for manufacturing exports (EXP) are compiled from the annual reports of the Central Bank of Sri Lanka (CBSL). For constructing the REER series, the producer price index is used for P_w. The weighted average of the P_w series is constructed based on the export share of six major trading partner countries (US, UK, Germany, France, Italy and India), which account for more than 90 per cent of Sri Lanka's manufacturing exports. The GDP deflator is used as a proxy for P_d instead of the CPI, since the CPI does not reflect the country-wide price changes and also can be a politically sensitive measure that would deliver wrong results. The base year used in all calculations is 2005. The data on the Nominal Exchange Rates (NER) were obtained from the UNCTAD (United Nations Conference on Trade and Development) site. Producer Price Indices of trading partners and nominal and real GDP data to calculate domestic GDP Deflator were obtained from World Development Indicators (WDI) of the World Bank site. World Demand (W_D) is approximated by the real income of trading partners. Data for W_D has been obtained from the WDI of the World Bank site. All variables in the model other than the dummy variables are used in natural logs. Data and the sources for each variable are summarized in Table 1. The summary statistics are given in Annexure 01 and graphs of data series on logged level are given in Annexure 02.

Table 1: Data and the Sources

Variable	Data	Source
MANUEXP		
GAREXP	Manufacturing exports	Central Bank of Sri Lanka (CBSL) publications
OTHEXP		
REER	Real Effective Exchange Rate	UNCTAD Statistics, United Nations Conferenc on Trade and Development
WD	World Demand : Trade weighted real GDP of trading partners	World Development Indicator -World Bank
FDI	Foreign Direct Investments : Total value of FDI	CBSL publications
MFA	Dummy for the non-MFA period	Based on Literature Survey
REG 1 (1970-1976)		
REG 2 (1977-2001)	Dummies for change in Policy regime	Based on Literature Survey
REG 3 (2002-2014)		

5. Estimation method

Since time series data are used in the study, it is necessary to examine whether the variables are stationary or non-stationary. Use of non-stationary data in regressions could produce spurious results through incorrect relationships. Therefore, logarithms of all variables were tested on the univariate basis, using the Augmented Dickey Fuller (ADF) test to examine the presence of unit roots, as proposed by Engle and Granger (1987). First logged level variables were tested and if a unit root for a particular series was found, then they were tested again by taking the first difference level of the series. If a series is stationary at level, the series is called I(0) and if a series becomes stationary after first differencing, the series is called I(1) series. When the ADF test is conducted, the intercept and trend were included based on the graphical analysis of each series. Table 2 presents the results of the ADF test.

Table 2: Results of ADF test

Variable	Level		First difference		Order of Integration
	ADF Test Statistic	Critical Value at 5% Level	ADF Test Statistic	Critical Value at 5% Level	
LMANUEXP	-2.896	-3.54	-4.672	-3.54	I(1)
LGAREXP	-2.638	-3.54	-3.729	-3.54	I(1)
LOTHEXP	-2.797	-3.54	-5.114	-3.54	I(1)
LREER	-1.834	-3.54	-4.612	-3.54	I(1)
LWD	-2.922	-3.54	-4.842	-3.54	I(1)
LFDI	-3.678	-3.54	-2.888	-3.54	I(0)

Source : Estimates using Eviews 9.5

Note : H0 : Series has a unit root, H0 is rejected at the 5per cent level

The ADF test results show that one of the independent variables, the FDI, is integrated of order zero (I(0)), while all other independent variables are integrated of order one.

When the export equation (1) above is estimated, it is necessary to estimate the long run relationships among the variables. The long run relationships can be estimated through a conventional co-integration technique, but the technique required all series to be integrated in the same order. According to the results of the unit root test, variables used in the study are a mix of I(0) and I(1). Therefore, the Autoregressive Distributed Lags (ARDL) method developed by Pesaran and Shin (1999) and Pesaran (2001) is used in the study.

