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STAFF STUDIES

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CENTRAL BANK OF SRI LANKA

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The views presented in these papers are those of the authors and do not necessarily indicate the views of the Central Bank of Sri Lanka.

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ABOUT THE AUTHORS

Dr. (Ms.) Hemantha Ekanayake is a Senior Economist attached to the Economic Research Department of the Central Bank of Sri Lanka. She received a B.Sc. Honours degree in Agriculture from the University of Ruhuna, Sri Lanka. She also received a M.Sc. degree in International and Development Economics and a Ph.D. degree in Economics from the Australian National University, Australia. Her research interests are in the fields of Fiscal Monetary Interrelations and Macroeconomic Modeling.

Dr. Anil Perera is a Senior Economist attached to the Economic Research Department of Central Bank of Sri Lanka. He received a BA Special Degree in Economics with First Class Honours from the University of Sri Jayewardenepura, Sri Lanka and Master of Social Sciences Degree in Economics from the University of Kelaniya, Sri Lanka. He received his Ph.D. Degree from Monash University, Australia. His research interests are in the fields of Monetary Policy, Financial Markets and Macroeconomic Management.

Ms. Niluka Ekanayake is a Senior Economist attached to the Economic Research Department of the Central Bank of Sri Lanka. She obtained her B.Sc. Special Degree in Business Administration from the University of Sri Jayewardenepura, Sri Lanka. She is a member of Institute of Bankers of Sri Lanka and the Association of Accounting Technicians of Sri Lanka. Her research interests are in the fields of International Trade and Macroeconomic Management.

Incidence and Duration of Fiscal Crises: Macroeconomic Determinants

Hemantha K. J. Ekanayake[1/]

Abstract

This paper examines the determinants of the incidence and duration of fiscal crises for a large sample of developed and developing countries using multivariate probit and survival models, for the period from 1975 to 2010. Overall, the findings suggest that most of the economic fundamentals that trigger crises, do not necessarily lengthen the duration of a crisis except for high levels of foreign reserves, which are associated with a lower probability of fiscal crises incidence as well as faster recovery from a crisis. Moreover, the paper argues for greater capital account openness and for inflation targeting regimes, since it identifies these two as important mechanisms through which fiscal discipline can be improved, which, in turn, contributes towards avoiding fiscal crises.

JEL Classification: C33, C41, H60, H63

Key Words: *Fiscal Crises, Survival Model, Foreign Reserves, Capital Account Openness, Inflation Targeting.*

1/ Author wishes to thank Prof. Ragbendra Jha, Prof. Premachandra Athukorala, Dr. Paul Burke, Dr. Roshan Perera, Dr. P.K.G. Harischandra and anonymous reviewers for their valuable comments and support. Corresponding email: hemantha@cbsl.lk

1. Introduction

"Fiscal crisis" is viewed in the literature as an umbrella term for all types of endangered fiscal solvency, including both external and domestic debt defaults. Unlike a financial crisis, a fiscal crisis has the ability to build up in the economy for a long time without being visible. During this suppressed period, it weakens the economy while allowing pressure to build up in the economy. In the end, when the economy has no resistance left, the situation erupts into a full blown fiscal crisis, forcing governments to alter their policies by restructuring public debt or accessing significant external financial support (in most cases sponsored by the IMF) to regain fiscal sustainability (Baldacci, *et al*. 2011).

The complex nature of fiscal imbalances makes it difficult to identify fiscal crisis episodes using observable data. Early research used public debt defaults or large scale official financing support to identify fiscal crisis events (Pescatori and Sy, 2004, Reinhart and Rogoff, 2010). More recent studies prefer a much broader definition of fiscal crisis, taking government rollover problems into account (Baldacci, *et al*. 2011). Early studies mainly focused on fiscal variables that are related to solvency and liquidity in explaining the reasons for a fiscal crisis. More recent studies, however, consider a much broader approach and use institutional and political variables to explain the incidence of a fiscal crisis. However, none of these studies has considered the duration of fiscal crises *i.e*., the time it takes for a crisis-hit country to return to normal levels, and the determinants of the duration of fiscal crises. Priority should be given to preventing crises, yet if a crisis does occur it is also worthwhile to know ways and means to shorten its duration. More recently, among others, Reinhart and Rogoff (2010) and Baldacci, *et al*. (2011) have provided comprehensive identification of fiscal crises. One distinctive feature of these studies is that they not only identify the onset of crises but also the recovery from crises, which provides an opportunity to analyse crisis incidence as well as crisis duration. This study aims at analysing the incidence and duration of fiscal crises for a sample of 81 countries over about three decades (1975–2010).

The purpose of this study is two-fold. First it identifies the macroeconomic fundamentals (social, economic, and political) that determine the probability of a fiscal crisis. Then it examines the effect of these macroeconomic fundamentals on fiscal crisis duration. This study offers some extensions to the previous studies on fiscal crises. It examines the importance of economic and socio-political variables on fiscal crises using a broader definition of a fiscal crisis which includes near-default events to identify the onset of a fiscal crisis (Baldacci, *et al*. 2011). Importantly all these variables are taken as five-year averages leading up to the crisis event, to explain how the pressure build-up in the economy could possibly predict the probability of a crisis occurring, as well as its duration. Secondly, and most importantly, this study analyses fiscal crisis duration and

its determinants, which has not been analysed in the literature previously, to explore the availability of specific policy measures that are necessary to shorten the crisis duration.

Fiscal crisis incidence is analysed by using a multivariate probit regression model and crisis duration is modeled using survival analysis. Based on estimation results, it is evident that some of the variables that significantly reduce the likelihood of a fiscal crisis do not necessarily reduce crisis duration and *vice versa*. The level of democracy and the age dependency ratio are found to be significant determinants of crisis duration, yet they do not contribute much to crisis incidence analysis. However, the level of foreign reserves of a country has a different effect as it reduces the likelihood of a crisis and shortens crisis duration. Therefore, this study argues that maintaining a high level of foreign reserves is one of the main tools available for policy makers to avoid a fiscal crisis, as well as to ensure an early exit from a fiscal crisis, if one does occur. Moreover, the paper argues for capital account openness and for inflation targeting regimes, since it identifies these two as important mechanisms through which fiscal discipline can be improved, which, in turn, contributes towards avoiding fiscal crises.

The rest of this paper is structured as follows. Section 2 presents an analytical survey of theoretical and empirical literature on the factors that underlie the imbalances causing fiscal crises. Section 3 sets out the empirical approach and Section 4 presents data. Section 5 discusses the results, and Section 6 presents conclusions.

2. Review of Literature

A fiscal crisis is generally defined as the failure to meet a principal or interest payment on the due date, resulting in debt defaults/restructuring or accessing official financing (Reinhart and Rogoff, 2011, Baldacci, *et al*. 2011). When a government is unable to identify a proper combination of expenditure cuts, revenue increases and borrowing, in line with its financial situation, the country's macroeconomic stability will be threatened. The country will eventually go into fiscal distress and, in the end, a fiscal crisis. There are several factors that may cause a country to experience such an event and they may also contribute to the longevity of the crisis. While numerous studies are devoted to analysing the characteristics of a fiscal crisis, including an external and/or domestic debt crisis, the factors behind crisis duration are less closely examined.

Theoretical models explain fiscal crises as a reflection of a country's critical problems of solvency or a minor problem of temporary illiquidity. Early generation models mainly examined sovereign debt crises and explained crises as a "willingness to pay" problem. At times, even when borrowers are solvent, they are reluctant to repay the debt on time if the benefits of a default are higher than its costs (Cole, *et al*. 1995, Dooley, 2000).

Unlike commercial debtors, sovereign debtors are immune to legal action and, making use of that immunity, debtor governments are able to make their decisions based on cost-benefit analysis. However, the effects from a default, such as a loss of reputation, can have a long lasting impact.

Second-generation models examine debt defaults as an 'ability to pay' problem, more than a 'willingness to pay' issue. The positive net worth of a country can reverse easily due to sudden shocks to its economy. Berg and Sachs (1988) and Agenor and Montiel (1999), among others, argue that the debt crisis of the early 1980s was of this kind. A sharp increase in the world interest rate hit most of the Latin American countries unexpectedly. As a result, some countries had to restructure their debt on an emergency basis, while others sought large-scale financing from the IMF. Obviously, this kind of situation cannot be categorised under willingness to pay. It is rather a problem of reduced ability to pay due to temporary illiquidity.

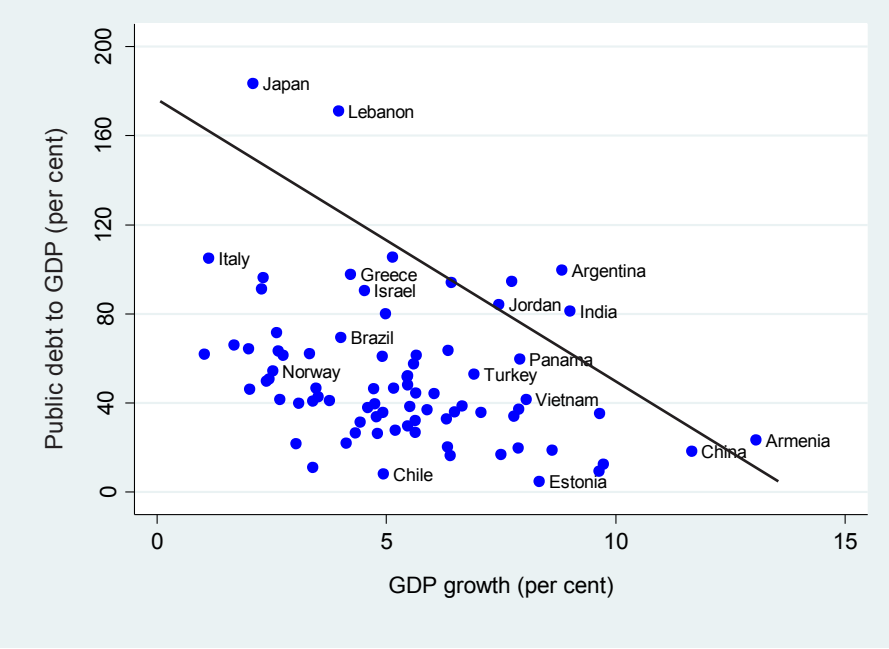
Another strand of literature explains debt crises as problems of self-fulfilling expectations. This happens when there is a lack of confidence among debt market participants. For example, if the market expects that the government will be unable to roll-over its maturing debt in the future, market participants will be reluctant to buy new debt today and the end result of this process may then be a debt default or restructuring. The Mexican (1994/1995) debt crisis, which could have been avoided by restructuring the composition of the debt from shorter maturity to longer ones, is considered to be of this category (Cole and Kehoe, 1998).

Empirical studies of debt crises have a long history. As is evident in the literature, the causes of fiscal crises are numerous and can even be unforeseen sometimes. The World Bank (2005) decomposes growth of public debt into its main sources, and emphasises that a rising public debt, which might lead a country into a fiscal crisis, is in fact underlined by several other deteriorated macroeconomic fundamentals. A weak fiscal position, in the form of gross debt to GDP ratio, short term debt to reserves, debt to exports or debt to reserves ratio, cannot be the sole factor behind a fiscal crisis. Other macroeconomic fundamentals might mitigate (or trigger) the negative effect of weak fiscal indicators, thereby lowering (or increasing) the probability of a fiscal crisis. Since most of the empirical literature on debt crises focuses mainly on crisis incidence and not on crisis duration, this study uses several hypotheses derived from the related literature on fiscal crisis incidence to identify factors affecting fiscal crisis duration.

1. The higher the rate of GDP growth, the lower will be the probability of a fiscal crisis.

Existing evidence indicates that there is a negative relation between GDP growth and fiscal crisis. In general, if a country exhibits a better growth performance, it is more likely that the debt stock is serviced properly, avoiding a fiscal crisis. Similarly, it is also argued that governments have no incentives to promote growth when the benefits of improved growth go to creditors in the form of debt service payments. Figure 1 shows the correlation between public debt and GDP growth for selected countries for the year 2008, at the onset of the Global Financial Crisis (GFC). As can be seen, most of the European countries that were experiencing high public debt to GDP ratio and lower GDP growth, went into debt crisis soon after.

Figure 1: Relationship between Economic Growth and Public Debt (Five year averages)



Source: Author's calculations based on World Bank (2011) data

2. The higher the real interest rate, the higher the likelihood of a fiscal crisis.

A rising real interest rate will increase the debt service payment and, as a result, there is a positive correlation between the real interest rate and fiscal crisis. One of the main causes

of the debt crisis of the 1980s, which badly affected Latin America and Africa, was the real interest rate. During the1980s, most of the loans were made at flexible interest rates and even inflation was unable to bring the real interest rate down and provide automatic debt relief. Rising interest rates have also been identified as one of the main causes of the Euro debt crisis (Schulmeister, 2011).

3. The higher the level of foreign reserves, the lower the likelihood of a fiscal crisis.

Traditionally, in countries with fixed, pegged or managed floating exchange rate regimes, accumulation of reserves was necessary to safeguard the exchange rate regime. However, in recent times even countries with floating exchange rate regimes have engaged in building reserves as an insurance against sudden stops or reversals of capital flows and/or to prevent exchange rate appreciation and maintain or promote the country's export competitiveness (Dooley, *et al*. 2003).[2/]

4. The greater the capital account openness, the lower the probability of a fiscal crisis.

Capital account openness (CAO) has been debated heavily in the literature on financial crises. Studies point out the importance of CAO in disciplining the fiscal deficit and public spending of a country. It is argued that CAO, which facilitates the globalisation of capital, curtails the ability of governments to pursue economic policies that are either expansionary or more interventionist than global trends (Garrett, 1995 p.663), thereby reducing government spending and any fiscal deficit. Therefore this study aims to identify the impact of CAO on fiscal crisis occurrence and its duration.

5. Inflation targeting (IT) reduces the probability of a fiscal crisis occurrence.

Inflation targeting (IT) has been a widely researched area in macroeconomics. Kumhof, *et al*. (2007) analyse the balance of payments crisis under an IT regime and find that it is more vulnerable to speculative attacks than other monetary regimes. They explain that "in an open economy, an inflation target always implies a commitment to intervene in the foreign exchange market to defend that target and that commitment could make speculative attacks possible". This study looks at the issue of inflation targeting from a different perspective. The motivation came from Tapsoba (2010), who empirically investigates whether an IT regime improves fiscal discipline, and finds a strong positive effect.

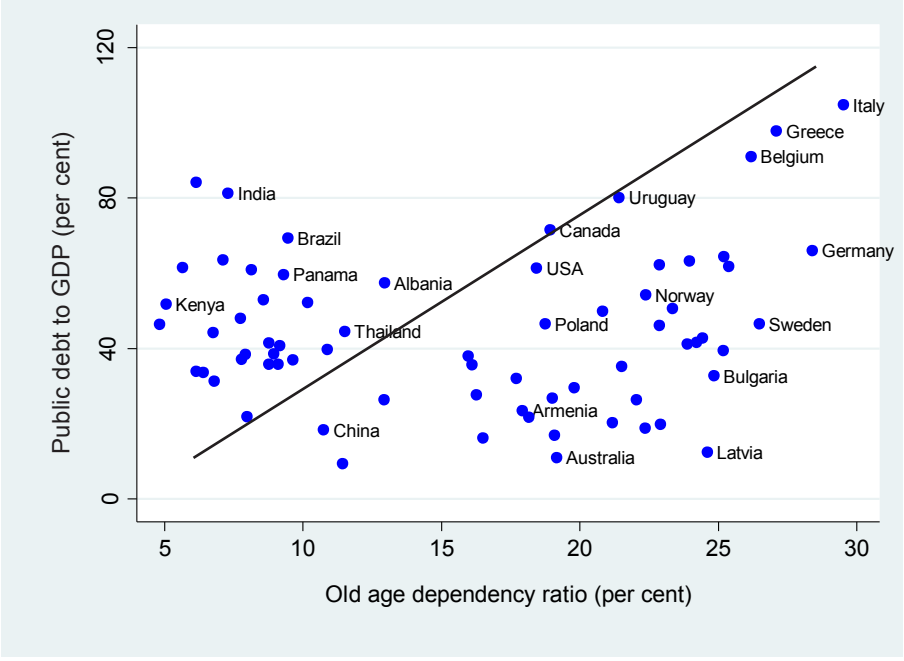
2/ However, reserve accumulation is associated with costs, such as high inflation, higher interest rates and quasi-fiscal costs; therefore, accumulation of reserves is advocated as an expensive yet, potentially useful self-insurance mechanism (Aizenman, 2009) against economic crises.

It is also argued that under IT there is limited scope for monetising public debt, which, in turn, encourages the government to reinforce its tax collection and rationalise its public expenditure (Minea and Villieu, 2009). Therefore, in line with this reasoning, this paper argues that, if an IT regime makes a country more fiscally disciplined, then there must be a lower probability of a fiscal crisis.

6. The higher the age dependency ratio, the higher the probability of a fiscal crisis.

Unlike other economic crises, a fiscal crisis is influenced by the demographic profile of a country. Old age-related spending (health care and pension expenditure) might fuel prevailing fiscal imbalances, threatening fiscal sustainability. Recent studies by Cecchetti, *et al*. (2010) and Baldacci, *et al*. (2011) explain the relevance of addressing demographic developments in analysing fiscal imbalances. Eberstadt and Groth (2010) show that during the period 1990–2010, an increase in the old age (65+) share of the total population is associated with an increase in the gross public debt to GDP ratio of about 7 percentage points.

Figure 2: Relationship between Gross Public Debt to GDP Ratio and Age Dependency Ratio



Source: Author's calculations based on World Bank (2011) data

Figure 2 shows a positive relationship between the two fundamentals for a sample of countries in 2008. Countries located in the top right hand corner (Greece, Italy), have a high old age dependency ratio and experience a higher public debt to GDP ratio. Importantly, these are the countries that experienced a fiscal crisis in 2009/2010.

7. The more democratic the ruling, the lower the probability of having a fiscal crisis.

It is irrational to discuss fiscal imbalances without paying attention to the political arena of an economy. Unlike other policies, such as monetary policy, exchange rate policy that are available for macroeconomic management, fiscal policy has a high salience in the electoral sphere, as fiscal policy decisions are immediately visible and directly affect the incomes of voters. In the end, fiscal outcomes might determine the future level of electoral support for the incumbent party. Fiscal policy always faces a democratic dilemma between preferable and effective policy decisions. Cline (1995) explains the importance of political economy factors, such as regime type, rule of law, elections, *etc*., during the debt crisis and fiscal consolidation periods in developing countries. Among these, regime types and economic policy choices have been debated for a long time. It is argued that democracies are more sensitive to political constraints than to economic constraints, which leads to higher social spending. However, drawing upon the Latin American debt crisis, Remmer (1990) argues that democracies are not only better at avoiding an acute crisis than autocracies, but also handle the crisis better if it occurs.

3. Estimation of the Model

3.1 Fiscal Crisis Incidence

Limited dependent variable probability models are commonly used in crisis incidence analysis (Kruger and Messmacher, 2004; Kraay and Nehru, 2004; Kohlscheen, 2010). These models account for non-linearity between the cause of a crisis and its eruption. This is an important consideration in the case of crisis incidence analysis, as underlying factors might build up in the economy slowly over time.

$$Pr\{ CI_t = 1|X_i \} = F(\beta X'_{it} + \upsilon_{it}) \qquad \text{(E 1)}$$

In each period a country is either experiencing a crisis or it is not. Therefore, CI_t is a binary variable which takes the value 1 during a crisis and 0 otherwise. The dependent variable[3/]

3/ To check for robustness, this paper also uses the Reinhart and Rogoff (2010) crisis data set, in which they define debt default as the failure to meet a principal or interest payment on the due date or within the specific grace period, and high inflation as greater than 20 per cent per annum. See Reinhart and Rogoff (2010) for details.

is obtained from Baldacci, *et al*. (2011), which defines a fiscal crisis as one or more of the following: public debt defaults/restructuring; the need to access large scale official IMF support; hyperinflation; and volatility of sovereign bond spreads. X_{it} is a vector of explanatory variables that capture economic, social and political factors and β is a vector of parameters to be estimated. All the explanatory variables are smoothed annually using the previous five years data, to address the possible endogeneity issue. υ_{it} represents the random error term E (υ_{it}) = 0.

Even though the panel nature of the data allows for using a country fixed effect model to examine country-specific dependence in the incidence of fiscal crises, it requires the omission of all the countries that have not experienced a fiscal crisis during the period under consideration. This process produces a biased sample (Greene, 1997; Demirgüc-Kunt and Detragiache, 1998). Therefore, this study does not consider using a fixed effect probability model for the estimation of crisis incidence.[4/]

3.2 Fiscal Crisis Duration

The determinants of crisis duration are examined by employing survival models. Survival models are primarily used in the field of medical science, bio-statistics, and political science. In economics they were first used in the field of unemployment and strike duration analysis (Kiefer, 1988; Nickell, 1979). Since then, their use has gradually become popular in other areas of economics, where the analysis of duration is a key issue. There are a few papers that use this technique to estimate financial crisis duration (Evrensel, 2008; Deb, 2005), but as yet it has hardly been used in the analysis of fiscal/debt crisis duration.

In survival analysis, the dependent variable measures the time (in days, weeks, or years) elapsed before a certain event occurred in each observation. In the literature this event is called a "failure".[5/] In the context of this study, the dependent variable measures the time at which a country first experienced fiscal crisis and the failure means the exit from the crisis. When the failure has not occurred by the end of the study period, either because the crisis is ongoing or to missing data, such observations are right-censored. Unlike other estimation techniques, the survival model treats censored data differently and this is one of the advantages of survival models. A non-parametric survival model, the Kaplan-Meier

4/ This study also implements an instrumental variable estimation (ivprobit) to address the endogeneity issue, even after averaging explanatory variables over the previous five years. There are two main candidates among these variables that can be endogenous to the system, *i.e.,* level of reserves and GDP growth. This study instruments the reserve level for each country by its remittances to GDP level while instrumenting GDP growth of a country by its export partners' growth rates.

5/ Survival analysis used in this study applies the Cox (1972) model, which, by its own nature, does not include any dynamics. Therefore, this study does not attempt to provide any dynamics for the underlying variables.

(KM)[6/] estimator, is normally used to compare survival functions of different sub-groups. This study uses the KM estimator to compare survivor functions (also known as survival functions) of the two sets of country groups. The first group consists of IT and non IT countries, whereas the second group considers experienced countries and non-experienced countries (countries experiencing their first crisis). When there are several covariates and some of these are continuous, regression based survival models are commonly used in the literature. In a similar vein in this study, the Cox (1972) semi-parametric model is applied to estimate the factors affecting duration of a fiscal crisis. The advantage of using the Cox model is that it is not necessary to know the distribution of the dependent variable, as required in parametric survival models. However, it is based on the proportional hazards assumption, which needs to be satisfied to obtain consistent estimators of covariates. In the event that the proportional hazard assumption does not hold, it is necessary to use a stratified Cox model, which relaxes the above assumption.

Let's consider the survival time T as a random variable that has probability distribution $F(t)$ and probability density function $f(t)$. Then the survivor function $S(t)$, which explains the probability of surviving time t or beyond, is given by:

$$S(t) = P(T >= t) = 1 - F(t) \quad (2)$$

Similarly the survivor function estimated by the KM estimator is as follows:

$$S_t = \prod_{j|t_{(j)} \leq t} \left(1 - \frac{d_j}{n_j}\right) \quad (3)$$

where, d_j is the number of failures at time t_j, and n_j is the number of countries not experiencing a failure at that time. The product is taken over all failures until time t_j. In the context of this study, the KM estimator explains the probability of experiencing a fiscal crisis until a particular year (t_j) for relevant country groups separately. In addition to the survival function, it is also important to know about the hazard function in survival models. In the Cox regression, the hazard function for individual i is modeled as follows:

$$h_i(t) = h_0(t) \exp(\beta^T X_i) \quad (4)$$

6/ The Kaplan-Meier estimator is a non-parametric methodology to calculate the probability of survival before the event of interest. These events could be death, recurrence of a disease, duration of employment and so forth. The KM estimator is particularly useful in comparing the survival of two or more groups. The KM curve in this study implies, for each time period (year) on the X axis, the share of countries that does not exit from the fiscal crisis as of that time.

Integrating the above, one can obtain the cumulative hazard function and the log of the cumulative hazard function is predicted by the Cox regression:

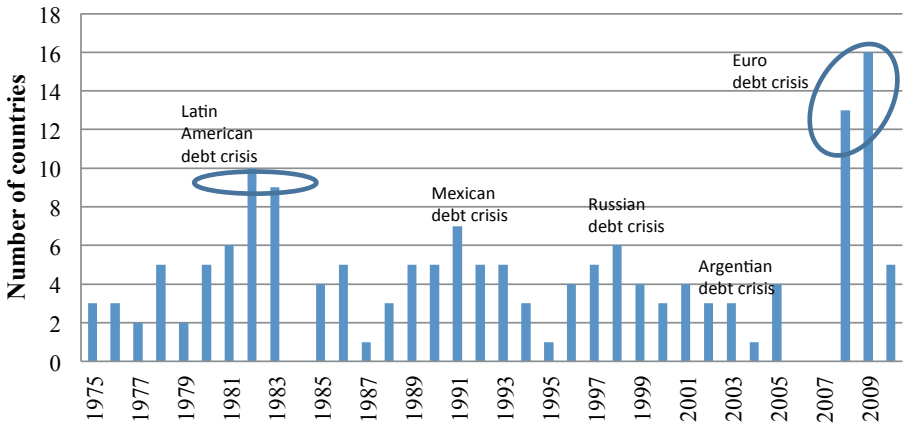
$$\log [H_i(t)] = \log H_0(t) + \beta^T X_i \quad (5)$$

where, $H_0(t)$ is the base line hazard function, which gives the hazard for an observation when all X_i variables are equal to or re-centered to 0. β are estimators and X_i is a vector that consists of factors affecting survival time. In the context of this study, the estimated hazard ratio by Cox regression means the probability that variable X_i can increase/decrease the likelihood of the crisis exit (failure).

4. Data

The data are of annual frequency and cover the period 1975–2010 for 81 countries. The dataset consists of 1,500 observations.

Figure 3: Fiscal Crisis Incidences Over Time

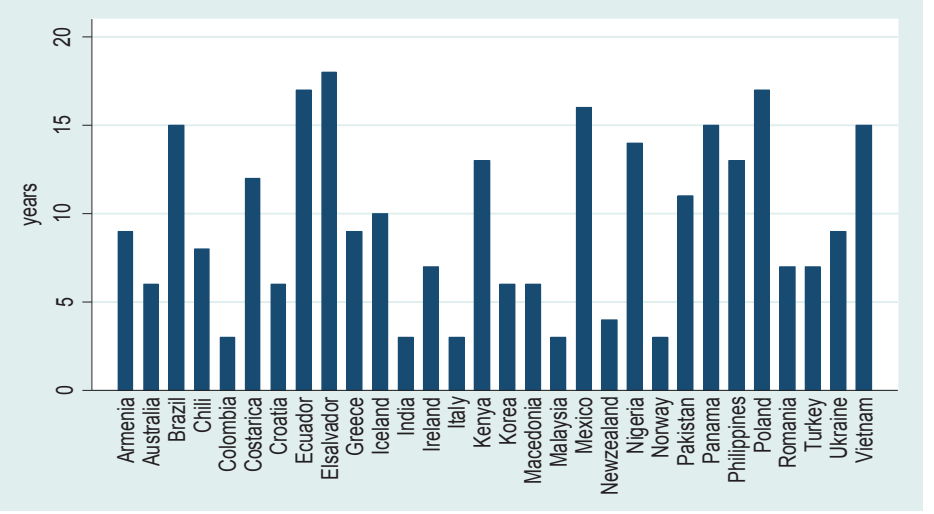


Source: Author's calculations based on Baldacci, *et al.* (2011)

Data for fiscal crisis incidence and its duration are taken from Baldacci, *et al*. (2011) and consist of 22 advanced economies and 48 emerging market economies. They also identify 11 countries that have not experienced a fiscal crisis during the study period (Appendix V). Figure 3 illustrates the number of countries in fiscal crisis over the period 1975 to 2010.

Figure 4 shows the average crisis duration for countries as identified by Baldacci, *et al*. (2011). It clearly illustrates the cross country variation of fiscal crisis duration. Similarly a single country can also experience different crisis durations at different times.

Figure 4: Variation of the Mean Duration of Fiscal Crisis



Source: Author's calculations based on Baldacci, *et al.* (2011)

Data for explanatory variables are taken from different published sources (Appendix I). The capital account openness index is sourced from Chinn and Ito (2008), who construct a capital account openness index for 181 countries since 1970. Limited availability of public debt data has been an issue for a long time. Abbas, *et al*. (2010) constructed a gross government debt to GDP ratio for almost the entire group of IMF member countries and it is now linked to the IMF World Economic Outlook (WEO) database. Consequently, government debt to GDP data is sourced from WEO (International Monetary Fund 2011).

To represent the impact of political factors on crisis incidence and duration, the democracy variable from the Polity IV project (Marshall, *et al*. 2008), is used. All the remaining data are from the World Bank's World Development Indicators (World Bank 2011).

5. Results

5.1 Incidence of Fiscal Crises

Results of the binary choice (probit) model are presented as marginal effects in Table 1. Marginal effects explain the impact of a unit change in an explanatory variable (X_i) on the probability of observing a fiscal crisis, when all other independent variables are held at their mean. This study uses two different data sets of fiscal crisis incidence, *i.e.*, the IMF (Baldacci, *et al*. 2011) data set and the RR (Reinhart and Rogoff, 2010) data set, as explained before. Model 1 uses the real interest rate and the GDP growth rate separately, while Model 2 uses the interest growth differential, in the absence of GDP growth and the real interest rate.

Table 1: Determinants of Fiscal Crises: Probit Estimation Results

	IMF crisis definition		RR crisis definition	
	Model 1	Model 2	Model 1	Model 2
Age dependency ratio	0.0016*	0.0013	0.0008	0.0007
	(1.92)	(1.58)	(1.24)	(1.15)
Democratic accountability	-0.0094***	-0.0081**	-0.0028	-0.0018
	(-2.85)	(-2.46)	(-1.32)	(-0.92)
Fiscal deficit/surplus	0.0077***	0.0074***	0.0164***	0.0157***
	(2.73)	(2.66)	(4.27)	(4.34)
Public debt	0.0001	0.0003	0.0009***	0.0011***
	(0.37)	(0.96)	(3.23)	(3.72)
Exports growth	-0.0062***	-0.0102***	-0.0028*	-0.0055**
	(-2.65)	(-4.96)	(-1.69)	(-3.35)
Private sector credit	-0.0008**	-0.0007**	-0.0010***	-0.0010***
	(-2.49)	(-2.47)	(-3.46)	(-3.49)
Real interest rate	0.0001		0.0015***	
	(0.08)		(2.61)	
GDP growth	-0.0171***		-0.0123***	
	(-3.75)		(-3.07)	
Capital account openness	-0.0266***	-0.0283***	-0.0443***	-0.0403***
	(-3.68)	(-4.00)	(-4.83)	(-4.65)
Reserves	-0.0031**	-0.0037***	-0.0040***	-0.0037***
	(-2.56)	(-3.03)	(-3.35)	(-3.24)
Dummy var. for Inflation targeting	-0.0399*	-0.0421*	-0.0799***	-0.0796***
	(-1.68)	(1.79)	(-5.21)	(-5.33)
Time trend	0.0024*	0.0021*	-0.0003	-0.0009
	(1.92)	(1.69)	(-0.3)	(-1.04)
Interest rate growth differential		0.0012		0.0020***
		(1.31)		(3.59)
N	1504	1504	941	941
Number of countries	70	70	38	38
Wald chi(11)	132.57	120.28	173.1	173.39
Prob> chi^2	0.0000	0.0000	0.0000	0.0000
Years: 1975-2010				

Notes:
Marginal effects are reported: (dy/dx) for discrete change of dummy variable from 0 to 1
Z statistics are in parentheses
*p<0.05, **p<0.01, ***p<0.001

Overall, results show similar patterns irrespective of the crisis definition used. However, to address the possibility of endogeneity between reserves and fiscal crisis incidence, the instrumental variable probit model is estimated. The results (Appendix II) fail to reject the null hypothesis of exogeneity (Wald Test of Exogeneity), which in turn statistically confirms that there is no endogeneity problem among the suspected variables.[7/] The results are consistent in the presence of either one or both instrumental variables. Consequently, this study draws conclusions from probit estimation. The coefficients of all variables are with expected signs, even though some of them are not statistically significant. By and large, results confirm the conventional wisdom on the impact of some of the fundamentals on fiscal crisis incidence. They also shed new light on a few other established relationships.

As expected, an increase in fiscal indicators results in increasing the probability of a fiscal crisis. Among the fiscal indicators, only the fiscal deficit (surplus) to GDP ratio provides a consistent relationship over all scenarios. Public debt to GDP becomes significant only under the RR crisis definition. Among the macroeconomic variables, capital account openness, level of international reserves, exports growth and GDP growth significantly reduce the probability of a fiscal crisis. Two institutional variables have been used in the analysis, *i.e*., domestic credit to GDP ratio to represent the financial development of a country, and a dummy variable for inflation targeting countries to indicate the monetary policy stance of a country. Both these variables indicate a negative and significant relationship with the incidence of fiscal crises.

The level of democracy shows a negative relationship with crisis incidence only under the IMF crisis definition. Similarly, the age dependency ratio shows a positive and significant relationship with the incidence of fiscal crises under the IMF crisis definition. On the other hand, interest rate related variables provide a valid contribution towards explaining the probability of fiscal crisis incidence under the RR crisis definition. What is striking here is that, in this study it is found that some of the results are consistent over all scenarios, indicating the strong validity and robustness of such findings.

The link between inflation targeting and the incidence of fiscal crises has not been studied much in the literature. This study finds that, on average, inflation targeting countries have a lower probability of fiscal crisis. Both crisis definitions confirm this possibility. Only a handful of studies analyse this issue empirically in relation to other types of economic crisis. Among them, Filho (2010) finds that inflation targeting countries dealt better with the recent financial crisis than non-inflation targeting countries, but emphasises the

7/ Not only statistically, but also intuitively, it is reasonable to argue that there is no significant endogeneity issue among these variables. As explained earlier, all the explanatory variables are smoothed annually using previous five-years data and this might eliminate the reverse causality issue thereby mitigating the endogeneity problem.

necessity of further research to establish the causal link between the two issues. This study provides evidence in support of the hypothesis that argues for a negative link between inflation targeting and crises. However, Kumhof, *et al*. (2007) argue that inflation targeting countries are vulnerable to speculative attacks.

Another highly debated economic fundamental in relation to crisis incidence is capital market openness. The results indicate that an increase in capital account openness will significantly reduce the probability of a fiscal crisis. As has been explained in earlier sections, capital account openness disciplines fiscal policy and might result in a lower probability of a fiscal crisis by disciplining fiscal policy. A similar result has been found by Vinals (1996), who argues that capital controls facilitate the implementation of expansionary policies by the authorities and can eventually lead to exchange rate market turbulence and a self-fulfilling currency crisis.

The foreign reserves to GDP ratio also significantly reduces the probability of a fiscal crisis, irrespective of the crisis definition used. In recent years, a number of studies have pointed out that there are more costs than benefits of reserve accumulation, which led to another wave of research to analyse the optimal level of reserve accumulation. However, some studies justify reserve accumulation in the context of the self-insurance motive. Based on estimated results, this study argues that a higher level of international reserves, which indicates a country's capacity to face unexpected external financial risks, significantly reduces the probability of a fiscal crisis.

Higher GDP growth and export growth can be considered sound economic fundamentals for a country and have the advantage of reinforcing each other. Therefore, higher levels of these variables increase a country's capacity to mitigate the impact of sudden shocks without entering into a crisis condition. As expected, these variables show a negative relationship with the incidence of fiscal crises. It implies that, on average, a one percentage point increase in GDP growth or export growth is associated with 1.71 percentage points and 0.6 percentage points lower probability of experiencing a fiscal crisis, respectively.

Financial development of a country widens the range of financial services available to the private sector, diversifying risk. To represent such financial development, this study uses the ratio of private sector credit to GDP (Levine, 1998). The results show that an increase in the private sector credit to GDP ratio is associated with a lower probability of a fiscal crisis occurring. One might argue that this result contradicts the experience with the credit bubble situation during the recent GFC, which occurred as a result of an increase in private sector credit due to easy access to financial services. It may be partly true, but it is important to note here that financial development is a much wider concept and consists of the factors, policies, and institutions that lead to effective financial intermediation and

markets, as well as deep and broad access to capital and financial services.[8/] However, there is one distinct feature in the private sector credit to GDP ratio that might be relevant for the discussion. Increasing private sector credit represents decreasing the credit issued to the public sector, including government and government agencies, from the banking sector. Therefore, financial development minimises public intervention in the financial system, improving fiscal discipline, which, in turn, is associated with a lower probability of a fiscal crisis.

An ageing demographic profile is always a concern for governments, as it is closely connected to fiscal expenditure through social security and/or health policies. This study uses the old age dependency ratio to represent the demographic profile of a country and finds that an increase in that ratio is related to a higher probability of a fiscal crisis. However, it turns out to be a significantly important determinant in only one case. Similarly, interest rate related variables provide a positive impact on the occurrence of fiscal crises, as expected from the theory, yet do not consistently become a significant determinant over all cases.

As has been explained earlier, fiscal policy, at times, is stuck between its party constitution and the economic undertakings required to tackle the economic downturn. Using the level of democracy as an explanatory variable of fiscal crisis incidence, this study finds that the higher the level of democracy, the lower is the probability of a fiscal crisis. This result, again, is not consistent over all cases; however, it has not signalled any positive relationship with crisis incidence.

5.2 Duration of Fiscal Crises

In an attempt to answer the second question of this study, *i.e.*, what contributes to quicker emergence from a fiscal crisis, survival analysis is employed.