The ARDL technique provides some additional advantages in the estimation process compared to other estimation methods. First, it allows the use of a mix of I(0) and/or I(1) in the ARDL and pre-testing for the unit root is only required to confirm that the series are not of I(2) or a higher order. Second, it supports small and finite samples to deliver statistically significant results compared to other techniques that prefer to have large samples to deliver reliable results. Third, the ARDL technique has the ability of accommodating different time lags for different variables in the model, while other techniques require all variables to be kept in the same order of lag. Fourthly, it takes care of omitted variables and serial correlation problems and addresses any endogeneity problem, since it provides unbiased estimates in the long-run model. Further, the ARDL model estimates both short run and long run dynamics simultaneously in one single reduced form equation (Harris & Sollis 2003).

The Log linear transformation of the model (1) in the ARDL specification is as follows;

$$\Delta Ln\,(REXP)_t = \alpha + \Sigma^{P}_{k-1}\,\psi_k\,\Delta\,Ln\,(REER)_{t-k} + \Sigma^{P}_{k-1}\,\gamma_k\,\Delta\,Ln\,(WD)_{t-k} + \Sigma^{P}_{k-1}\,\delta_k\,\Delta\,Ln(FDI)_{t-k} + \Sigma^{P}_{k-1}\,\lambda_k\,\Delta\,Ln(REXP)_{t-k} + \beta_1\,Ln\,(REER)_{t-1} + \beta_2\,Ln\,(WD)_{t-1} + \beta_3\,Ln\,(FDI)_{t-1} + \beta_4\,Ln\,(REXP)_{t-1} + \beta_5\,TIME_t + \beta_6\,REG2_t + \beta_7\,REG3_t + \beta_8\,MFA_t + \epsilon_t \quad \textbf{(2)}$$

where Δ indicates the variables are in the first-difference form and p is the optimal lag length. ϵ_t is the random error term. Coefficients $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6, \beta_7$, and β_8 show long term dynamics while $\psi_k, \gamma_k, \delta_k$, and λ_k stand for short term dynamics.

The study followed the three stages of the ARDL approach to Cointegration as follows;

First, the orders of the lags in the ARDL model can be selected either by the Akaike information criterion (AIC) or the Schwarz Bayesian criterion (SBC). Since the study used annual data, it used two as the maximum order of lags in the estimations, as Pesaran and Shin (1999) recommended. The AIC (Akaike Information criterion) is used to decide the lag structure of the series.

In the second step, the bound testing approach (Wald test) is employed to examine the existence of a long- run relationship between the variables. Whether to include the long-run dynamics in the model is decided by comparing the F test statistic with the critical values proposed by Pesaran (2001).

The null hypothesis in the F test is,

$$H0: \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = \beta_7 = \beta_8 = 0$$

which check against,

$$H1: \beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq \beta_5 \neq \beta_6 \neq \beta_7 \neq \beta_8 \neq 0$$

The F statistic depends on the number of independent variables in the regression (k), the sample size (n), stationary I(0) and non-stationary I(1) properties and whether the estimated model has a trend and/or intercept.

Two sets of critical values are provided by Pesaran (2001); an upper bound critical value (UCB) that is used when all variables in the model are integrated of order I(1), and a lower bound critical value (LCB) that is used when variables are (I(0)). If the calculated F statistic by the joint test is greater than the upper bound critical value, the variables are said to be co-integrated, where there is a long run relationship in the model.

In the third step, the following long-run model is estimated if there is evidence of a long-run relationship (cointegration) of the variables.

$$Ln(REXP)_t = \alpha_1 + \Sigma^{P}_{k-1} \psi_{1k} Ln(REER)_{t-k} + \Sigma^{P}_{k-1} \gamma_{1k} Ln(WD)_{t-k} + \Sigma^{P}_{k-1} \delta_{1k} Ln(FDI)_{t-k} + \Sigma^{P}_{k-1} \lambda_{1k} Ln(REXP)_{t-k} + \mu_t \quad \textbf{(3)}$$

The ARDL specification of the short-run dynamics, derived by constructing an Error Correction Model (ECM) is as follows;

$$\Delta Ln(REXP)_t = \alpha_2 + \Sigma^{P}_{k-1} \psi_{2k} \Delta Ln(REER)_{t-k} + \Sigma^{P}_{k-1} \gamma_{2k} \Delta Ln(WD)_{t-k} + \Sigma^{P}_{k-1} \delta_{2k} \Delta Ln(FDI)_{t-k} + \Sigma^{P}_{k-1} \lambda_{2k} \Delta Ln(REXP)_{t-k} + \gamma ECM_{t-1} + \varrho_t \quad \textbf{(4)}$$

$$ECM_t = Ln(REXP)_t - \alpha_1 - \Sigma^{P}_{k-1} \psi_{1k} Ln(REER)_{t-k} - \Sigma^{P}_{k-1} \gamma_{1k} Ln(WD)_{t-k} - \Sigma^{P}_{k-1} \delta_{1k} Ln(FDI)_{t-k} - \Sigma^{P}_{k-1} \lambda_{1k} Ln(REXP)_{t-k} \quad \textbf{(5)}$$

In the short-run equation, all coefficients are related to the short-run dynamics of the model's convergence to equilibrium and γ represents the speed of adjustment.

Following the methodology above, the study estimates three different models; for Total Manufacturing Exports (MANUEXP), Garment Exports (GAREXP) and Other Exports (OTHEXP).

After estimating the models, the residual of all selected models are tested for unit root, to check whether they are stationary at level, which further confirms the long run equilibrium that exists among variables.

Further, the most common and standard residual diagnostics tests i.e. Serial Correlation LM test and Breusch-Pagan-Godfrey test for Heteroskedasticity were performed. In addition, the other standard residual diagnostic tests were performed to confirm the validity of the estimated model. Further, the stability of the system is tested by the CUSUM test.

6. Results

The prime objective of the study is to examine the impact of the REER on export performance. As the first step, bivariate models for all three categories of exports are estimated. However, the TIME variable had to be included in the models in order to preserve the fitness and stability of the models. AIC is used to determine the optimal number of lags to be included in the models. The lag length that minimizes AIC is one for all three models. The Model selection summary output is given in Annexure 03.The summary of the bivariate model estimations is given in Table 3.

Table 3: Bivariate Models

Variable	MANUEXP	GAREXP	OTHEXP
C	-0.549	-1.224	0.160
	(0.704)	(1.083)	(0.152)
D(LREER)	0.777***	0.301**	0.470**
	(2.814)	(2.056)	(1.911)
D(LREER(-1))	-0.185	0.629*	0.205
	(0.465)	(1.941)	(0.518)
D(LEXP(-1))	0.516***	0.105	0.132**
	(3.773)	(0.743)	(1.919)
LREER(-1)	0.403**	0.426	0.330**
	(2.076)	(1.422)	(2.172)
LEXP(-1)	0.475***	0.149	0.285***
	(3.434)	(1.352)	(3.570)
TIME	0.028***	0.015	0.0135*
	(3.067)	(1.392)	(1.768)
R^2	0.466	0.488	0.530
Adj. R^2	0.377	0.403	0.452
F stat	5.238	5.719	6.779
SE	0.236	0.169	0.238
DW	2.068	1.879	2.037
LMS-F	0.808	0.348	0.487
JBN	30.995	1.896	3.567
HSC	1.645	3.219	1.632

*Level of statistical significance: *=10%, **=5%, ***=1%*

t-statistics are given in parenthesis.

The short-run coefficient of the REER is significant in all three cases. However, the study is more focused on the impact of long run dynamics in models, as long run impacts are more favorable to analyse the issue.

In the long-run, garment exports do not respond to the changes in the REER. The impact of the REER on the total manufacturing exports and other exports is positive and highly significant. If the REER depreciated by 1 percent, total manufacturing exports and other exports would increase by 0.4 and 0.33 percent, respectively.

In the second step, the full models were estimated for Total Manufacturing Exports (MANUEXP), Garment Exports (GAREXP) and Other Exports (OTHEXP), including the REER and all other controlled variables.

Policy regime dummies (REG 2, REG 3) are included in the original model (1) to capture any other impact due to regime shifts other than the REER related policies, i.e., economic stability, institutions, investment perception and secure business environment. However, regime shift dummies in the full model are highly correlated with the REER variable and the models were not sufficiently fit and stable. The movements of the REER during the past few decades show a distinctive pattern in line with the changes in policy regimes. In all three policy regimes, there were significant policy implications on the REER causing it to depreciate or appreciate. Accordingly, the model (1) is estimated excluding regime shift variables (REG 1 and REG 2).