As explained in the methodology section, this study carries out both non-parametric and semi-parametric models of survival analysis. However, this section suffers from a major data limitation. Even though the time period is the same as for crisis incidence analysis, survival analysis only uses data for fiscal crisis episodes. For example, during the period of study (1975–2010), Argentina only provides three observations whereas Mexico provides five. The issue of limited data is made worse by missing data for some explanatory variables. The number of observations for survival analysis has been limited to

8/ The financial development concept goes well beyond the financial depth or credit extended to the private sector (WEF, 2011). The WEF has constructed a comprehensive financial development index for 60 countries since 2008, yet, due to the panel data structure of this study, the index cannot be readily utilised to represent financial development for the empirical estimation.

75, based on the IMF crisis definition and 35 based on the RR crisis definition. Therefore, conclusions drawn from this section are mainly based on the data from Baldacci, *et al*. (2011) or the IMF crisis definition.[9/]

Non-parametric survival analysis calculates the probability of surviving over the last period of time using simple calculus, ignoring the effect of explanatory variables. This study uses Kaplan-Meier (KM) estimates of the survivor function. Table 2 below shows the survival probabilities up to the 10 years duration of the full sample.

Table 2: Kaplan-Meier Estimates of Survivor Function

Time in Years	Survivor Function	[95% Conf. Int.]	
1	0.5029	0.4267	0.5742
2	0.3486	0.2788	0.4191
3	0.2343	0.1746	0.2992
4	0.2057	0.1494	0.2684
5	0.1763	0.1239	0.2364
6	0.1234	0.0797	0.1773
8	0.1104	0.0690	0.1627
9	0.1039	0.0638	0.1554
10	0.0909	0.0535	0.1405

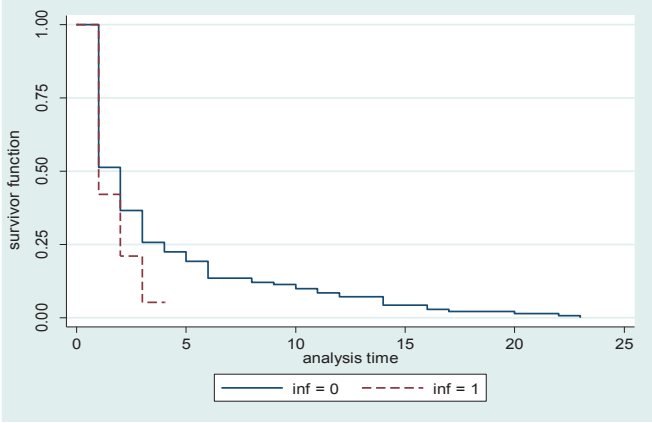
It shows that there is about a fifty per cent probability that a fiscal crisis lasts for more than a year. However, after the 4th year, the chance of the crisis duration extending to another year is less than 20 per cent. The KM estimator can also be used to compare survivor functions for different groups. These estimated survivor functions then can be tested using the log rank test for equality. If the log rank test rejects the null hypothesis of equal survivor functions for different groups, it confirms that the two survivor functions are significantly different from one another. There are two sets of country groups in this study. The first one, as in the previous analysis, represents inflation targeting (IT) and non-inflation targeting countries. If a country is explicitly targeting inflation on the start year of a crisis it is given 1 while allocating 0 for the rest of the sample.

The second group is constructed on the basis of previous crisis experience of a country. The dummy variable equals 1 if a country has experienced at least one fiscal crisis before and it equals 0 otherwise.

Figure 5 shows the survivor functions for the IT and non IT country groups.

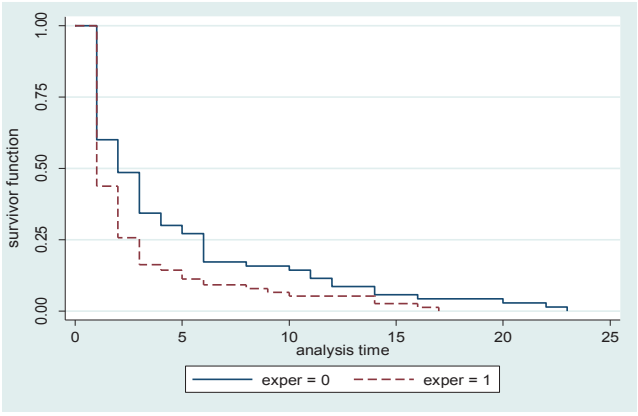
9/ Estimation results based on the RR crisis definition are presented in Appendix IV.

Figure 5: KM Survivor Functions: IT vs. Non-IT Countries



As can be seen, IT countries have emerged from fiscal crises much sooner than non-IT countries. The log rank test also confirms that these two survivor functions are not equal. The result is somewhat convincing, in the sense that the IT countries are more fiscally disciplined than non-IT countries and this might lead to a reduced crisis length. However, it is important to note here that the sub-samples used in this analysis are not balanced. Therefore the result needs to be interpreted cautiously.

Figure 6: KM Survivor Functions for First Time vs. Previously Crisis-Hit Countries



A similar experiment carried out for the second country grouping shows that when a country has previous experience of a crisis, it recovers relatively quicker than a country that faces a crisis for the first time. For example, there is about a 75 per cent probability that a country with previous experience would recover from a fiscal crisis within 2 years. The equivalent probability for a first time country is about 50 per cent (Figure 6). Log rank tests confirm that the two survival functions are significantly different from one another.

A non-parametric survival model only allows, at most, a comparison of survivor functions under different groupings, or, in other words, only uses discrete time explanatory variables. Most of the variables in this study are continuous time and, therefore, to understand the factors affecting the survival function, this study employs a semi-parametric (Cox 1972) survival model for crisis duration analysis.[10/]

It is more likely that the economic, social and political situations at the time of entering a crisis would contribute to longer or shorter crisis episodes. Therefore, this study uses explanatory variables as at the crisis onset year. However, to be consistent with the previous section (crisis incidence analysis), annual smoothed (five-year) data of the same explanatory variables have also been tested. It is necessary to test the proportional hazard assumption before interpreting the results of semi-parametric analysis, as it is the fundamental assumption of the model.

Table 3: Durational Analysis: Semi-Parametric Model

Explanatory variables	Model 1	Model 2
Age dependency ratio	0.9536***	0.9578**
Democratic accountability	1.0522***	1.0751***
Real interest rate	0.9961	0.997
Fiscal deficit/surplus	0.9983	0.9835
Public debt	0.9998	0.9963
Export growth	0.9690**	0.9859*
Domestic credit	0.9954	0.9972
GDP growth	0.9597	1.0129
Capital account Openness	0.9943	1.1915**
Reserves	1.0249**	1.0165**
World GDP	1.1092	1.0729
N	86	70
Prob> chi^2	0.0003	0.0003
Test of PH assumption	0.9879	0.9989

Note:
1. Model 1 : Explanatory variables are five-year averages leading to a crisis
   Model 2 : Explanatory variables are annual data at the onset of a crisis
2. Hazard ratios after survival analysis are reported :
3. * p<0.05, ** p<0.01, *** p<0.001

10/ Similar results are obtained from parametric survival models and are reported in Appendix III. This study relies on semi-parametric models, as they are not dependent on an author-specified distribution function.

It is found that neither of these models violates the proportional hazard assumption and, consequently, they provide a valid explanation for fiscal crisis duration. As can be seen in Table 3, only a few variables show a significant contribution to fiscal crisis duration, irrespective of the different timing of the explanatory variables. Higher levels of the reserves to GDP ratio and democratic accountability increase the probability of a shorter crisis. In contrast, the age dependency ratio and export growth are significantly associated with slower recovery. Survival model results are reported as hazard ratios. A hazard ratio of 1 means that a change in the independent variable is not associated with any change in the dependent variable (crisis spell), whereas a hazard ratio greater than (smaller than) 1 indicates that an increase in the independent variable is associated with a faster (slower) ending of the crisis. The hazard ratio of 1.0165 in the case of reserves to GDP implies that an increase in the reserves to GDP ratio is associated with a relatively faster ending to the fiscal crisis.

Based on estimation results, reserve accumulation not only acts as insurance that mitigates crisis occurrence, but also works as a shock absorber, reducing the duration of a crisis. There are a number of studies that explain the cost of reserve accumulation and emphasise the importance of knowing the threshold level of reserves for a country. However, none of these studies deny the important role that reserves can play in relation to a crisis. A higher level of democracy is also found to be a significant factor that reduces the duration of a fiscal crisis. This result is in line with studies that argue democratic regimes handle crisis more effectively than autocratic ones.

A higher age dependency ratio contributes to longer fiscal crisis duration (by about 5 per cent). The impact of an ageing society can come in two ways. On the one hand, it is associated with compulsory government expenditure through social security and health payments. On the other hand, the higher age dependency means a smaller workforce, which, in turn, limits the level of available human capital. Therefore, it is more likely that a higher age dependency ratio increases the time needed to recover from a fiscal crisis.

In contrast to conventional wisdom, the results indicate that higher export growth is associated with longer crisis spells. This relationship is consistent over both models and even with different survival model techniques (Appendix IV). In an attempt to explain this result, this study advances the following argument. An increase in export growth, either during the previous five years or in the crisis start year, might imply that country's higher dependence on exports, as well as its greater interactions with the rest of the world. When a crisis hits, the higher export dependence and inability to meet export obligations, can paralyse the economy badly, leading to a slower recovery. Moreover, if a crisis has occurred simultaneously in its trading partners, this situation can be further aggravated. Therefore, at normal times higher export growth reduces the likelihood of a crisis, but in

a crisis period it might result in a longer crisis. The Latin American experience during the mid-1980s is quite relevant to this issue.

Capital account openness does not provide consistent results over the two specifications and this study leaves further analysis of the relationship between capital account openness and fiscal crisis duration for future research.

6. Conclusions

This study analyses the determinants of incidence and duration of fiscal crises using data from 81 countries over the period 1975–2010. The probit model has been used to estimate fiscal crisis incidence and a survival model is employed to estimate the determinants of fiscal crisis duration. This study finds that capital account openness, domestic financial market development, higher reserves to GDP, higher exports to GDP, high GDP growth, democratic accountability, and inflation targeting regimes are all associated with a lower probability of a fiscal crisis. On the other hand, fiscal indicators such as fiscal deficit (surplus) to GDP or public debt to GDP, raise the probability of a fiscal crisis. These results are robust for different definitions of a fiscal crisis. Factors affecting fiscal crisis duration have been analysed using both non-parametric and parametric models. Some evidence has been obtained that the fiscal crisis recovery process is different for IT and non-IT countries. This study finds that IT countries recover sooner from a fiscal crisis than non-IT countries. Similarly, countries with previous crisis experience recover from a fiscal crisis relatively faster. Results from the semi-parametric model show higher levels of reserves and more democratic political regimes lead to a faster recovery from a fiscal crisis, whereas a higher age dependency ratio makes crisis duration longer.

For any economic crisis such as banking, currency or fiscal, the first priority is to take relevant policy actions to avoid its occurrence. However, if a crisis hits an economy, then obviously the next and the most important step should be to shorten the duration and minimise the negative impact. Therefore, it is vital to analyse crisis incidence and duration together, to identify possible factors behind each process, as has been done in this study. Overall, most of these findings are in line with conventional wisdom, even though some new light is shed. More importantly, the highly debated fundamentals in economics, such as reserve accumulation, capital account openness and an inflation targeting regime, are found to be favourable in helping to avoid a fiscal crisis. These findings also reveal the importance of fiscal discipline, which mitigates fiscal imbalances and thereby helps to avoid a fiscal crisis. It is also evident here that economic fundamentals do not affect crisis occurrence and duration in a similar way. Some of the factors, such as demographic profile and level of democracy, are found to be more effective in explaining the duration,

rather than the incidence of a fiscal crisis, whereas factors like exports to GDP acts in the opposite direction for crisis incidence as opposed to its duration.

In summary, this research first argues that maintaining a higher level of reserve is an optimal policy in relation to a fiscal crisis, as it reduces the likelihood that a crisis will occur and also shortens the duration, if a crisis does happen. This study is well aware of the cost of reserve accumulation and, therefore, an optimal level of reserve hoarding must be identified and it needs to be country specific. Secondly, and perhaps more importantly, this study emphasises the notion of fiscal discipline in relation to fiscal crisis, irrespective of whether it stems from an inflation targeting regime and/or greater capital account openness.

However, there are limitations to this study. The second part is heavily influenced by the small size of the sample and, as a result, robustness checks might not be reliable. Therefore, care must be taken in interpreting inconsistent results (such as sign reversal of CAO) of durational analysis. Furthermore, this study is unable to use some of the comprehensive indices to represent the financial development and/or political stance of a country, due to unavailability of suitable time series data. Even though the panel estimation does not require data over a longer time period, the survival model would have been severely affected if the time period had been any shorter.

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Appendix I : Summary Statistics and Data Sources

Summary Statistics

Variable	Mean	Std. Dev.
Age dependency ratio (per cent)	14.963	6.858
Democratic accountability (index)	7.448	3.324
Fiscal deficit/surplus to GDP (per cent)	-2.619	4.011
Public debt to GDP (per cent)	53.990	29.881
Exports growth ratio (per cent)	0.023	0.053
Domestic credit to GDP (per cent)	58.657	40.015
Real interest rate (per cent)	6.114	8.972
GDP growth (per cent)	3.671	2.423
Capital account openness (index)	0.641	1.499
Reserves to GDP (per cent)	10.816	12.217
Interest rate growth differential	2.292	9.527
	Sum	
Countries	90	
Observations	1,504	

Data sources:

Fiscal crisis: Baldacci (2011) and Reinhart and Rogoff (2010).
Old age dependency ratio: World Development Indicators (online)
Fiscal surplus/deficit: World Development Indicators (online)
Public debt: World Economic Outlook (online)
Annual growth rate of exports: World Development Indicators (online)
Domestic credit: World Development Indicators (online)
Real interest rate: World Development Indicators (online)
GDP growth: World Development Indicators (online)
Interest rate growth differential: Compiled by the Author using data from World Development Indicators
International Reserves: World Development Indicators (online)
Democracy: Polity project, www.systemicpeace.org
Capital account Openness: Chinn and Ito (2008)
Inflation targeting countries: Hammond, G. (2012)

Appendix II : Instrumental Variable Estimation for IMF Data

	Model 1	Model 2
Age dependency ratio	-0.001	0.001
	(-0.18)	-0.16
Democratic accountability	-0.078***	-0.072***
	(-3.58)	(-3.25)
Fiscal deficit/surplus	0.038*	0.034
	-1.73	-1.52
Public debt	0.003	0.003
	-1.31	-1.11
Exports growth	-0.026**	-0.027**
	(-2.06)	(-2.09)
Domestic credit	-0.003**	-0.003
	(-2.49)	(-1.18)
Capital account openness	-0.04	-0.032
	(-0.86)	(-0.67)
Reserves	-0.064***	-0.053***
	(-3.48)	(-2.86)
Dummy var. for Inflation targeting	0.156	0.149
	-0.97	-0.91
Time trend	0.025*	0.019*
	-2.03	-1.61
Interest rate growth differential	0.006*	0.007
	-1.72	-1.27
N	867	867
Number of countries	70	70
Wald test of exogeneity	1.86	0.52
Prob> chi^2	0.1724	0.4697
Instruments	Remittances to GDP	Remittances to GDP
		Export partner growth rates

Appendix III : Parametric Survival Models with Five Year Averages of Explanatory Variables

Explanatory variables	Stcox	Streg(exp)	Streg(weibull)	Streg(Gomperz)
Age dependency ratio	0.9536***	0.9538***	0.9124***	0.9325***
Democratic accountability	1.0522***	1.0519***	1.1093***	1.0872***
Real interest rate	0.9961	0.9948	0.9909	0.9926
Fiscal deficit/surplus	0.9983	0.9995	0.9944	0.9877
Public debt	0.9998	0.9995	1.0013	1.0001
Export growth	0.9690**	0.9673***	0.9294***	0.9477***
Domestic credit	0.9954	0.9952	0.9914	0.9934
GDP growth	0.9597	0.9567	0.9589	0.9633
Capital account openness	0.9943	0.9928	1.0197	1.0033
Reserves	1.0249**	1.0242**	1.0396**	1.0340**
World GDP	1.1092	1.0961	1.0092	1.0134
N	86	86	86	86
Prob> chi^2	0.0003	0.0001	0.0008	0.0002

Notes:
1. Hazard ratios after survival analysis are reported :
2. * p<0.05, ** p<0.01, *** p<0.001

Appendix IV : Semi Parametric Survival Analysis: RR Data

Explanatory variables	Model 1	Model 2
Age dependency ratio	1.0345	0.9842
Democratic accountability	1.0781***	1.0681**
Real interest rate	1.0032	0.9952
Fiscal deficit/surplus	0.9996	0.9372***
Public debt	1.0102	1.0065
Export growth	0.9949	1.0385**
Domestic credit	1.0110	1.0015
GDP growth	1.1649*	1.0882**
Capital account openness	0.8974	1.1992*
Reserves	1.0002	0.9962
World GDP	0.8276	0.7934
N	35	32
Prob> chi^2	0.0612	0.0012

Notes:
1. Model 1: Explanatory variables are five year averages leading to a crisis
   Model 2 : Explanatory variables are annual data at the onset of a crisis
2. Hazard ratios after survival analysis are reported :
3. * p<0.05, ** p<0.01, *** p<0.001

Appendix V : List of Countries in the Main Sample

Crisis countries			Non-crisis countries
Albania	India	Morocco	Austria
Algeria	Indonesia	New Zealand	Belgium
Argentina	Ireland	Nigeria	Hong Kong SAR,
Armenia	Israel	Norway	Netherlands
Australia	Italy	Pakistan	Singapore
Bosnia and Herzegovina	Jamaica	Panama	Slovak Republic
Brazil	Japan	Peru	United States
Bulgaria	Jordan	Philippines	China
Canada	Guatemala	Poland	Estonia
Chile	Hungary	Portugal	Lebanon
Colombia	Iceland	Romania	Saudi Arabia
Costa Rica	India	Russia	
Croatia	Indonesia	Serbia	
Czech Republic	Ireland	Slovenia	
Denmark	Israel	South Africa	
Dominican Republic	Italy	Spain	
Ecuador	Jamaica	Sri Lanka	
Egypt	Japan	Sweden	
El Salvador	Jordan	Switzerland	
Finland	Kazakhstan	Thailand	
France	Kenya	Tunisia	
Georgia	Korea,	Turkey	
Germany	Latvia	Ukraine	
Greece	Lithuania	United Kingdom	
Guatemala	Macedonia	Uruguay	
Hungary	Malaysia	Venezuela	
Iceland	Mexico	Vietnam	

Monetary Transmission Mechanism in Sri Lanka: A Comprehensive Assessment with New Evidence

Anil Perera[1/]

Abstract

This study provides a comprehensive assessment of the transmission of monetary policy in Sri Lanka starting from changes to central bank policy to the response of final target variables-output and prices. As such, the study provides estimates for interest rate pass-through and suggests that pass-through is yet to achieve the completeness except for prime lending rates. Based on the empirical estimates obtained employing both unrestricted and structural vector auto regressions, this study observes that monetary policy in Sri Lanka is quite effective to influence the target variables of the central bank. It also suggests that monetary policy changes affect target variables through different intermediate transmission channels such as bank credit, exchange rates as well as asset prices. These results provide important policy implications for the Central Bank of Sri Lanka in the conduct of monetary policy and assessing its effectiveness.