The optimal number of lags to be included in the models were decided based on AIC. The model selection summary output is given in Annexure 04. The best three models for MANUEXP, GAREXP and OTHEXP were selected using the co-integration analysis and all the diagnostic test results are presented below.

The bound tests proved the existence of a long- run relationship among the variables in the selected three models. The F test statistics for the selected three different models and the relevant lower and upper bound critical values from Pesaran (2001) table are reported in Table 4 below.

Table 4 : F Test Statistics and Bound Test Results

Models	F Statistics	P Value
MANUEXP	11.191	0.000***
GAREXP	5.765	0.000***
OTHEXP	5.300	0.000***
	LCB	**UCB**
*5% significant level	3.23	4.35

Source: Pesaran (2001), Table CI(iii) Unrestricted intercept and no trend

Test statistics of all three models lie outside UCB and LCB values and exceed the UCB critical value. Therefore, the null hypothesis is rejected in favour of the alternative and it can be concluded that there are long-run relationships in all three models.

The residual of all three models were tested for unit root tests and test results revealed that residuals are stationary at level, which further confirmed the long run equilibrium that exists among variables. The results of the Serial Correlation LM test and Breusch-Pagan-Godfrey test for Heteroskedasticity confirmed that there is no Serial Correlation in the systems and also no heteroskedasticity is present in all three cases. The residual diagnostic test results for the selected three models are given in Table 5.

Table 5: Residual Diagnostic Test Results

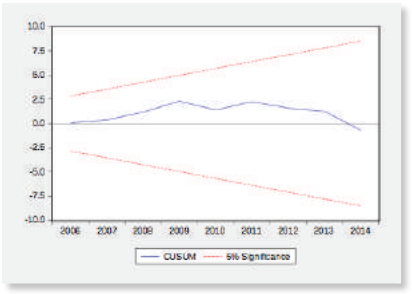
Models	Test Statistics	F Value*	Results
MANUEXP	Serial Correlation LM test	0.221306 (0.8032)	No serial correlation
	Heteroskedasticity Test B beusch-pegan-godfrey	0.822565 (0.6515)	No heteroskedasticity
GAREXP	Serial Correlation LM test	1.385025 (0.2733)	No serial correlation
	Heteroskedasticity Test B beusch-pegan-godfrey	0.875139 (0.6126)	No heteroskedasticity
OTHEXP	Serial Correlation LM test	0.444334 (0.6464)	No serial correlation
	Heteroskedasticity Test B beusch-pegan-godfrey	1.671438 (0.1215)	No heteroskedasticity

Values in the Parenthesis are the P-values

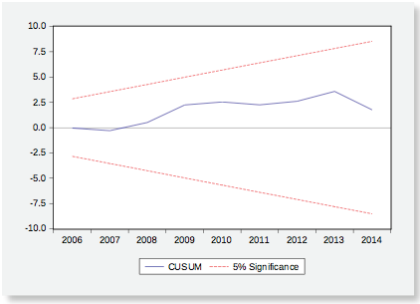
The CUSUM test results revealed that all three systems are stable. Figure 1 presents the plots of the CUSUM statistics for three models that fall inside the critical bands at 5% confidence interval.

Figure 1: CUSUM test results

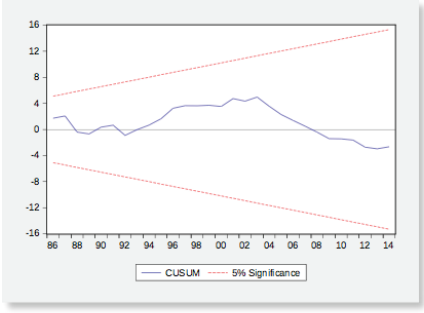
Model for MANUEXP



Model for GAREXP



Model for OTHEXP



Based on the results of the co-integration analysis and the diagnostic tests, the three models that were selected as the most preferred models in the study are as follows.

Table 6: The Short Run Dynamics: Error Correction Representation for the selected ARDL Models

	MANUEXP	GAREXP	OTHEXP
CONS	-61.118***	-	-27.526**
	(4.892)		*(2.276))*
D(LREER)	-	-	-0.781*
			(1.790)
D(LREER(-1))	0.950**	-0.473	-0.243
	(2.211)	*(1.462)*	*(0.559)*
D(LREER(-2))	1.219**	-0.590	-0.789
	(2.540)	*(1.937)*	*(1.372)*
D(LWD)	7.103***	2.635**	8.402***
	(4.133)	*(2.962)*	*(3.895)*
D(LWD(-1))	-0.764	3.272**	-
	(0.417)	*(2.901)*	
D(LWD(-2))	1.831	-2.207*	-
	(1.032)	*(2.083)*	
D(LFDI)	-	0.171***	-
		(3.183)	
D(LFDI(-1))	0.172**	0.330***	0.237**
	(2.109)	*(5.684)*	*(2.386)*
D(LFDI(-2))	-	0.170***	-
		(3.669)	
D(LEXP(-1))	0.642***	-0.654***	0.258*
	(5.4888)	*(4.527)*	*(1.910)*
D(LEXP(-2))	0.325**	-0.222	0.272*
	(2.218)	*(1.638)*	*(1.944)*
TIME	-0.009	0.027**	-0.009
	(0.372)	*(2.190)*	*(2.089)*
MFA	-0.389	-0.887	-

	(3.012)	*(1.260)*	
ECM(-1)	-0.2786***	-0.370***	-0.392***
	(5.071)	*(3.592)*	*(3.897)*
R^2	*0.815*	*0.905*	*0.686*
Adj. R^2	*0.718*	*0.850*	*0.556*
F stat	*8.478*	*20.443*	*5.281*
SE	*0.155*	*0.085*	*0.199*
DW	*2.195*	*1.871*	*2.181*
LMS-F	*6.000*	*0.172*	*0.236*
RESET	*0.055*	*0.034*	*0.082*
HSC	*0.766*	*0.471*	*0.234*

*Level of statistical significance: *=10%, **=5%, ***=1%*

t-statistics are given in parenthesis.

The results of the ECM for the three export categories are presented in Table 6 and the long-run estimations given in Table 7.

In all three models, coefficients of error correction terms (ECM (-1) are negative and highly significant at a 1% level. The absolute value of coefficient of (ECM (-1) indicates the rate of convergence to equilibrium or the speed of adjustment to equilibrium following a short run shock. Accordingly, the whole system of manufacturing exports will get back to the long-run equilibrium at the speed of 28 per cent. The systems for garment exports and other exports will move to the long-run equilibrium at the speed of 37 per cent and 39 per cent, respectively. These results provide the evidence of co-integration (long-run relationship) among variables in all three models.

Table 7: The Long Run Estimation Results

	MANUEXP	GAREXP	OTHEXP
LREER(-1)	1.129**	3.373**	2.109**
	(2.103)	*(1.816)*	*(1.955)*
LWD(-1)	5.338**	-0.758**	3.876**
	(5.950)	*-1.474*	*(2.206)*
LFDI(-1)	-0.089	-0.055	-0.089**
	(1.269)	*(0.197)*	*(0.638)*
TIME	-0.013	0.141**	-0.0216
	(0.372)	*(2.551)*	*(0.365)*
MFA	-0.509***	-0.459	-
	(3.487)	*(1.394)*	

*Level of statistical significance: *=10%, **=5%, ***=1%*
t-statistics are given in parenthesis.

In the short-run, coefficients of the REER are positive and significant only in the total manufacturing equation and the REER is not statistically significant in other two cases. However, in the long-run the REER is significant at a 5 per cent level and also reported a positive sign in all three categories of exports. A one percent depreciation of the REER would lead to the increase of exports by more than one percent in the long-run, which creates a more elastic situation.

The short-run coefficients of WD are positive and significant in all three models and relative sizes of the coefficients show that WD is the dominant determinant of manufacturing exports from Sri Lanka. The results are considerably similar with the long-run results, except for the garment exports. In the long-run, WD is significant with the negative sign in the garment export equation, suggesting that the garment industry has the potential of capturing the markets with upper income by improving the quality standards and catering to globally branded products.