JEL Classification: E43, E44, E52, E58

Key Words: *Interest Rate Pass-through, Monetary Transmission Mechanism, Error Correction Models, Vector Auto Regressions*

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1. Introduction

The consensus view is that price stability, which is one of the prime objectives of modern central banking, is achieved by appropriate monetary policy supported by other macroeconomic stabilisation policies. To that end, as argued by Mishkin (1995), monetary policy remains at the centre of macroeconomic policy making. The role of monetary policy and its success can be justified by the improved macroeconomic performance over the past few decades, especially in advanced countries. In particular, inflation and inflation volatility in advanced countries have fallen significantly, while output volatility has either fallen or risen only marginally (Cecchetti, Flores-Lagunes, and Krause, 2006).[2/] Monetary policy remains the driving force behind this improved performance, which is also supported by reductions in the variability of supply shocks and changes in the structure in economies including financial systems (Cecchetti *et al*., 2006).

Macroeconomic stability achieved in emerging market economies is clearly evident in the behaviour of macroeconomic variables such as inflation, growth of real output and current account deficits (Montiel and Servén, 2006).[3/] Although there is no consensus on the role of monetary policy in the emerging market economies compared to exchange rate policy and fiscal policy in macroeconomic management, it appears that monetary policy plays a credible role in terms of economic stabilisation and welfare in emerging market economies (Cook, 2004; Devereux, Lane, and Xu, 2006).[4/]

It is evident that macroeconomic aggregates are less volatile in the Sri Lankan economy during the post-1980s than in the preceding decades. According to Table 1, on average, real output variability (as measured by the standard deviation of real GDP growth) has declined from 2.1 per cent during 1950–1980 to around 1.9 per cent during 1981–2012. Despite the somewhat reversed trend during 2001–2012 (2.6 per cent) probably due to the impact of volatile domestic and external environment, broadly a declining trend is observed particularly in the 1990s recording the lowest figure of around 1.0 per cent. Volatility in prices (as measured by the standard deviation of the GDP deflator) has also declined considerably from 7.6 per cent during 1950–1980 to around 4.3 per cent during

2/ According to World Development Indicators (WDI) of the World Bank, global inflation has declined from 17.28 per cent in 1980 to 3.67 per cent in 2012. Also during the same period, advanced country inflation has declined from 12.89 per cent to 2.44 per cent.

3/ Inflation in emerging market economies has significantly moderated from 28.29 per cent to 5.32 per cent during 1980-2012.

4/ For example, Cooper (1992) examines the challenges, *i.e.,* costs of relying on monetary policy to combat sustained increases in price levels in emerging market economies. Little, Cooper, Corden and Rajapatirana (1993) also show that how monetary policy becomes largely an adjunct of fiscal policy and of the commitment to an exchange rate in these countries, and hence monetary policy plays a rather subsidiary role.

Table 1: Macroeconomic Performance in Sri Lanka (1950–2012)

This table presents various indicators of macroeconomic performance in Sri Lanka for the period 1950–2012. Each column presents the average for the decade.

Item	1950–1959	1960–1969	1970–1979	1980–1989	1990–1999	2000–2012
GDP Growth (%)	3.1	4.7	3.9	4.3	5.2	5.3
Per Capita GDP at Market Prices (US dollars)	140.0*	149.6	231.9	362.5	706.7	1,300.2
CPI Inflation (%)	0.7	2.2	6.9	12.8	11.3	10.9
GDP Deflator (%)	2.9	1.5	11.0	11.5	10.2	9.8
Budget Deficit (% of GDP)	-2.9	-6.0	-7.1	-11.3	-7.9	-8.1
Current Account Balance (% of GDP)	-0.4	-2.8	-2.0	-7.7	-4.8	-3.4
Interest Rate, 91-day Treasury bill Rate (%)	1.2	3.1	6.2	13.6	15.9	12.0
Exchange Rate (US dollar/Rupee)	4.8	5.0	8.6	25.8	52.3	100.9
Reserve Money Growth (%)	4.3	6.6	15.4	17.9	14.4	11.4
Broad Money (M_2) Growth - M_2 (%)	5.1	6.9	18.8	17.9	16.8	15.1
All Share Price Index	–	–	–	–	727.5	1,786.6
GDP Growth Volatility	2.0	2.0	2.1	1.5	1.0	2.6
CPI Inflation Volatility	1.3	2.7	4.3	6.7	4.7	5.4
GDP Deflator Volatility	2.2	3.5	7.9	6.1	4.0	3.8
Interest Rate (91-day Treasury bill Rate) Volatility	0.7	0.5	2.0	2.8	3.3	4.9
Exchange Rate Volatility	0.0	0.5	3.8	6.0	10.0	11.5
Reserve Money Growth Volatility	13.6	5.4	14.2	9.3	8.8	6.5
Broad Money (M_2) Growth Volatility	9.4	4.1	13.4	7.7	4.7	3.4
Share Price Index Return Volatility	–	–	–	–	48.6	45.2

Notes: * denotes GDP per capita in 1959.
Volatility is measured by the standard deviation

Source: Updated and modified by the author based on Perera and Liyanage (2012).

1981–2012. Also monetary volatility has reduced significantly in the post-1980 period. Such macroeconomic improvement could be due to the effectiveness of monetary policy.

In particular, as the Sri Lankan economy had adopted a range of economic and financial sector reforms since the 1980s with acceleration in the 1990s, transmission of monetary policy and its effectiveness may have improved considerably. On the other hand, similar to many advanced countries and emerging market economies focusing more on price stability [for example, see Boivin, Kiley and Mishkin (2010)], monetary policy in Sri

Lanka appears more responsive to inflationary pressures with a view to create a conducive environment for sustainable economic growth.[5/]

However, despite its importance, the role of monetary policy and its transmission have not been examined extensively in the Sri Lankan context. For example, existing literature on interest rate pass-through is very limited for Sri Lanka. Amongst the available studies, Amarasekara (2005) examines interest rate pass-through and Aazim and Cooray (2012) examine monetary policy and yield curve dynamics. However, these studies do not focus on the transmission of the impact of interest rates into final policy variables and hence are limited to early stage of monetary transmission. Whether and to what extent monetary policy will be able to transmit its impact through different channels will depend crucially on the impact of policy rate innovations on market interest rates, and hence it deserves a closer examination (Égert and Jamilov, 2014). This study contributes to the ever growing literature on the interest-rate pass-through by evaluating its empirical importance for an emerging market economy, Sri Lanka. In relation to the transmission to final target variables, Jayamaha (1995) examines monetary transmission in Sri Lanka, but the study is limited to the early years of deregulation. Amarasekara (2008) also examines the effects of interest rate, money growth and the movements in nominal exchange rate on real GDP growth and inflation in Sri Lanka, and the results are broadly in line with the established empirical findings, especially when the interest rate is considered the monetary policy variable. Both studies of Amarasekara (2005; 2008) provide a comprehensive analysis on monetary transmission in Sri Lanka, but the sample is restricted to 2004. As there are considerable developments in the monetary policy conduct since 2004, it would be imperative to provide new empirical evidence for both interest rate pass-through and monetary transmission within the context of a single study. As such, this study serves this purpose by providing a comprehensive assessment of the monetary transmission mechanism in Sri Lanka.

The remainder of the paper is structured as follows: Section 2 briefly discusses the developments of monetary policy conduct in Sri Lanka. Section 3 provides relevant theoretical underpinnings and Section 4 presents a discussion on the data and methodology of the study. Section 5 presents empirical estimates and related discussion, Section 6 is devoted to summary and conclusions.

5/ Communications of the Central Bank of Sri Lanka (CBSL) indicate that its primary responsibility is to fight inflation while securing financial system stability (Central Bank of Sri Lanka, 2011; 2012).

2. Financial and Monetary Policy in Sri Lanka: A Brief Snapshot of Historical Developments

Since the establishment of the Central Bank in 1950 under the Monetary Law Act, (No. 58 of 1949), monetary policy in Sri Lanka has evolved to achieve both the economic stabilisation objective and the development objective (Central Bank of Sri Lanka, 1998). Since inception, the Central Bank has exercised multiple objectives such as stabilisation of domestic monetary values, preservation of the stability of the exchange rate, promotion of a high level of production, employment and real income and encouragement and promotion of development of productive resources. Hence, the Central Bank was required to align its monetary policy to achieve these two broad objectives. The Monetary Law Act also provided the Central Bank with an array of instruments to implement monetary policy and the main instruments include operations in foreign exchange (external reserve management, changes in the exchange rate and exchange control regulations), credit operations with banking institutions (refinance facilities and other credit to commercial banks and other financial institutions and lender of last resort facilities), reserve requirements on commercial bank deposits, quantitative restrictions on credit, interest rate management, open market operations and the use of moral suasion. Amongst different monetary policy tools, open market operations were particularly used in the 1950s and in the post 1985 period. At the same time, the Bank Rate and the Statutory Reserve Requirement (SRR) have been used extensively. However the Bank Rate has not been used after the mid-1980s. Direct controls have served as the more important monetary policy tools in the closed economy era of the 1960s and 1970s (Central Bank of Sri Lanka, 1998). In line with such practices, two major issues can be identified in regards to implementing monetary policy in Sri Lanka, *i.e.* the relatively underdeveloped nature of financial markets and the lack of congruence between fiscal policy and monetary policy (Central Bank of Sri Lanka, 1998). In fact, the financial system has been regulated for a long period of time displaying specific characteristics such as interest rate controls, directed lending, inefficient banking system, capital controls, institutional deficiencies, *etc*. (Cooray, 2000; Paudel and Jayanthakumaran, 2009). On the other hand, from the 1950s to the 1990s, fiscal policy has been expansionary, compelling monetary policy to be contractionary to dampen inflationary pressures emanating from high fiscal deficits (Central Bank of Sri Lanka, 1998).

The Sri Lankan economy has embarked on a wide range of liberalisation policies since 1977. The policy reform package contained various measures and strategies such as trade liberalisation, exchange rate realignment, financial sector reforms, *etc*. (Cuthbertson and Athukorala, 1990). Particularly, the financial sector reforms package included several measures such as changes to interest rate policy, lifting entry barriers in the banking sector, phasing-out interest rate subsidy schemes, encouraging market-driven financial products,

and strengthening the regulatory framework, *etc*. (Athukorala and Rajapatirana, 1993; Perera, 2014). More importantly, interest rates have been deregulated since the early 1980s (Athukorala and Rajapatirana, 1993) and stock market liberalisation was a significant event of the reform agenda (Alles, 2008; Perera and Wickramanayake, 2012). During the period of economic liberalisation, coordination was developed among monetary policy, fiscal policy and exchange rate policy (Central Bank of Sri Lanka, 1998). In 2001, Sri Lanka marked a significant step by moving towards a free-floating exchange rate system and subsequently modifying the monetary policy framework while placing greater emphasis on market based monetary policy instruments (Central Bank of Sri Lanka, 2005).

In response to the changing economic environment, the Monetary Law Act was also amended in 2002 to streamline central bank objectives and to focus on two key objectives: economic and price stability and financial system stability (Central Bank of Sri Lanka, 2005). Monetary management in Sri Lanka relies on a monetary targeting framework and under this framework, the final target, price stability, is to be achieved by influencing the changes in broad money supply which is linked to reserve money (operating target) through a multiplier. Currently, to achieve monetary targets and thereby final objectives, the monetary policy framework predominantly relies on indirect monetary instruments such as open market operations and interest rates management (Central Bank of Sri Lanka, 2011).

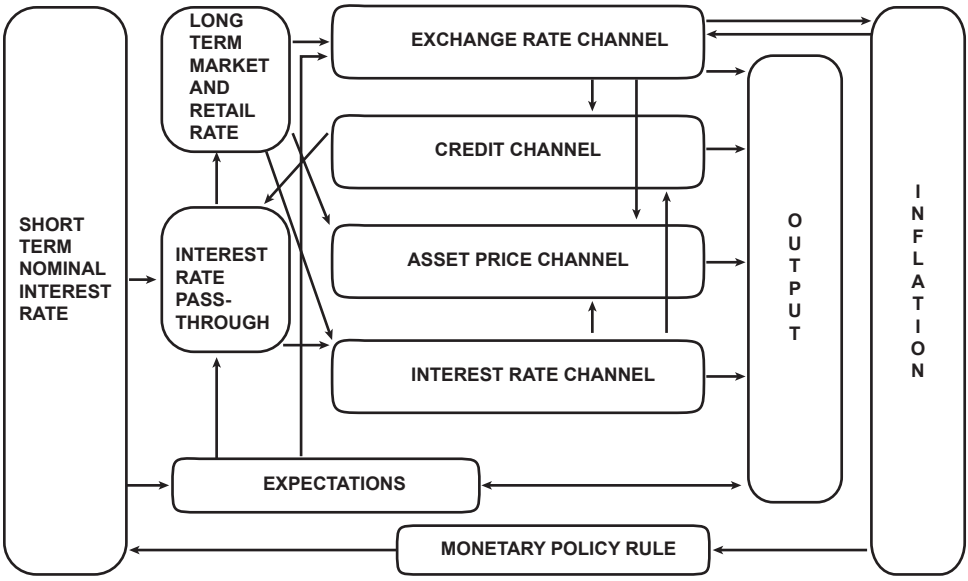
As a continuation to the modifications to the monetary policy framework, at the beginning of 2011, the CBSL adopted a more dynamic dual approach to its monetary policy analysis. Accordingly, a broader and more in-depth analysis of economic developments is carried out parallel to the analysis of monetary developments. This approach is expected to supplement the existing monetary targeting framework and strengthen the control over demand driven inflationary pressures (Central Bank of Sri Lanka, 2010).

3. Theoretical Underpinnings of Monetary Transmission Mechanism

3.1 Transmission from Monetary Policy Changes to Market Interest Rates

The monetary transmission mechanism (MTM hereafter) illustrates how policy-induced changes in monetary policy instruments of a central bank (the nominal money stock or the short-term nominal interest rate) influence real variables such as aggregate output and employment and the key nominal variable: inflation (Mishkin, 1995; Taylor, 1995). MTM begins with a change to central bank policy and then proceeds *via* different active channels such as interest rates, exchange rates, asset prices, credit as well as expectations (Mishkin, 1995; Woodford, 2003).

Figure 1: Interest Rate Pass-Through and Monetary Transmission Mechanism



Source: Adopted from Égert and MacDonald (2009).

In the process of transmission, interest rate pass-through (IRPT hereafter) becomes an important and essential element. Figure 1 provides a schematic overview of different channels of MTM and the ways they are interrelated and it mainly suggests that IRPT is the first and foremost step of the entire MTM. The process of IRPT can be decomposed into two stages (De Bondt, 2005). The first stage describes how changes in central bank monetary policy rates are transmitted to short- and long-term market rates while the second stage measures how changes in the market rates influence retail interest rates (lending and deposit rates).[6/] The 'cost of funds approach' described by De Bondt (2005) is considered the best way to describe this second stage (Égert *et al*., 2007). Accordingly, based on the idea of price setting by banks, *i.e*. mark-up pricing model of Rousseas (1985), De Bondt

6/ The first stage is largely influenced by the stability of the yield curve and hence the connection between short- and long-term interest rates is basically established by the term structure of interest rates (De Bondt, 2005). If the term structure (yield curve) remains stable over time, pass-through from policy rates to market interest rates is said to be proportionate. The slope and the dynamics of term structure is well explained employing a combination of standard prepositions like liquidity preference and market segmentation theories and also based on the expectations theory of yield curve (De Bondt, 2005; Égert, Crespo-Cuaresma, and Reininger, 2007).

(2005) explains the connection between money market and retail interest rates. According to this model, the price set by a financial institution, *i.e*., retail interest rate i^B equals to marginal cost of funding approximated by a comparable marke interest rate i^M and a constant mark-up α as shown in the following specification (De Bondt, 2005):

$$i^B = \alpha + \beta.i^M \quad (1)$$

In this Eq. (1), β represents the pass-through parameter (degree of long run IRPT) and it depends on the demand elasticity of loans and deposits with respect to retail interest rates. If the demand for loans and deposits is not fully elastic, parameter β is expected to be less than unity. In other words, β is equal to 1 in the case of a complete pass-through, *i.e*. 'completeness hypothesis' holds (De Graeve, De Jonghe, and Vennet, 2007). It is argued that speedy and complete IRPT leads to strengthen the entire MTM and thus affects price stability (De Bondt, 2005). To that end, a complete and faster IRPT implies that monetary policy is quite effective. In contrast, an incomplete and slower (disproportionate) IRPT suggests that monetary policy is less effective requiring long lags in influencing aggregate demand.[7/]

A complete IRPT may not be observed due to several reasons such as menu costs, high switching costs, imperfect competition, and asymmetric information (Chong, Liu, and Shrestha, 2006). The menu costs hypothesis suggests that financial firms are reluctant to re-quote the prices of their products if changes in those prices are deemed to be very small and/or temporary in nature. The switching costs hypothesis argues that uninformed customers are less likely to switch financial products and/or institutions in search of the best price (or yield) when there are (perceived or real) high switching costs (Chong *et al*., 2006). According to the imperfect competition hypothesis, interest rates are likely to adjust more slowly in uncompetitive markets (Hannan and Berger, 1991).[8/] As discussed by Stiglitz and Weiss (1981), the asymmetric information hypothesis states that banks encounter both adverse selection and moral hazard problems when they need to raise lending rates in response to rising market interest rates. In view of these problems, banks are generally reluctant to raise lending rates but they are more likely to ration the amount of credit extended when there is upward pressure on lending rates. Taken together,

7/ As Marotta (2009) argues, an incomplete IRPT could actually violate the Taylor principle – that a central bank should raise its interest rate instrument more than one-to-one with the increase in inflation, and as a result monetary policy would fail to be stabilising. Hofmann and Mizen (2004) however argue that while complete IRPT is more efficient in its ability to control inflation, incomplete IRPT is still effective if it is predictable.

8/ This can also be discussed under the preposition of collusion leading to asymmetric adjustment (Heffernan, 1997; Fuertes and Heffernan, 2009). Because of the collusive price arrangement among banks, rate adjustments in uncompetitive markets can be asymmetric, *i.e.*, deposit rates are expected to be rigid upwards, while lending rates are expected to be rigid downwards (Chong et al., 2006).

if the banking system is perfectly competitive and information is totally transparent, then the market price will be equal to the marginal cost. In that case, price changes perfectly reveal the changes of the marginal cost in Eq. (1), so the ratio of the price change to the marginal cost change is 1 (β=1).[9/]

Several studies have shown that the short run adjustment in interest rates may be asymmetric, *i.e.*, adjustment speed may differ when rates are further away from equilibrium (Scholnick, 1996; 1999; Chong *et al*., 2006; Sander and Kleimeier, 2006; Liu, Margaritis, and Tourani-Rad, 2008; Chong, 2010). Such asymmetry of IRPT needs to be specifically considered as it distorts the MTM (Scholnick, 1996). This is because expansionary and restrictive monetary policy would have differential impacts on the economy and hence the transmission will not be uniform (De Bondt, 2005; Chong, 2010).