In contrast to the positive and significant impact of FDI on all three types of exports in the short-run, FDI has no significant impact on total manufacturing exports and garment exports in the long-run and also reported a negative sign in all three cases. This confirms that Sri Lanka has failed to utilize FDI flows to improve the export-oriented manufacturing industries during the last few decades. Despite many incentive packages offered to attract investments over the years, the investment climate has not been attractive to foreign investors in export oriented manufacturing industries. The possible reasons may be political instability, policy uncertainty and inefficient institutional structures in terms of FDI promotion and facilitation.

The Coefficient of TIME variable, which captures the improvement in production capacity, is expected to be positive, assuming that exports will increase due to improvements in production capabilities over time, even though there are no other factors that facilitate the export sector. However, the impact is not significant with respect to the total manufacturing exports and other exports.

The dummy used for the MFA has no significant impact on garment exports in both the short-run and long-run, which implies that the abolition of the MFA in 2005 had no significant impact on the export performance. It is sensible, because the garment industry had been diversified to non-quota categories of high value products and had been able to establish strong market links. Moreover, the garment industry in Sri Lanka has already been well established and has become internationally competitive due to trade and investment liberalization reforms that have been implemented over the past three decades (Athukorala & Ekanayake 2015).

Results clearly suggest that the REER has been a key determinant of export performance of the country. According to the overall estimations, it can be suggested that domestic supply side related factors are important in determining the export performance as well as the factors associated with external demand factors.

7. Conclusion

The results clearly suggest that the REER has been a key determinant of manufacturing exports of Sri Lanka. Policy makers should aim at maintaining the REER at a realistic (market-consistent) level to reap such benefits. In order to restore international competitiveness, the nominal exchange rate should be allowed to adjust to the equilibrium level, which needs a significant depreciation. However, nominal depreciation itself will not achieve the objective; it is crucial to maintain domestic macro- economic stability, as it impacts the objective through the relative prices. Results also suggest that Sri Lanka has the ability to penetrate the world market through improvements in supply side competitiveness.

In the current economic conditions of a nation with a large deficit of trade and current account balances of the Balance of Payments, and a significantly higher ratio of foreign debt, nominal depreciation alone would not resolve the problem of those imbalances, since it also would be an expensive instrument, that would worsen government budgetary conditions further. It could also lead to sudden capital outflows due to adverse effects on investor sentiment. Therefore, a more prudent consolidated policy package is required, including a more flexible exchange rate policy and more disciplined fiscal management system to reduce public debt in a sustainable manner. Moreover, a more consistent but independent monetary policy framework, and trade and investment policy reforms are necessary to improve the overall economic condition in the country and foster sustainable growth.

References

Athukorala P & Jayasuriya S 2015, '*Victory in War and Defeat in Pace: Politics and Economics of Post-Conflict Sri Lanka*', Asian Economic Papers, Vol.14, No.3, pp. 22-54.

Athukorala P & Rajapatirana S 2000, '*Liberalization and industrial transformation: Lessons from the Sri Lankan Experience'.* Economic Development and Cultural Change , Vol.48, No. 3, pp. 543-573.

Athukorala P & Ekanayake R 2015, '*Repositioning in the Global Apparel Value Chain in the Post-MFA Era: Strategic Issues and Evidence from Sri Lanka'*, Colombo: Institute of Policy Studies.

Athukorala P & Riedel J 1997, *'Modelling NIE Exports: Aggregation, Quantitative Restrictions and Choice of Econometric Methodology,'* Journal of Development Studies, Vol.33, No.1, pp. 81-98.

Athukorala, P 2012, '*Sri Lanka's trade policy; Reverting to dirigisme*?', The World Economy, vol.35, no. 12, pp. 1662-1686.

Central Bank of Sri Lanka, *Annual Report*, Colombo, Sri Lanka, various issues.

Dheerasinghe R 2009, *'Garment Industry in Sri Lanka Challenges, Prospects and Strategies',* Central Bank of Sri Lanka, Staff Studies, Vol.33, No.1, pp.33–72.

Edwards S 1989, '*Real Exchange Rates, Devaluation and Adjustment: Exchange Rate Policies in Developing Countries*', Cambridge.