Based on this theoretical guidance, it is expected to provide short run and long run estimates for IRPT based on the Sri Lankan context and to assess the effectiveness of interest rate adjustment while focusing on asymmetric adjustments.

3.2 Transmission from Market Interest Rates to Target Variables through Different Channels

The response of macroeconomic aggregates to monetary policy shocks is explained by Bernanke and Gertler (1995) as follows: (*i*) Although an unanticipated tightening in monetary policy has only transitory effects on interest rates, monetary tightening is followed by a sustained decline in output and prices; (*ii*) Falling relatively quickly after a change in policy, final demand absorbs the initial impact of monetary tightening (production also falls with a lag implying that inventories could rise in the short run, but declines later); (*iii*) The earliest and the sharpest declines in final demand can be seen in residential investment; (*iv*) Fixed business investment eventually declines in response to monetary tightening after housing and consumer durables. Thus, the effectiveness of monetary policy can be gauged by models of MTM, which show the dynamic responses of key economic aggregates targeted by the central bank, *i.e.,* output and prices, to an unanticipated tightening of monetary policy. Moreover, theories of MTM assume that prices react to monetary policy with a longer lag than output (Kilponen and Leitemo, 2011). This is because nominal prices cannot adjust immediately and proportionately following a change in monetary policy due to the degree of frictions in the economy (Ireland, 2008; Walsh, 2010).

9/ Switching and menu costs are more likely to be primary factors in influencing the short-term adjustment speed whereas imperfect competition and asymmetric information are more likely to be primary factors in affecting the long-term adjustment process (Chong *et al.*, 2006).

A number of propagation mechanisms, *i.e.,* different channels of MTM are identified in the monetary economics literature. For example, Mishkin (1995) describes various channels through which monetary policy actions affect the economy: (*i*) interest rate channel, (*ii*) exchange rate channel, (*iii*) other asset prices channel, and (*iv*) credit based channels.[10/]

Amongst different channels, interest rates and the credit view deserve much attention as monetary policy actions affect credit flows and the economy either from the 'interest rate side' or from the 'credit side' (Romer and Romer, 1994). The impact of interest rates on the components of aggregate demand is considered as the interest rate or money view, *i.e.,* the traditional channel (Bernanke and Blinder, 1988; Morris and Sellon, 1995), which is also treated as the primary/central transmission channel (Taylor, 1995; Sellon, 2002).[11/] It is however argued that policy-induced changes in the cost of capital (through interest rates) are insufficient to explain the size, timing and the composition of economic responses to a monetary policy shock (Bernanke and Gertler, 1995; Kandrac, 2012) as market imperfections play a pivotal role in MTM through the so-called 'credit channels' (Kashyap and Stein, 1995). Such channels arise mainly through asymmetric information and the imperfect nature of credit markets (Gertler and Gilchrist, 1993) that depend on several features of the financial system. These financial market frictions and imperfections amplify the effects of monetary policy mainly through two distinct sub-channels: the 'bank lending channel' and the 'balance sheet channel' (Bernanke and Blinder, 1988; Mishkin, 1995). The bank lending channel suggests that monetary policy is transmitted through the supply of bank loans (Kashyap and Stein, 1995). The balance sheet channel focuses on the role of financial positions of private agents play in the MTM, which operates through borrowers' balance sheets (Aysun and Hepp, 2011).

The exchange rate channel works through the changes in the currency value and the adjustments in net exports affecting aggregate demand directly, while the asset price

10/ Taylor (1995) classifies these channels into two broad categories: (*i*) financial market prices (short-term interest rates, bond yields, exchange rates), and (*ii*) financial market quantities (money supply, bank credit, supply of government bonds, foreign denominated assets). Boivin *et al*. (2010) differentiate channels of MTM into two broad strands: (*i*) neo-classical channels in which financial markets are perfect, and (*ii*) non-neo-classical channels that involve financial market imperfections. These neo-classical channels are built upon core models of investment, consumption, and international trade behaviour (*i.e.,* direct interest rate channel) as well as Tobin's q, wealth effects, intertemporal substitution effects and exchange rate channels. The non-neo-classical channels refer to the credit view, which includes effects on credit supply from government interventions in credit markets, bank-based channels (through lending and bank capital), and balance sheet channel (affecting both firms and households).

11/ This view claims that changes to central bank monetary policy stance influence real economic activity through interest rates affecting the opportunity cost of capital. It also takes bonds and loans to be perfect substitutes and only allows for the monetary policy effects on aggregate investment, consumption and savings through changes in interest rates (Bolton and Freixas, 2006).

channel operates mainly through capital (stock) markets and real estate markets. Hence, these channels are based on the investment decisions of firms and households (Mishkin, 1995; Boivin *et al*., 2010) as well as the financial wealth of the investors having implications on the aggregate demand (Sellin, 2001). In addition to these core channels, expectations have also gained some attention in contemporary literature (Roberts, 1998; Svensson, 1999). Table 2 provides a schematic overview of different transmission channels including key sub-channels.

Table 2: Stylised Illustration of Key Channels of Monetary Transmission

This table shows the workings of key channels of monetary transmission. The table is compiled by the author based on Mishkin (1995); Taylor (1995) and Boivin *et al.* (2010).

Channel	Causation Chains
Interest Rate Channel	
– Nominal Variant	*Money* ↑ → *Interest Rate* ↓ → *Investment* ↑ → *Aggregate Demand* ↑
– Real Variant	*Money* ↑ → *Expected Price* ↑ → *Expected Inflation* ↑ → *Real Interest Rate* ↓ → *Investment* ↑ → *Aggregate Demand* ↑
Open Economy Channel	
– Exchange Rate Channel	*Money* ↑ → *Interest Rate* ↓ → *Exchange Rate* ↑ *(Depreciates)* → *Exports* ↑ → *Net Exports* ↑ → *Aggregate Demand* ↑
Credit Channel	
– Bank Lending	*Money* ↑ → *Deposits* ↑ → *Bank Loans* ↑ → *Investment* ↑ → *Aggregate Demand* ↑
– Balance Sheet	*Money* ↑ → *Price of Stocks (Net Worth)* ↑ → *Adverse Selection* ↓ → *Moral Hazard* ↓ → *Lending* ↑ → *Investment* ↑ → *Aggregate Demand* ↑
– Cash Flow	*Money* ↑ → *Interest Rate* ↓ → *Cash Flow* ↑ → *Adverse Selection* ↓ → *Moral Hazard* ↓ → *Lending* ↑ → *Investment* ↑ → *Aggregate Demand* ↑
– Unanticipated Price Level	*Money* ↑ → *Unanticipated Price of Stocks* ↑ → *Adverse Selection* ↓ → *Moral Hazard* ↓ → *Lending* ↑ → *Investment* ↑ → *Aggregate Demand* ↑
– Liquidity Effects	*Money* ↑ → *Price of Stocks* ↑ → *Value of Financial Assets* ↑ → *Likelihood of Financial Distress* ↓ → *Consumer Durables and Housing Expenditure* ↑ → *Aggregate Demand* ↑
Other Channels	
– Wealth Effect	*Money* ↑ → *Price of Stocks* ↑ → *Wealth* ↑ → *Consumption* ↑ → *Aggregate Demand* ↑
– Tobin's q	*Money* ↑ → *Price of Stocks* ↑ → *Tobin's q* ↑ → *Investment* ↑ → *Aggregate Demand* ↑
– Expectations	*Money* ↑ → *Expected Inflation* ↑ → *Consumption/Investment* ↑ → *Aggregate Demand* ↑

In this study, it is expected to examine whether empirical evidence on the effects of monetary policy on output and prices in Sri Lanka corresponds with existing theoretical explanations and empirical findings. Specifically, it will be tested whether target variables of the central bank – output and prices respond following a monetary policy shock. At the same time, it is expected to examine the response of other key macroeconomic aggregates such as money and exchanges rates and the working of different intermediate channels in transmitting monetary policy.

4. Data and Methodology

4.1 Transmission from Monetary Policy Changes to Market Interest Rates

The policy interest rate (CBR) is the key interest rate directly administered by a central bank. However, empirical exercises generally rely on proxy rates for monetary policy indicators in place of central bank policy rates, as policy rates do not provide econometrically appealing results. The standard proxies used are the short-term money market rates, *i.e.*, either overnight interbank rate or the Treasury bill rate. Accordingly, as in Amarasekara (2005), preliminary empirical models of this study are estimated using the weighted average of interbank call money rates (MMR). However, co-integrations between the retail rates and the MMR were not observed for most of the cases leading to insignificant and inconsistent results. This could be due to higher volatility in the MMR, which is largely attributed to liquidity fluctuations arising mainly from the impact of foreign exchange operations of the CBSL and the changes in liquidity demand by commercial banks, particularly due to government fiscal operations. Thus, following previous empirical literature, for example, Cottarelli and Kourelis (1994); Espinosa-Vega and Rebucci (2004) and Haughton and Iglesias (2012), the 3-month Treasury bill rate (TBR) is employed as the main exogenous rate, *i.e.*, monetary policy indicator. It remains the appropriate rate that influences monetary policy in the absence of interbank rates (Haughton and Iglesias, 2012).[12/]

To provide empirical estimates for IRPT, aggregate (average) monthly interest rate data are used for the period January 1990 to December 2012. In addition to the 3-month Treasury bill rates (TBR), the sample consists of average bank lending rates (LR) and deposit rates (DR). Average bank lending rates include average prime lending rates (AWPR) for licenced commercial banks (LCBs) and average lending rates (LRS) for licenced specialised banks (LSBs). Average bank deposit rates include average savings rates and average fixed deposit rates (AWDR and AWFDR) for LCBs and average deposit rates

12/ A strong correlation between CBR and TBR is also observed.

(DRS) for LSBs. The data are mainly obtained from International Financial Statistics (IFS) and the CBSL.

Prior to conducting the empirical analysis, first, contemporaneous correlation coefficients between the money market rates and the retail interest rates are examined as the basic indicators of IRPT (Bredin, Fitzpatrick, and O'Reilly, 2002). Second, unit root tests for each interest rate series are conducted to examine the stationary property of the data using the augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests. Thereafter, the Johansen (1988) maximum likelihood procedure is used to examine co-integration between each retail rate and the money market rates. Moreover, standard Granger causality tests (Granger, 1969; 1981) are used to gain a preliminary insight into the nature of the temporal relationships among interest rates and hence, to examine whether changes in money market rates cause changes in retail rates (Diebold and Sharpe, 1990; Chong *et al*., 2006).

The main empirical approach of this part of study is based on the existing literature, for example, Heffernan (1997); Disyatat and Vongsinsirikul (2003); De Bondt (2005); Chong *et al*., (2006); Hofmann (2006); De Graeve *et al*., (2007); Liu *et al*., (2008); Chong (2010). Accordingly, standard error correction models (ECM) are used to determine empirical estimates of IRPT. The ECM method seems suitable to estimate IRPT since it provides an economically appealing interpretation of model parameters (De Bondt, 2005; Chong *et al*., 2006). In particular, ECMs based on the single-equation approach is considered appropriate to model both short- and long run pass-through of interest rates (Heffernan, 1997; Bredin *et al*., 2002).

Accordingly, being guided by the cost of funds approach (Rousseas, 1985; De Bondt, 2005) described by Eq. (1), the long run relationship between the endogenous retail interest rate and the exogenous money market rate is established as follows:

$$R_t = \alpha_0 + \alpha_1 M_t + \varepsilon_t \qquad (2)$$

where, R_t is the relevant endogenous retail interest rate (lending or deposit rate), M_t is the exogenous short-term money market rate (proxy for the central bank policy rate) and ε_t is the error term. α_0 and α_1 measure the constant mark-up (or mark-down) and the degree of long run pass-through, respectively. If α_1=1, long run IRPT is complete, and to ascertain the completeness, the standard Wald test is used to determine whether α_1=1. If α_1 is less than unity, IRPT is said to be incomplete.

In order to examine short run dynamics of IRPT and to determine the extent that takes retail interest rates to fully adjust in response to changes in money market rates,

an ECM representation corresponding to a general auto regressive distributed lag (ARDL) (*p,q*) model is specified. This is based on the Engle and Granger (1987) error correction procedure. Accordingly, the following model is applied to examine short run adjustments:

$$\Delta R_t = \beta_1 \Delta M_t + \beta_2 (R_{t-1} - \alpha_0 - \alpha_1 M_{t-1}) + v_t \qquad (3)$$

where, Δ denotes first differenced operator and v_t is the error term. $R_{(t-1)}$ and $M_{(t-1)}$ are lagged variables and the relevant lag structure is determined by the general to specific method (Mojon, 2000; Bredin *et al*., 2002) and is based on the information criteria of lag selection.

Eq. (3) characterises the reduced form of the dynamic relationship between retail interest rates and money market rates and the term in brackets represents the lagged deviation of retail interest rate from its steady state equilibrium value, or in general, the error correction term. In this model, β_1 measures short run (immediate, contemporaneous or impact) pass-through, *i.e*., the degree of the change in retail interest rate in response to a change in money market rate during the same period. $\hat{\varepsilon}_{(t-1)} = (R_{t-1} - \alpha_0 - \alpha_1 M_{t-1})$ represents the extent of retail rate disequilibrium at time (t-1), which is the residual of the long run relationship modelled by Eq. (2). Hence, β_2 captures the error correction adjustment speed to the long run value when the rates are away from their equilibrium level. In the mean reverting case of interest rates, sign of β_2 is expected to be negative and the absolute size of the coefficient indicates how fast a disequilibrium in retail interest rate settings will be removed (Chong *et al*., 2006; Liu *et al*., 2008). Moreover, mean adjustment lag (MAL) of a complete pass-through can be calculated as follows using the approach suggested by Hendry (1995):

$$(1 - \beta_2) / \beta_2 \qquad (4)$$

Eq. (4) indicates the average months needed to reach the long run value of pass-through, *i.e*., speed at which the market interest rate is fully passed-through to retail rates (Hendry, 1995). It takes into account the proportion of the adjustment, which takes place in the first period and the total adjustment in the long run. Robustness of these results obtained from the ECM estimates are formally checked by estimating bivariate VAR models and comparing impulse responses as suggested by Diebold and Sharpe (1990); De Bondt (2005) and Berument and Froyen (2006).

Thereafter, to examine the asymmetric adjustment when the rates are above or below the equilibrium, an indicator (dummy) variable λ is created and incorporated into Eq. (3).

λ is equal to 1 if the residual $\hat{\varepsilon}_{(t-1)} = (R_{t-1} - \alpha_0 - \alpha_1 M_{t-1})$ is positive and 0 otherwise. Hence, the asymmetric short run dynamic equation can be specified as follows:

$$\Delta R_t = \delta_1 \Delta M_t + \delta_2 \lambda \hat{\varepsilon}_{t-1} + \delta_3 (1-\lambda) \hat{\varepsilon}_{t-1} + \eta_t \quad (5)$$

where, δ_2 captures the error correction adjustment speed when the rates are above the equilibrium and δ_3 captures the error correction adjustment speed when the rates are below the equilibrium values. A Wald test is used to determine if δ_2 is significantly different from δ_3 and hence to examine the presence of asymmetric adjustment. Similar to the case of symmetric adjustment, asymmetric MALs for a complete IRPT from money market rates to retail rates can be defined as follows:

$$MAL^{+} = (1-\delta_1) / \delta_2 \quad (6)$$

$$MAL^{-} = (1-\delta_1) / \delta_3 \quad (7)$$

Mean adjustment lag when the rates are above their equilibrium value is given by MAL^{+} and when rates are below their equilibrium value is represented by MAL^{-} (Chong *et al*., 2006; Liu *et al*., 2008).

4.2 Transmission from Market Interest Rates to Target Variables through Different Channels

In order to provide empirical estimates under this section, quarterly data for the period March 1996 – December 2012 are used. The required data are mainly obtained from the published databases of the CBSL and the IFS.

The empirical approach of this study is based on estimating vector auto regression (VAR) models. VAR models have been progressively used for emerging market studies such as Agung (1998) for Indonesia, Disyatat and Vongsinsirikul (2003); Charoenseang and Manakit (2007) for Thailand and Elbourne and de Haan (2006) for some transition countries, among others.

First, to establish MTM and to examine the effectiveness of monetary policy in Sri Lanka, an unrestricted–baseline VAR model is estimated. This model assumes that the system is recursive and hence the Choleski decomposition is employed for identification. The estimated baseline VAR specification can be written in following matrix form:

$$y_t = k + A(L)\, y_{t-1} + Bx_t + u_t \quad (8)$$

where, y_t is the vector of endogenous variables, k is the vector of constants, x_t is the vector of exogenous variables and u_t is the vector of serially uncorrelated disturbances that have a zero mean and a time invariant covariance matrix. A(L) denotes a matrix polynomial in the lag operator L and B is a coefficient matrix. In the baseline specification, the vector of endogenous variables *i.e.*, y_t consists of key variables: real gross domestic product (GDP_t), consumer price index (CPI_t), a measure of monetary aggregate, *i.e.,* narrow money supply ($M1_t$) and the domestic nominal short-term interest rate given by the interbank money market rate (MMR_t), and hence can be written as follows.[13/]

$$y'_t = (GDP_t \quad CPI_t \quad M1_t \quad MMR_t) \tag{9}$$

GDP_t and CPI_t are the key target variables of the monetary authority, which respond to innovations to the monetary policy rate (MMR_t). The use of narrow money aggregate ($M1_t$) is guided by prior literature, for example, Sims (1992); Berument and Froyen (2006); Ito and Sato (2008); Rafiq and Mallick (2008); Laopodis (2013) to incorporate the impact of liquidity into the VAR system.[14/] The use of the money market rate (MMR_t) as the monetary policy indicator is also guided by prior literature such as Ito and Sato (2008); Rafiq and Mallick (2008), and it captures the exogenous shifts in the monetary policy stance (Gertler and Gilchrist, 1993).[15/] The ordering of variables is consistent with the central bank response to output and inflation dynamics and the dynamic structure of the economy (Disyatat and Vongsinsirikul, 2003). Therefore, the policy variable (MMR_t) is ordered last implying that an innovation in the money market rate has no contemporaneous impact on the variables in the system but has only a lagged influence on the other variables (Gertler and Gilchrist, 1993; Garretsen and Swank, 1998). A dummy variable is also included in the model to capture the impact of the structural break that occurred in 2001 due to exchange rate liberalisation. However, the impact of the global financial crisis is not considered in this model as there was no structural break in the data, which is consistent with the approach used in a study of Carpenter and Demiralp (2012).

Following Gerlach and Smets (1995); Berument and Froyen (2006); Hesse (2007); Carpenter and Demiralp (2012), among others, all non-interest rate variables are measured in natural logarithms. Also, based on the widely used X-11 procedure for seasonal adjustment, variables are seasonally adjusted. If the variables in the system are non-stationary, but co-integrated, Sims, Stock and Watson (1990) and Lütkepohl and

13/ Generally, baseline VAR models include four key variables, *i.e.,* real output, inflation rates, nominal interest rate and a financial variable of interest (for example, monetary aggregates) (Gertler and Gilchrist, 1993).

14/ Base or narrow money allows for the effect of monetary policy on inflation (Ito and Sato, 2008).

15/ In the previous section, the 3-month Treasury bill rate is used as the monetary policy indicator to estimate IRPT in Sri Lanka due to the high volatility in the interbank money market rates. However, based on the standard MTM literature, interbank money market rate is used in this analysis.

Reimers (1992) prescribe that estimating VARs in (log) levels will provide consistent estimates. Although there is loss of efficiency in the VAR due to estimations in levels, it will prevent the loss of information about the long run relationships when a VAR is estimated in first differences. Accordingly, being guided by similar prior research, for example, Disyatat and Vongsinsirikul (2003); Iacoviello and Minetti (2003); Berument and Froyen (2006), among others, an unrestricted VAR model is estimated in levels.[16/] Impact of monetary policy shocks on the target variables are identified based on impulse response functions (IRFs). Also, in order to get an idea about the share of fluctuations in a given variable that are caused by different shocks, variance decompositions (forecast error decompositions) for each variable at different forecast horizons are also estimated.

Thereafter, a structural VAR (SVAR) model is estimated for Sri Lanka. This SVAR model is consistent with economic theory and it imposes enough restrictions to identify policy shocks, which recognise the intertwines and complex relationships between policy variables and other macroeconomic variables (Leeper, Sims, and Zha, 1996; Boivin and Giannoni, 2006). Importantly, the SVAR approach is better suited for small open economies like Sri Lanka than the traditional identification methods. This is because of its ability to capture more of the salient features of such economies (Elbourne and de Haan, 2006).[17/] To that end, using a SVAR model for the Sri Lankan economy is well justified due to several reasons. First, being an open economy, the SVAR model can uncover the interdependence between the domestic monetary policy instrument variable and the nominal exchange rate. Second, although the short-term interest rate remains the main policy variable, the CBSL targets monetary aggregates (base/reserve money) as its operating target. Hence, it is not clear or hard to determine the most appropriate monetary policy instrument used to identify monetary policy shocks. The SVAR model considers combinations of monetary aggregates and short-term interest rates, helping to identify monetary policy shocks appropriately. Third, a SVAR model is preferred as it takes no account of the time series properties of the data (Dale and Haldane, 1995; MacDonald, Mullineux, and Sensarma, 2009) also and due to relatively small sample size (MacDonald *et al*., 2009).

Guided by the prior literature, mainly Kim and Roubini (2000), the following seven variables are included in the model: global commodity price index of the IMF ($COMP_t$), US Federal funds rate ($FEDR_t$), real output (GDP_t), consumer price index (CPI_t), money stock given by narrow money ($M1_t$), short-term domestic interest rate given by the

16/ As indicated by the unreported results, the ADF and PP tests all fail to reject a unit root in the levels of these time series but can be rejected in the first differences. Also, both Johansen's λ-max and λ-trace tests decisively reject the hypothesis of no cointegration for both sets of variables.

17/ In general, Kim and Roubini (2000) argue that SVARs resolve a number of anomalies related to exchange rates, prices and liquidity, which are detected in the empirical small open economy recursive VAR models.

interbank money market rate (MMR_t) and the nominal exchange rate (Sri Lankan rupee with respect to US dollar - EXR_t. All these variables are seasonally adjusted and specified in logs except for interest rates. Before estimating the SVAR model, first, an unrestricted VAR model is estimated and is diagnosed for stability, absence of autocorrelation and heteroskedasticity. Then, the same model is augmented in the SVAR setting, which is identified by several short run restrictions as discussed in Appendix I.

Using the 7-variable SVAR model, structural innovations for an unanticipated positive interest rate shock (restrictive monetary policy) are obtained and the variance decompositions are estimated. Also, models are re-estimated using some alternative variables in order to ensure the validity of the 7-variable SVAR model.

After establishing monetary transmission, the workings of different channels are examined based on the extensions to the baseline VAR model. Accordingly, to identify the workings of the particular channel, the shutdown/blocking-off method is used as in the studies of Morsink and Bayoumi (2001) and Disyatat and Vongsinsirikul (2003). As such, to gauge the relative strength of different channels, IRFs for target variables (output and prices) are compared under two scenarios: (*i*) estimates with relevant channel endogenous versus (*ii*) estimates with relevant channel exogenous. Any deviation of the IRFs of the later model from IRFs of the former model represent the strength of each channel, *i.e*. the larger the deviation, the stronger or more important the particular channel.

5. Empirical Results

5.1 Transmission from Central Bank Monetary Policy Changes to Interest Rates

First, Table 3 reports the data descriptions and descriptive statistics for different interest rates used for the empirical analysis. The mean value of the short-term money market rate (3-month Treasury bill rate, TBR) is 13.21 per cent. It appears that on average, retail interest rates remain high and volatile in Sri Lanka. This could be due to high volatility in money market rates and the relatively high and volatile inflation rates as well as due to high risk premiums.[18/] In particular, lending rates in LCBs (for example, AWPR), which are linked to overnight interbank call money market rates, are more volatile. It is also noticed that deposit rates of LCBs (AWDR and AWFDR) remain below the TBR. Mean values suggest that LSBs offer high deposit rates (DRS) while charging high for lending (LRS). This high rate structure could be due to the nature of their business activity, for example, long term lending and due to the impact of higher non-performing assets in LSBs.

18/ It is generally observed that Sri Lankan banks operate with high net interest margins driven by individual bank's dominance in the market, cost structure, risk profile, ownership form, access to alternative funding sources, *etc*. (Perera, Skully, and Nguyen, 2012).

Table 3: Data Description and Descriptive Statistics

This table presents descriptions and descriptive statistics of data for the period 1990:1–2012:12 used to model the transmission from central bank monetary policy changes to interest rates.

Variable	Variable Code	Description	Descriptive Statistics				
			No. of Obs	Mean	Std. Dev.	Min.	Max.
Panel A: Monetary Policy Indicator							
Money market rate	TBR	3-month Treasury bill rate	276	13.21	4.07	6.97	21.30
Panel B: Different Interest Rates							
LicensedCommercial Banks (LCBs)							
Average lending rate	AWPR	Weighted average prime lending rate	276	15.42	3.76	8.94	22.86
Average deposit rate	AWDR	Weighted average deposit rate	276	10.05	3.07	4.84	19.40
Average fixed deposit rate[1/]	AWFDR	Weighted average fixed deposit rate	193	11.20	2.76	6.82	16.92
LicensedSpecialised Banks (LSBs)							
Average lending rate	LRS	Average lending rate for major 3 LSBs	276	16.91	3.16	11.33	22.17
Average deposit rate	DRS	Average fixed deposit rate for major 3 LSBs	276	12.93	3.31	7.00	17.67

1/ Available since 1997

Thereafter, stationary properties, co-integration and Granger causality of money market rates and retail interest rates are established as reported in Table 4. Based on the results presented in Panel A, at the levels, both ADF and PP tests do not reject the hypotheses that all interest rate series are unit root non-stationary, but all series are stationary at the first differences. Thus, all rates are found to be integrated of order one, *i.e.*, I(1). Based on the Johansen's method, Panel B presents evidence for statistically significant long run relationships between money market and retail interest rates. Moreover, the results in Panel C confirm that money market rates Granger cause the retail interest rates and as expected, one-way causality is running from money market rates to retail rates. Unreported results confirm that policy interest rates (CBR) also have the same causality.

After having observed the co-integrating relationships between money market and retail interest rates, long and short run dynamics of IRPT are examined. The results are reported in Table 5. These results are obtained through estimating the long run model given in

Table 4: Stationarity, Cointegration and Granger Causality

This table presents stationarity test results based on unit root tests (Panel A), cointegration test results based on Johansen's method (Panel B) and Granger causality test results (Panel C) of interest rates.

Panel A: Unit Root Tests of Interest Rates

Category	Variable	Augmented Dickey-Fuller (ADF) Test				Phillips-Perron (PP) Test			
		Level		First Difference		Level		First Difference	
		T-Statistic	*Probability**	*T-Statistic*	*Probability**	*T-Statistic*	*Probability**	*T-Statistic*	*Probability**
Money Market Rate	TBR	-1.90	0.33	-15.05	0.00	-2.25	0.19	-15.16	0.00
Lending Rates	AWPR	-2.97	0.14	-6.94	0.00	-2.55	0.30	-14.67	0.00
	LRS	-2.57	0.29	-6.75	0.00	-1.90	0.65	-17.43	0.00
Deposit Rates	AWDR	-3.32	0.07	-8.34	0.00	-3.00	0.13	-15.23	0.00
	AWFDR	-2.54	0.31	-3.52	0.04	-1.82	0.69	-8.87	0.00
	DRS	-2.65	0.26	-4.81	0.00	-1.99	0.60	-13.72	0.00

Panel B: Cointegration between Money Market and Retail Interest Rates

Category	Variables	Test Statistics				Cointegration between Interest Rates
		Trace Test		Maximum Eigenvalue Test		
		None	At Most 1	None	At Most 1	
Full Sample (1990 - 2012)						
Lending Rates	TBR & AWPR	29.96**	4.17**	22.79**	4.17**	Yes
	TBR & LRS	49.09**	5.08**	44.01**	5.08**	Yes
Deposit Rates	TBR & AWDR	63.39**	4.54**	58.85**	4.54**	Yes
	TBR & AWFDR	23.45**	5.77**	17.69**	5.77**	Yes
	TBR & DRS	35.60**	2.84	32.75**	2.84	Yes

Panel C: Causality between Money Market and Retail Interest Rates

Category	Direction of Causality	F-Value	P-Value	Decesion*	Implication
Lending Rates	TBR to AWPR	15.39	0.00	Rejected	TB3 Granger causes AWPR
	TBR to LRS	36.37	0.00	Rejected	TB3 Granger causes LRS
Deposit Rates	TBR to AWDR	22.12	0.00	Rejected	TB3 Granger causes AWDR
	TBR to AWFDR	29.49	0.00	Rejected	TB3 Granger causes AWFDR
	TBR to DRS	11.41	0.00	Rejected	TB3 Granger causes DRS

Table 5: Estimates of Long Run and Short Run Interest Rate Pass-Through

This table provides estimates for long run and short run pass-through coefficients. Long run coefficients are obtained based on the following long run model estimated using the robust OLS method:

$$R_t = \alpha_0 + \alpha_1 M_t + \varepsilon_t \qquad (2)$$

where R_t is relevant retail interest rate (lending or deposit rate), M_t is short-term money market rate, *i.e.,* 3-month Treasury bill rate (proxy for central bank policy rate) and ε_t is the error term. α_0 and α_1 measure constant mark-up (or mark-down) and the degree of long run pass-through, respectively. Complete pass-through is examined based on Wald test (H0: $\alpha_1 = 1$). The relevant standard (symmetric) error correction model (ECM) for short run dynamics is given by:

$$\Delta R_t = \beta_1 \Delta M_t + \beta_2 (R_{t-1} - \alpha_0 - \alpha_1 M_{t-1} + v_t \qquad (3)$$

where Δ denotes first differenced operator and v_t is the error term. R_{t-1} and M_{t-1} are lagged variables and the lag length is identified using Schwarz information criterion (SIC). β_1 measures the short run pass-through, β_2 captures the adjustment speed and mean adjustment lag is measured by $(1-\beta_1)/\beta_2$. All the interest rates are defined in Table 3. Panel A presents the results for lending rates while Panel B presents the results for deposit rates. Model estimates are adjusted for Newey-West procedure that produces 'HAC' (Heteroscedasticity and Autocorrelation Consistent) standard errors correcting for both autocorrelation and heteroscedasticity. n.o. denotes no observations. Subscripts *, ** and *** indicate statistical significance at 10%, 5% and 1% respectively. The sample period is 1990:1-2012:12.

Retail Interest Rates	Model Estimates											
	Coefficients									Diagnostics		
	Mark-Up (α_0)		Long Run Pass-Through (α_1)		Short Run Pass-Through (β_1)		Adjustment Speed (β_2)		MAL	Wald Test (H0: $\alpha_1 = 1$)		Adjusted R^2
	Coefficient	t-Value	Coefficient	t-Value	Coefficient	t-Value	Coefficient	t-Value		F-Value	p-Value	
Panel A: Lending Rates												
AWPR	3.020***	4.420	0.9332***	19.030	0.3389***	8.453	-0.1965***	-6.410	3.36	1.863	0.1720	0.277
LRS	3.988***	2.930	0.9582***	9.799	0.0715***	7.731	-0.0745***	-6.240	12.46	0.178	0.6730	0.181
Panel B: Deposit Rates												
AWDR	0.2901***	0.285	0.7033***	9.680	0.0669***	6.560	-0.0949***	-7.064	9.84	16.701	0.0000	0.164
AWFDR	0.8288	1.296	0.8797***	16.39	0.1007***	11.61	-0.1142***	-10.03	7.89	5.029	0.0250	0.429
DRS	1.452*	2.001	0.8569***	16.45	0.1143***	7.817	-0.1336***	-7.420	6.63	7.533	0.0000	0.187

Eq. (2) and the error correction models given in Eq. (3). It is observed that models are broadly robust for diagnostics, but the long list of test results is not reported for brevity.[19/]

According to the results in Table 5, somewhat higher mark-ups (α_0) are observed for lending rates. This indicates the riskiness of loans in comparison to deposits (Horváth and Podpiera, 2012) and this is consistent with similar studies of Chong *et al*. (2006) for Singapore, Liu *et al*. (2008) for New Zealand and Zulkhibri (2012) for Malaysia *etc*. Meanwhile, high and almost complete long run pass-through (α_1) is observed for lending rates of LCBs and LSBs (AWPR and LRS, respectively in Panel A). High pass-through in the AWPR could be due to several reasons. First, AWPR is mostly based on short-term loans of LCBs (such as credit granted for working capital needs or trade related activities) and are broadly linked to the changes in short-term money market rates. The higher response of AWPR to money market rates also suggests that monetary policy is quite effective at the shorter end of the yield curve (De Bondt, 2005; Liu *et al*., 2008).

Second, it indicates that short-term lending rates are much more competitive than the long-term lending and/or deposit rates. In particular, as argued by Bredin *et al*. (2002) in the context of Ireland, high IRPT could be due to the impact of borrowings by large corporations (generally prime customers). These firms have greater access to alternative financing that are unavailable for average customers encouraging the LCBs to fully and quickly adjust their prime lending rates. High pass-through in lending rates of LSBs (LRS) could be due to emerging competition in this sector.[20/] In contrast, relatively low or somewhat incomplete long run pass-through is observed for deposit rates (Panel B of Table 5). As De Bondt (2005) suggests in the case of European markets, this could be due to the existing uncompetitive forces and/or prevailing switching and asymmetric information costs in deposit markets in comparison to the lending markets.

Table 5 also reports the results for short run dynamics estimated using ECMs.[21/] Accordingly, lending rates of LCBs (AWPR) record the highest short run pass-through (β_1) of about 34 per cent ($\beta_1 = 0.3389$). Both lending rates of LSBs (LRS) and deposit rates of LCBs (AWDR) report low levels of short run pass-through of around 7 per cent ($\beta_1 = 0.0715$ and 0.0669, respectively). Meanwhile, error correction adjustments (β_2) that

19/ Key diagnostics tests: Breusch-Godfrey serial correlation Lagrange multiplier test for serial correlation; Ramsey RESET test for functional form; skewness and kurtosis tests for residuals based on Jarque-Bera statistic for normality and White's heteroscedasticity test for homescedasticity are conducted based on Pesaran and Pesaran (1997); Brooks (2008). The results are available upon request.

20/ This is reflected in the declining market share of the National Savings Bank, which accounted for about more than 90 per cent of total LSB sector assets in 1997 and then declined to about 75 per cent by 2012.

21/ The optimal lag structure for the ECM is determined using Schwartz Information Criteria (SIC) and it suggests that lag of one period is sufficient for Sri Lanka, which is consistent across many studies in this nature [for example, Espinosa-Vega and Rebucci (2004); De Bondt (2005); Zulkhibri (2012), *etc*.].

represent the speed of adjustment are negative and statistically significant indicating the mean reversion of the interest rates toward long run equilibrium. While AWPR records the lowest MAL of 3.36 months indicating the faster adjustment, LRS reports the highest MAL of 12.46 months indicating the slowest adjustment. Hence, although long run IRPT for LSB lending rates is higher, short run adjustment remains sluggish, which could be due to high switching costs, adverse selection as well as due to moral hazard problems in these lending markets (Chong *et al*., 2006).

Taken together, on average, lending rates report the highest long run and short run pass-through, *i.e.,* 95 per cent and 20 per cent, respectively. For deposit rates, the average long run pass-through is about 86 per cent and the short-run pass-through is about 10 per cent.[22/]

To confirm the robustness of the above discussed results, the system equation approach is used. Accordingly, responses of retail interest rates to money market rate innovations are examined based on impulse response functions (IRF) within a VAR framework. As such, IRFs are estimated for 12 months for a shock standardised to equal a 1 per cent point (100 basis points) change in the money market rate. The instantaneous response shows how an unanticipated shock to the money market rate (TBR) is transmitted to retail rates within a month. The maximum response represents the maximum pass-through within a year.

Based on the results in Table 6, which reports the results for shocks, it is evident that lending rate pass-through is comparatively higher than the deposit rate pass-through. In particular, both instantaneous and maximum responses are higher for AWPR. Second, amongst the deposit rates, AWFDR records the highest long term pass-through.

Next, in order to observe whether interest rates adjustments are above or below their equilibrium levels, asymmetric rigidity is examined. Table 7 presents the results for both symmetric and asymmetric MALs obtained using the ECM estimates. These results broadly suggest that symmetric and asymmetric MALs are lower for lending rates. For example, Panel A of Table 7 confirms that both symmetric MAL and asymmetric MALs (MAL^+ and MAL^-) remain less than 4 months for AWPR. This indicates that residual errors are lower for AWPR, and hence, they are linked with equilibrium values leading to improvements in MALs (Chong, 2010). Nevertheless, significant asymmetry is observed for lending rates in LSBs and especially for deposit rates.

22/ These results cannot be compared with some previous estimates for Sri Lanka due to the differences in selected interest rates and samples. For example, based on a sample for the regulated period, Cottarelli and Kourelis (1994) observe that short run pass-through is about 15 per cent from discount rates to lending rates. Based on a sample for 1996-2004, Amarasekara (2005) finds that long run pass-through to prime lending rates from call money rates is about 50 per cent.