Edwards S 1988, '*Real and Monetary Determinants of Real Exchange Rate Behaviour : Theory and Evidence form Developing Countries*', Journal of Development Economics, Vol. 29, pp.311-341.

Ekanayake EM 1999, '*Real Exchange Rate Volatility and Sri Lanka's Exports to the Developed Countries, 1978-96*', Journal of Development Economics, Vol. 24, No. 1, pp. 147-165.

Export Development Board in Sri Lanka 2015, *'Performance of the Export Sector in Sri Lanka - 2014',* Export Development Board in Sri Lanka.

Fang WS et al 2006, '*Export Promotion through Exchange Rate Changes: Exchange Rate Depreciation or Stabilization*?', Southern Economic Journal, vol. 72, No. 3, pp. 611–626.

Government of Sri Lanka, 2008, *Strategic development projects act, no. 14 of 2008*, Government Publication Bureau, Colombo.

Grobar LM 1993, '*The effect of real exchange rate uncertainty on LDC manufactured exports', Journal of Development Economics*, Vol. 41, pp.367-376.

Harris, R & Sollis, R 2003, *Applied time series modelling and forecasting*, West Sussex: Wiley.

Hinkle LE & Monteil PJ 1999, '*Exchange Rate misalignment: Concepts and Measurement for Developing Countries',* Oxford University, New York, United States.

Krugman, P. (1986), *'Pricing to Market When the Exchange Rate Changes'*, NBER Working Paper 1926, National Bureau of Economic Research, Cambridge, MA.

Rodrik D 2008, '*Disequilibrium Exchange Rates as Industrialization Policy', Journal of Development Economics*, Vol. 23, No. 1, pp. 89–106.

Pesaran, M & Shin, Y 1999, '*An autoregressive distributed lag modeling approach to cointegration analysis*', in S Strom (ed), '*Econometrics and economic theory in the 20th century: The Ragnar Frisch centennial symposium'*, Cambridge: Cambridge University Press, pp. 371–413.

Pesaran, M 2001, 'Bounds testing approaches to the analysis of level relationship', *Journal of Applied Economics*, vol. *16*, no.3, pp. 289–326.

Schatz, H. J. and D. G. Tarr (2002), *'Exchange Rate Overvaluation and Trade Protection'*, in B. Hoekman, P. English, and A. Mattoo (eds.), *Development, Trade, and the WTO: A Handbook*, Washington DC: World Bank. Willet T 1986, '*Exchange Rate Volatility, International Trade, and Resource Allocation',* Jounal of International money and Finnace, Vol.5, pp.101-112.

Wickramarachchi V D 2015, *'Determinants of Foreign Direct Investment (FDI) in Developing Countries: The Case of Sri Lanka',*

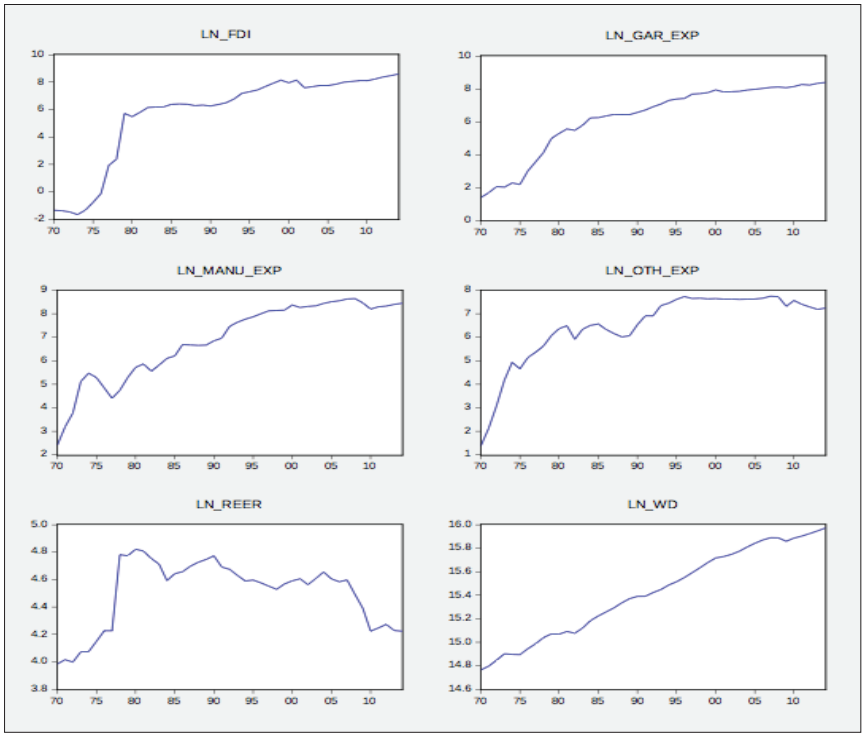
Wignaraja, G. (1998), Trade Liberalization in Sri Lanka: Exports, Technology and Industrial Policy, London: Macmillan Press, 1998 and New York: St. Martins Press.

Annexures

Annexure I: Descriptive Statistics

	LMANUEXP	LGAREXP	LOTHEXP	LREER	LWD	LFDI
Mean	5.756	4.913	4.932	4.501	14.340	5.682
Median	6.645	6.272	5.430	4.591	14.326	6.498
Maximum	9.239	8.765	8.218	4.821	14.961	8.595
Minimum	-2.303	-3.507	-2.659	3.984	13.673	-1.661
Std. Dev.	3.082	3.642	2.800	0.247	0.396	3.261
Observations	45	45	45	45	45	45

Annexure II : Logged Level Time Series



Annexure III : Bivariate Models -Model Selection Summery Output

Models	Lag Length	AIC	SIC	DW	Wald F.
ARDL(MANUEXP,REER)	(2,2)	0.2357	0.5667	1.6012	4.8575
	(1,1)*	0.0990	0.3857	2.0685	5.9778
	(2,1)	0.1724	0.5034	1.6121	4.9408
	(1,2)	0.1888	0.4778	1.5857	5.8720
ARDL(GAREXP,REER)	(2,2)	-0.5156	-0.1846	1.8495	2.2177
	(1,1)*	-0.5666	-0.2799	1.8795	1.9727
	(2,1)	-0.4955	-0.1646	1.7176	1.7695
	(1,2)	-0.5415	-0.2519	1.9700	2.1245
ARDL(OTHEXP,REER)	(2,2)	0.1799	0.5109	1.9032	6.5470
	(1,1)*	0.1192	0.4059	2.0377	9.2199
	(2,1)	0.1524	0.5031	1.8121	6.8408
	(1,2)	0.2485	0.4758	1.6367	8.8720

** The models selected based on AIC*

Annexure IV: Multivariate Models - Model Selection Summery Output

Models	Lag Length	AIC	SIC	DW	Wald F.
ARDL(MANUEXP,REER,WD,FDI)	(2,2,2,2)	-0.6671	0.0776	2.3446	16.4763
	(2,2,2,1)*	-0.7133	-0.0099	2.3446	17.1324
	(1,1,0,1)	-0.1288	0.4037	2.3443	6.0846
	(1,1,1,1)	0.0206	0.5121	2.1858	7.1387
	(2,2,0,1)	-0.6622	-0.1244	2.1107	16.3312
ARDL(GAREXP,REER,WD,FDI)	(2,2,2,2)*	-1.8179	-1.1559	1.8712	7.1452
	(1,1,1,1)	-1.3262	-0.7937	2.3614	4.3354
	(1,1,0,1)	-1.3832	-0.9326	2.4977	4.8029
	(1,2,2,2)	-1.7673	-1.1467	1.8332	6.2356
	(1,0,2,2)	-1.7209	-1.1417	1.6861	5.1539
ARDL(OTHEXP,REER,WD,FDI)	(2,2,2,2)	-0.0643	0.6390	1.8791	6.6842
	(1,1,1,1)	-0.0067	0.5257	2.4094	4.7779
	(1,1,0,1)	-0.0508	0.4407	2.3712	4.9208
	(2,2,0,1)*	-0.1419	0.3960	2.2814	6.9621
	(2,2,1,1)	-0.1380	0.3998	2.2845	6.6150

** The models selected based on AIC*