Table 6: VAR Estimates of Interest Rate Pass-Through

This table provides estimates for instantaneous and long run interest rate pass-through based on the impulse response functions by estimating a VAR model given by the following representation:

$$Y_t = c + \sum_{i=1}^{n} A_i Y_{t-1} + \varepsilon_t \qquad (10)$$

with:

$$Y_t = \begin{bmatrix} R \\ M \end{bmatrix}_t \qquad (10.1)$$

where Y_t is a vector of endogenous and exogenous variables and i is optimal lag length decided by SIC. R_t is relevant retail interest rate, *i.e.,* 3-month Treasury bill rate (lending or deposit rate), M_t is short-term money market rate (proxy for central bank policy rate, *i.e.,* TBR), ε_t is error term. Following Choleski decomposition, impulse response functions are estimated for a period of 12 months for a shock standardised to equal a 1 per cent point (100 basis points) change in the money market rate to examine instantaneous and the maximum responses.
* Maximum response is the largest response within 12-month period in the same direction as the movement in the money market rate following the innovation. The sample period is 1990:1 – 2012:12.

Retail Interest Rates / Impulse Response	Coefficient
Panel A : Lending Rates	
AWPR	
Instantaneous	0.32
Maximum Response	0.90
LRS	
Instantaneous	0.03
Maximum Response	0.84
Panel B : Deposit Rates	
AWPR	
Instantaneous	0.03
Maximum Response	0.41
AWFDR	
Instantaneous	0.07
Maximum Response	0.72
DRS	
Instantaneous	0.11
Maximum Response	0.49

Table 7: Symmetric and Asymmetric Mean Adjustment Lags

This table provides symmetric and asymmetric mean adjustment lags (MALs), estimated using the coefficients derived based on Eq. (4) and Eq. (6) - Eq. (7). Panel A present results for individual rates and Panel B present results for averages. The sample period is 1990:1-2012:12.

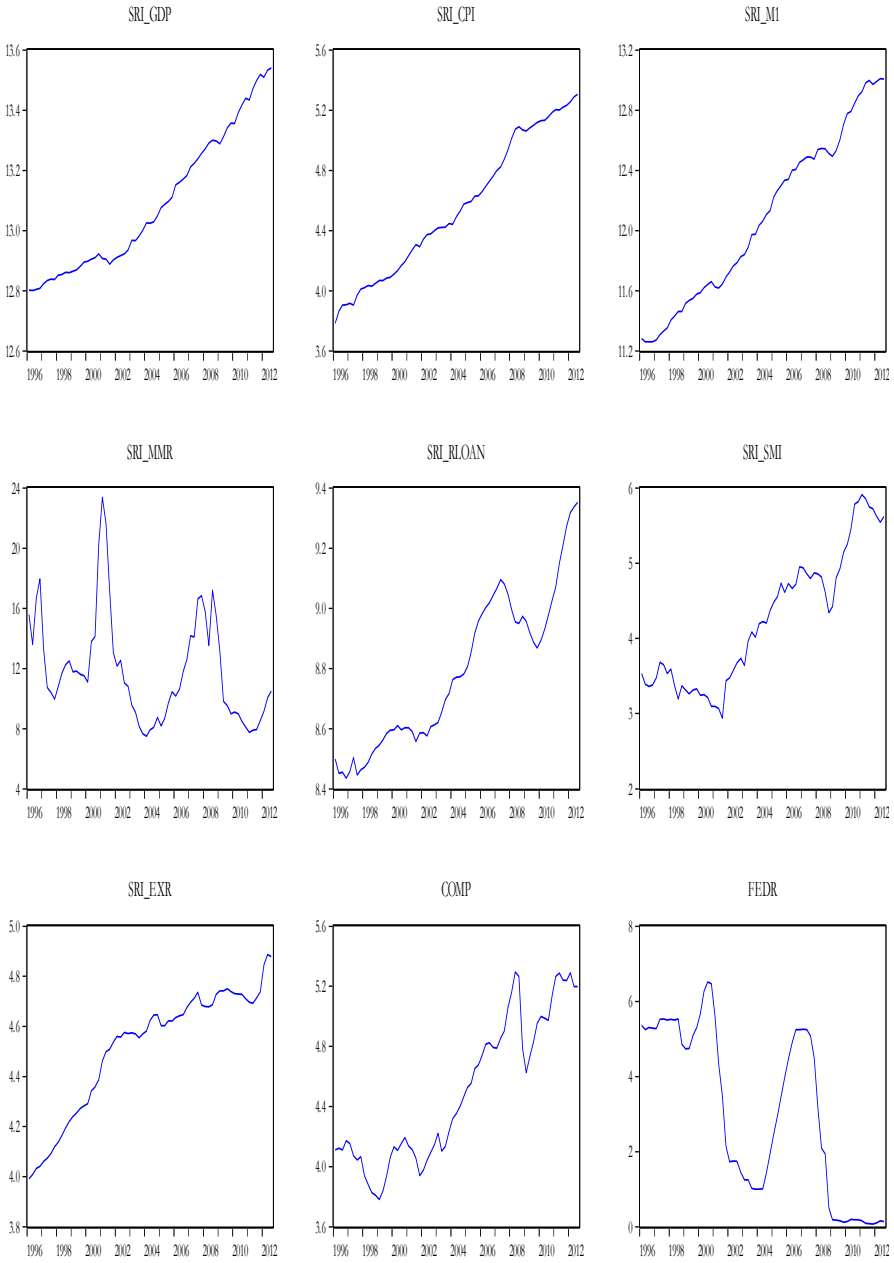
Retail Interest Rates	Symmetric Model	Asymmetric Model	
	MAL	MAL^{+}	MAL^{-}
Panel A : Lending Rates			
AWPR	3.36	3.47	3.33
LRS	12.46	10.52	14.14
Panel B : Deposit Rates			
AWDR	9.84	7.52	17.22
AWFDR	7.89	7.51	8.59
DRS	6.63	6.81	6.52
Panel C : Averages			
Lending Rates	7.91	7.00	8.73
Deposit Rates	8.12	7.28	10.78

To that end, these results suggest that asymmetric adjustments continue to exist in the Sri Lankan context. For example, it is observed that both symmetric and asymmetric MALs are lower for lending rates relative to the deposit rates indicating faster adjustments in AWPR. However, similar adjustments are not observed for other interest rates. As observed in the prior empirical studies for other countries, for example, Chong (2010), such asymmetry could continue to exist due to the oligopolistic structure of the banking market and due to bank market power.

5.2 Transmission from Market Interest Rates to Target Variables through Different Channels

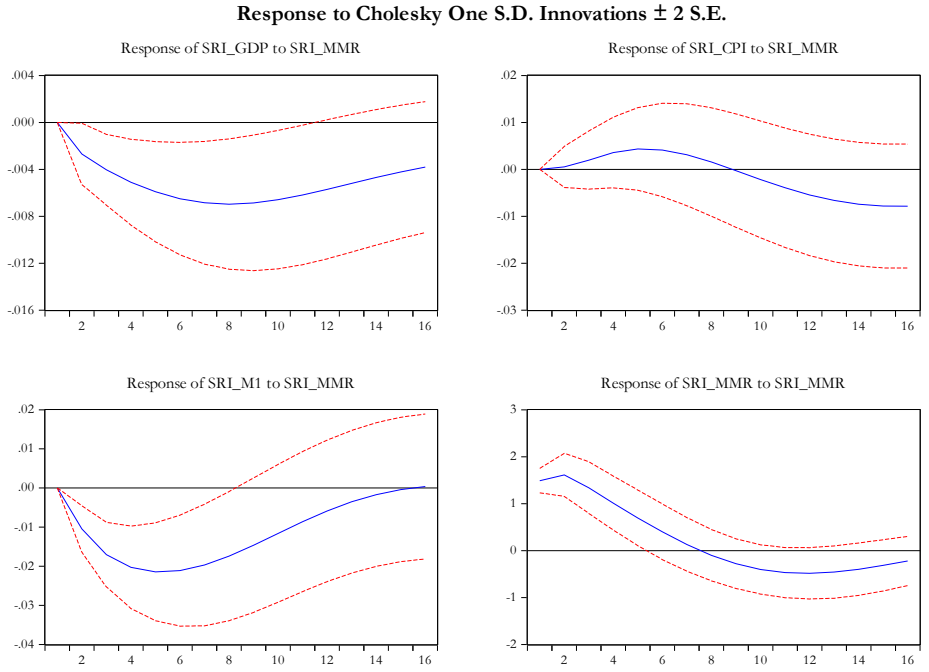
First, Figure 2 depicts the behaviour of the variables used for VAR and SVAR models based on quarterly seasonally adjusted data for the period March 1996 to December 2012. Since these figures are self-explanatory, a detailed discussion is not provided.

Figure 2: Plots of Data Series – Quarterly VAR and SVAR Models



As a benchmark model for monetary transmission, first, an unrestricted VAR model is estimated. This benchmark model (Eq. 8) includes real output (GDP_t), consumer prices (CPI_t), a monetary aggregate ($M1_t$) and the short-term interbank money market rate (MMR_t).[23/] Having established a baseline VAR model, then, impulse response functions (IRFs) are calculated and presented in Figure 3.

Figure 3: Impulse Response Functions (Baseline VAR Model)



23/ Unreported unit root (ADF and PP) tests and the Johansen cointegration test results suggest that interest rate is I(0), whilst all the other variables are I(1) and that there are four cointegrating vectors in the VAR system. Hence, it confirms the appropriateness of the strategy suggested by Sims et al. (1990) and Lütkepohl and Reimers (1992) to estimate the VAR in levels despite the fact that series are integrated. Therefore, estimates of the models are carried out in levels. The optimal lag length under different information criteria (Schwarz and Hannan-Quinn criteria) appears to be one. However, one lag is too short to capture underlying dynamics of the system while it could run into the degrees of freedom problem if many lags are included (Disyatat and Vongsinsirikul, 2003). Moreover, in the case of SVAR, it could pose a risk of over-parameterisation. Also, a lag order of one may lead to autocorrelation in the residuals and more lags tend to show greater variability in impulse responses. As such, guided by prior literature, VAR models are estimated with two lags. Relevant VAR models are also tested for stability, no serial correlation and the absence of heteroskedasticity. As suggested by these unreported results, estimated VAR model appears broadly valid. These results are available upon request.

As shown in Figure 3, first, an unexpected rise in short-term interest rates causes a statistically significant decline in real output (SRI_GDP). In particular, an unexpected tightening of monetary policy gives rise to a U-shaped output response that bottoms-out after 6-8 quarters. The relatively quicker response in output to a monetary contraction is consistent with the observations in prior research, for example, Leeper *et al*. (1996) and Berument and Froyen (2006) for US, Disyatat and Vongsinsirikul (2003) for Thailand, Arin and Jolly (2005) for Australia and New Zealand, *etc*. Second, consumer prices (SRI_CPI) initially report a positive reaction to an interest rate innovation showing a 'price puzzle'.[24/] Third, following an interest rate shock, monetary aggregates (SRI_M1) react immediately, which is consistent with the evidence reported in Leeper *et al*. (1996); Kim and Roubini (2000); Sousa and Zaghini (2007); Ito and Sato (2008) and Rafiq and Mallick (2008). In fact Leeper *et al*. (1996) describe a similar monetary contraction as a strong liquidity effect: money contracts quickly and stays persistently below average following an interest rate jump that is itself persistent. According to Figure 3, the effect on M1 bottoms out by the fourth quarter and starts dissipating. Finally, the interest rate shock (SRI_MMR) is quite persistent and starts returning to its initial levels after about seven quarters. As expected, the shock results in a considerable initial increase, with the short-term money market rate actually peaking after two quarters and a subsequent steady decline. It continues to decline below the initial level and reaches the lowest point by 11–12 quarters after the shock, and then begins to increase towards the base level.

In order to examine the contributions to fluctuations in a given variable caused by different shocks, variance composition (VD) for each variable at forecast horizons of one through to four years is examined. These results are presented in Table 8.

According to the results, output (SRI_GDP) indicates that after four years (16 quarters), interest rate shocks account for about 31 per cent of the fluctuation in output, with own shocks accounting for most of the rest. This is consistent with prior studies indicating that interest rate innovations lead to long run fluctuations in economic activity. Meanwhile, VD for prices (SRI_CPI) indicates that after four years (16 quarters), money accounts for 41 per cent of the fluctuation in prices while own shocks account for more than 50 per cent of the variance. Interest rate innovations alone account only for about 5 per cent after

24/ In the VAR systems, positive orthogonalised shocks to central bank policy rates are related to a protracted rise in the price levels suggesting that some inflation indicator is missing from the VAR (Laopodis, 2013). This is well known as 'price puzzle', *i.e.,* prices increase following an interest rate tightening (Sims, 1992; Leeper *et al*., 1996; Kim and Roubini, 2000). Sims (1992) suggests that the price puzzle might be due to the fact that interest rate innovations partly reflect inflationary pressures leading to price increases and also states as the failure to include a rich enough specification of the information available to policy makers. This is quite common in similar empirical literature. For example, Dale and Haldane (1995) for UK, Leeper *et al.* (1996) for the US, Morsink and Bayoumi (2001) for Japan, Disyatat and Vongsinsirikul (2003) for Thailand, Arin and Jolly (2005) for Australia and New Zealand, *etc*., report similar positive responses in prices.

Table 8: Variance Decomposition (Baseline VAR Model)

This table presents forecast error variance decomposition of output (SRI_GDP), prices (SRI_CPI), narrow money (SRI_M1) and short-term interest rate (SRI_MMR) for the baseline VAR model. Cholesky Ordering: SRI_GDP SRI_CPI SRI_M1 SRI_MMR. Period is given by number of quarters.

Variance Decomposition of SRI_GDP:

Period	S.E.	SRI_GDP	SRI_CPI	SRI_M1	SRI_MMR
1	0.0109	100.0	0.00	0.00	0.00
2	0.0145	94.90	0.02	1.60	3.48
3	0.0176	88.99	0.24	3.13	7.64
4	0.0203	82.96	0.41	4.56	12.07
5	0.0227	77.33	0.46	5.81	16.41
6	0.0249	72.22	0.41	6.89	20.48
7	0.0269	67.69	0.35	7.86	24.10
8	0.0286	63.73	0.39	8.74	27.14
9	0.0302	60.29	0.61	9.57	29.53
10	0.0316	57.24	1.09	10.40	31.27
11	0.0329	54.50	1.89	11.24	32.37
12	0.0342	51.95	3.02	12.13	32.90
13	0.0353	49.53	4.47	13.07	32.94
14	0.0365	47.17	6.18	14.09	32.56
15	0.0376	44.85	8.09	15.18	31.88
16	0.0388	42.55	10.13	16.36	30.96

Variance Decomposition of SRI_M1:

Period	S.E.	SRI_GDP	SRI_CPI	SRI_M1	SRI_MMR
1	0.0238	1.96	0.03	98.01	0.00
2	0.0359	2.31	1.65	87.54	8.50
3	0.0471	1.73	1.73	78.56	17.99
4	0.0569	1.23	1.84	71.83	25.11
5	0.0652	0.95	2.35	66.78	29.93
6	0.0723	0.87	3.45	62.85	32.83
7	0.0786	0.96	5.24	59.70	34.10
8	0.0842	1.18	7.73	57.07	34.02
9	0.0893	1.48	10.85	54.77	32.90
10	0.0942	1.82	14.41	52.69	31.08
11	0.0991	2.18	18.16	50.78	28.88
12	0.1039	2.54	21.85	49.05	26.56
13	0.1088	2.86	25.27	47.53	24.34
14	0.1137	3.16	28.27	46.26	22.30
15	0.1186	3.44	30.80	45.27	20.49
16	0.1235	3.70	32.84	44.55	18.91

Variance Decomposition of SRI_CPI:

Period	S.E.	SRI_GDP	SRI_CPI	SRI_M1	SRI_MMR
1	0.0186	0.43	99.57	0.0000	0.00
2	0.0285	0.41	97.94	1.62	0.03
3	0.0360	0.46	95.40	3.83	0.32
4	0.0421	0.48	92.24	6.33	0.95
5	0.0474	0.49	88.72	9.21	1.59
6	0.0521	0.48	85.06	12.52	1.94
7	0.0564	0.45	81.36	16.24	1.95
8	0.0604	0.41	77.62	20.19	1.77
9	0.0641	0.37	73.87	24.18	1.57
10	0.0677	0.33	70.17	27.98	1.51
11	0.0713	0.32	66.61	31.40	1.67
12	0.0749	0.35	63.29	34.32	2.04
13	0.0785	0.43	60.30	36.70	2.57
14	0.0822	0.56	57.71	38.56	3.17
15	0.0858	0.76	55.56	39.94	3.73
16	0.0895	1.01	53.86	40.93	4.20

Variance Decomposition of SRI_MMR:

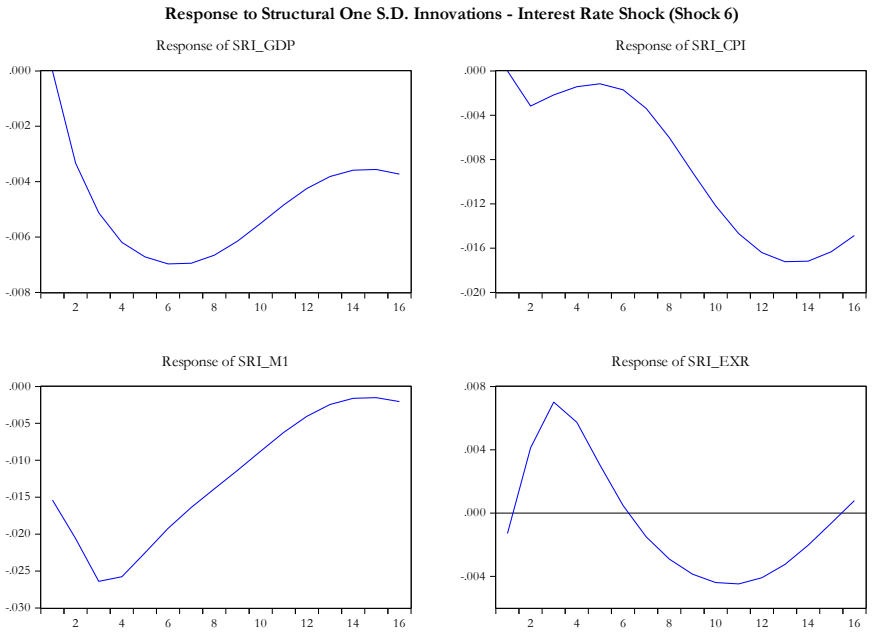
Period	S.E.	SRI_GDP	SRI_CPI	SRI_M1	SRI_MMR
1	1.541	0.76	1.36	4.40	93.48
2	2.307	0.35	5.77	3.39	90.49
3	2.710	0.38	7.06	2.50	90.06
4	2.907	0.61	6.74	2.35	90.30
5	3.003	0.89	6.32	2.82	89.97
6	3.055	1.16	6.53	3.68	88.63
7	3.096	1.35	7.52	4.69	86.45
8	3.144	1.45	9.02	5.57	83.96
9	3.202	1.47	10.64	6.18	81.72
10	3.266	1.44	12.02	6.47	80.07
11	3.328	1.39	13.01	6.51	79.10
12	3.382	1.34	13.58	6.41	78.67
13	3.423	1.32	13.82	6.27	78.59
14	3.451	1.32	13.85	6.17	78.65
15	3.468	1.34	13.80	6.14	78.72
16	3.477	1.37	13.73	6.19	78.71

four years (16 quarters). Overall, the results of the baseline VAR model (both IRFs and VD analyses) confirm that an unanticipated monetary policy shock given by an interest rate shock causes reductions in output and prices.

Next, the validity of the baseline VAR results is investigated using the SVAR model. This is estimated based on the 'A_B approach' of Amisano and Giannini (1997) and the detailed estimates are reported in Table A.1 in Appendix II. The Likelihood Ratio (LR) test is used to examine over-identification restrictions of the model. According to the results of LR test presented in the same table, the validity of over-identification restrictions cannot be rejected at the standard significance level. The contemporaneous coefficients presented in this table provide some information regarding the importance of particular variables

and the restrictions in the VAR system. However, they do not provide information about the dynamic relationships between the variables. Prior literature, for example, Leeper *et al*. (1996); Elbourne (2008); Li, İşcan and Xu (2010), among others, relies on dynamic responses to structural shocks in order to identify the effects and to gauge the effectiveness of monetary policy innovations. Accordingly, IRFs (structural innovations) obtained from SVAR estimates are used to identify monetary policy effects and the key responses are presented in Figure 4. It suggests that the SVAR model is a satisfactory description of MTM in Sri Lanka and provides an adequate explanation of the theoretical underpinnings. As per structural innovations, a monetary policy shock represented by a one-standard deviation innovation to money market rate (Shock 6 of the SVAR model) has the following effects.

Figure 4: Structural Innovations (Impulse Response Functions) of the SVAR Model



First, the target variable output (SRI_GDP) responds by the second quarter. The relatively immediate decline in output is consistent with prior research like Kim and Roubini (2000) for UK and Canada, Dungey and Pagan (2000); Berkelmans (2005) and Fraser, Macdonald and Mullineux (2012) for Australia, Li *et al*. (2010) for US and Canada, Sousa and Zaghini (2007) for G-5 countries, *etc*. Roughly after 6-7 quarters, the impact on output starts reversing and thus moves up towards the base. Second, after a monetary contraction, despite there remaining a marginal reversal during the first year, price levels (SRI_CPI) decline persistently to reach a maximum of about 1.5 per cent to a 1 per cent increase in interest rates by the 12th quarter. Again, this observation is consistent with prior literature [for example, Dungey and Pagan (2000) for Australia, Kim and Roubini (2000) for Italy, Elbourne (2008) for UK, Ito and Sato (2008) for Thailand and Philippines]. Importantly, structural innovations indicate that the price puzzle is weaker and the impact of monetary policy on prices is persistent although it starts dissipating in the long run.

Third, as in Leeper *et al*. (1996) for US and Kim and Roubini (2000) for UK, monetary aggregates (SRI_M1) respond to monetary policy shock showing some liquidity effect.[25/] Fourth, the exchange rate (SRI_EXR) indicates some initial increase, but the effect is relatively short-lived. This suggests that after an unexpected shock to interest rates, nominal exchange rates quickly depreciate for up to 2–3 quarters, indicating some evidence for an exchange rate puzzle though it starts appreciating from about the sixth quarter. These observations also correspond with similar research for small open economies. For example, Fraser *et al*. (2012) observe that in the presence of a monetary policy shock, exchange rate rises initially, but the effect is relatively short-lived. Kim and Roubini (2000) also show that initial increase in the exchange rate (depreciation) is justifiable in a VAR model for an open economy. In the context of Indonesia, Afandi (2005) argues that an increase in the domestic interest rate often follows exchange rate depreciation in an attempt to sterilise the expansionary effect of central bank intervention in the foreign exchange market. A similar scenario can also be observed in Sri Lanka as exchange rates tend to depreciate during periods of monetary tightening, which can be considered as a situation of reverse causality.

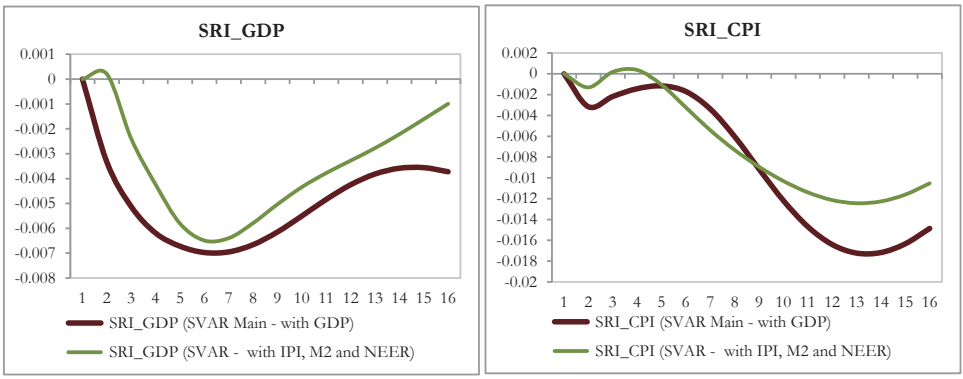
Overall, the results of the SVAR model for Sri Lanka show that both output and prices respond negatively to an unanticipated rise in interest rates (monetary contraction) and the price reaction appears strong and persistent. Hence, the results suggest that monetary policy is quiet effective to affect target variables of the central bank. To that end, any output puzzle (increase in output in response to a contractionary monetary shock) is not observed and there is substantial reduction in the price puzzle. Moreover, a liquidity

25/ When the effect is not persistent, it can be argued that central bank actions do not have direct and persistent effects on monetary aggregates (Duguay, 1994).

puzzle (increase in monetary aggregate in response to a contractionary monetary shock) cannot be observed, but an exchange rate puzzle (exchange rate depreciates in response to a contractionary monetary shock) exists.

These results are quiet robust for alternative SVAR models, which are not reported to preserve space. Amongst them, for example, the results of an alternative SVAR model that includes variables such as industrial production index (IPI), a broad money aggregate (M2), nominal effective exchange rates (NEER) are broadly compatible with the above discussed (7-variable) SVAR model. This consistency can be observed through the structural innovations presented in Figure 5. To that end, it is evident that monetary transmission in Sri Lanka is well explained by the standard 7-varibale SVAR model suggested by Kim and Roubini (2000) in the context of advanced countries.

Figure 5: Comparison of 7-Variable SVAR and Alternative SVAR Models

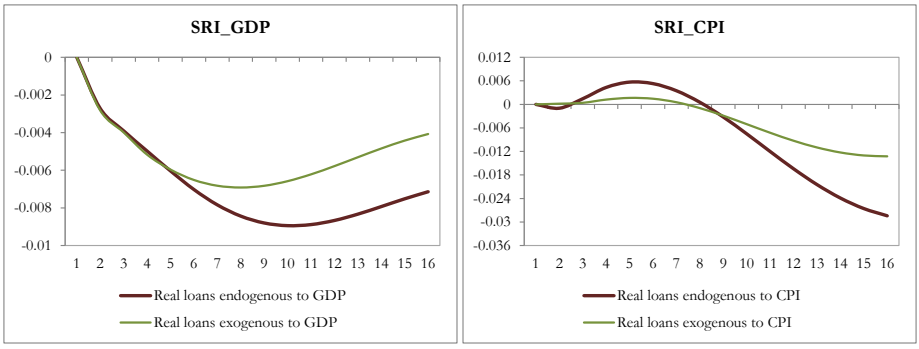


Meanwhile, forecast error variance decompositions (VD) for each variable up to four years is calculated to identify the fluctuations in the target variables. As per VD values presented in Table A.2 in Appendix II, first, except for the own shock, in the short run (around the second quarter), the highest source of variance in output (SRI_GDP) comes from the global commodity prices (Shock 1). In the period commencing from about 4th–5th quarter, the observable variation in the GDP is explained by money shock (Shock 5). However, as observed by Dale and Haldane (1995) and Elbourne (2008) for the UK, the impact of money is not substantially high as it only accounts for about 13 per cent of total GDP variation. In the long run, exchange rate shocks (Shock 7) dominate the variation in GDP. Second, similar to the observations of Ito and Sato (2008), in the short run, commodity price shocks (Shock 1) appear to be the main source of fluctuations in prices apart from its own shock. After about four quarters, innovations in both money and exchange rates (Shock 5 and 7, respectively) dominate price variations. In particular,

consistent with some similar studies, for example, Morsink and Bayoumi (2001) for Japan, money shock (Shock 5) continues to dominate even in the 16th quarter confirming that money is the main source of long run price dynamics. Moreover, similar to Ito and Sato (2008) for Indonesia, Korea, Thailand, and the Philippines, it is observed that exchange rate shock (Shock 7) is an important determinant in the fluctuations of prices. Although, interest rate shocks (Shock 6) remain modest and the maximum impact seems to be about 12 per cent of the total price variation by about 9th quarter, its impact remains broadly persistent over the time horizon. Again, the evidence is consistent with the results of Ito and Sato (2008).

Next, in order to gauge the relative importance of different channels in transmitting monetary policy shocks in Sri Lanka, the baseline VAR model is appended using relevant variables that capture particular channels. First, to identify the bank lending channel, the baseline VAR model is appended using log of real bank credit ($RLOAN_t$). As such, the appended VAR model comprises of GDP_t, CPI_t, $M1_t$, $RLOAN_t$ and MMR_t. Based on the shut-down method, Figure 6 presents IRFs for the relative importance of the bank lending channel. In the calculation of IRFs, bank loans are exogenised (blocked-off).

Figure 6: Comparison of VAR Models with Bank Lending Endogenous and Exogenous

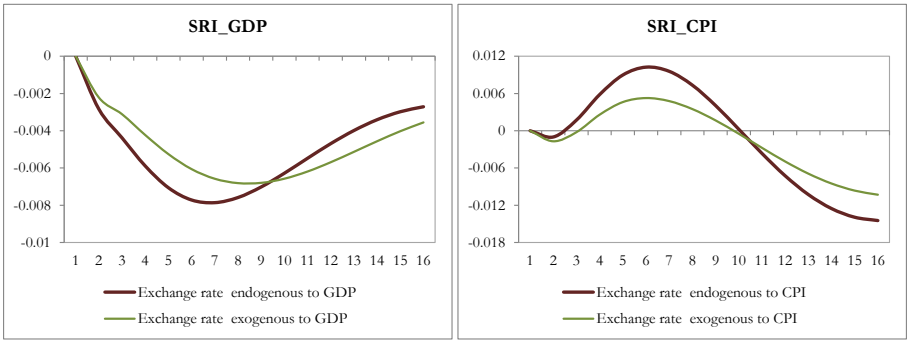


The output response (SRI_GDP) to an interest rate shock with and without real bank loans exogenised is broadly similar during the first five quarters. However, during the latter part of the time horizon, a notable difference is observed. In particular, it is evident that output response is clearly dampened when the role of bank loans is blocked-off. Similarly, the impact of interest rate shock is much pronounced for prices (SRI_CPI) when the bank loans are endogenous in comparison to the shock when bank loans are blocked-off. To that end, it appears that monetary policy in Sri Lanka is also transmitted via bank

credit. Existence of a significant bank lending channel in the Sri Lankan context seems to be justifiable due to heavy reliance on bank credit as a main source of funding in Sri Lanka. This is a common feature for many emerging market economies (Cole, Moshirian, and Wu, 2008).

Second, the importance of the exchange rate channel is assessed by augmenting the baseline VAR model with the log of nominal exchange rate (EXR_t) and hence the relevant VAR model comprises GDP_t, CPI_t, $M1_t$, MMR_t and EXR_t.[26/] Figure 7 depicts the reaction of output and prices to innovations in interest rates with and without the nominal exchange rate exogenised. With the exchange rate channel blocked-off, output (SRI_GDP) and price (SRI_CPI) responses appear somewhat dampened. For example, trough output is lower in the exogenous model than the case when the exchange rate is endogenous. This suggests that the endogenous presence of the nominal exchange rate magnifies the effect of a monetary policy shock.

Figure 7: Comparison of VAR Models with Exchange Rate Endogenous and Exogenous



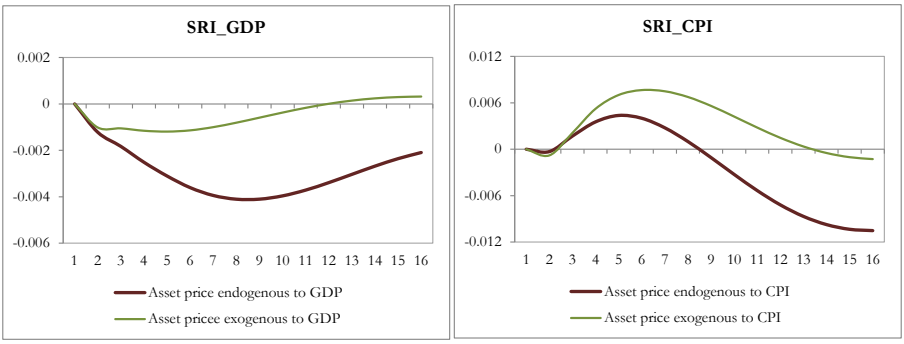
Disyatat and Vongsinsirikul (2003) suggest that evidence related to the exchange rate channel should be viewed with some caution. This is because modifications to the exchange rate system and regime changes could have implications on the non-linear movements in exchange rates. To examine this, the relevant VAR model is re-estimated excluding the impact of the fixed exchange rate regime (period prior to 2001 with the managed floating system) expecting that a move towards a more liberalised exchange rate regime will enhance the effects of monetary policy as monetary policy is subordinate to maintenance

26/ Inclusion of nominal exchange rate in the VAR system is consistent with prior studies, for example, Dale and Haldane (1995); Arin and Jolly (2005); Elbourne and de Haan (2006).

of the exchange rate in a fixed regime.[27/] Also, it can be expected that a move from a fixed to a floating exchange rate regime would enhance the importance of the exchange rate channel for the reason that nominal exchange rates are not allowed to fluctuate in the former case. However, as per unreported results, blocking-off the exchange rate channel does not greatly dampen the impact of monetary policy. To that end, it can be concluded that exclusion of the data for the managed exchange rate period does not increase the significance of the exchange rates in propagating monetary shocks. This may be suggesting the impact of the exchange rate management policy of the CBSL.

Third, the propagation of monetary policy shocks *via* asset prices is examined. Accordingly, the baseline VAR model is appended to include the log of stock market index (SMI_t). The significance of the asset prices in transmitting monetary policy shocks can be clearly examined by exogenising asset prices on the calculation of IRFs as in Figure 8.

Figure 8: Comparison of VAR Models with Asset Prices Endogenous and Exogenous



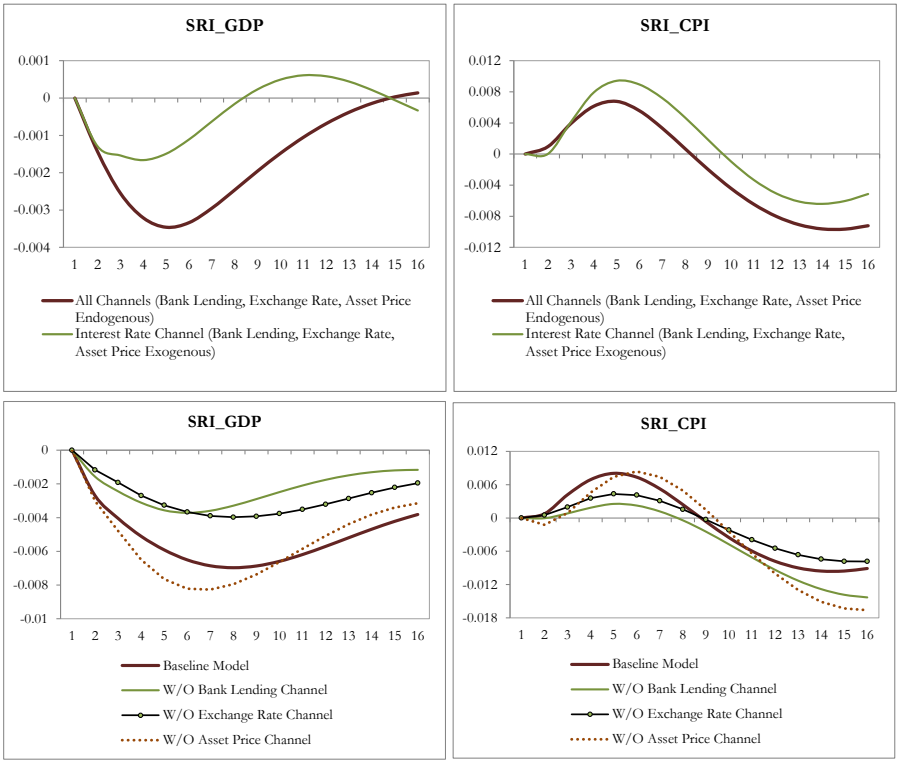
It is observed that exogenising of asset prices significantly dampens the response of output (SRI_GDP) and prices (SRI_CPI) indicating an existence of an asset price channel. In particular, although a significant deviation is not observed between endogenised and exogenised responses for the first 2–3 quarters, a notable difference is observed from about the fourth quarter. It is a common feature that the asset price channel is gradually gaining much importance in emerging market economies in propagating monetary policy shocks (Disyatat and Vongsinsirikul, 2003). An existence of an asset price channel in

27/ For an open economy operating with a fixed exchange rate regime, there is little scope for independent conduct of monetary policy and to have an effective monetary transmission. This is known as 'impossible trinity', which suggests that no country can enjoy (*i*) a fixed exchange rate, (*ii*) open capital account, and (*iii*) an independent monetary policy.

Sri Lanka could be due to increased penetration and developments in the stock market activity in recent decades.

Finally, a summary VAR model is estimated to isolate and identify the workings of the traditional direct interest rate channel in the presence of other channels. Accordingly, the baseline unrestricted VAR model is estimated including variables for bank lending, exchange rates and asset prices and hence the relevant model comprises of GDP_t, CPI_t, $M1_t$, $RLOAN_t$, SMI_t, MMR_t and EXR_t (in the given order) as well as an exchange rate dummy (EXR_DUM) to control for structural changes that occurred due to exchange rate liberalisation. Relevant model is estimated by including bank loans, the nominal exchange rate and the stock market index and then, output and price responses are compared with and without these variables exogenised. Based on these model estimates, Figure 9 presents IRFs for the direct interest rate channel.

Figure 9: Comparison of Direct Interest Rates and Other Channels



First two graphs presented in Figure 9 suggests that the interest rate channel accounts for about one third of the responses of output (SRI_GDP) and prices (SRI_CPI), particularly after about four quarters. In other words, the other three channels (bank lending, exchange rates and asset prices) together explain the remainder. The other two graphs in the lower panel ascertain the relative importance of each transmission channel. The left-hand side graph suggests that output (SRI_GDP) response is significantly dampened when bank lending and exchange rate channels are blocked-off indicating the existence of those two channels. Although the asset price channel is not much significant for some time, after the tenth quarter, it shows some importance indicating that asset prices have effects in the long run. A similar scenario is observed for responses in prices (SRI_CPI) in the right-hand side graph. In particular, in the long run (after about 9–10 quarters), the impact of exchange rates appears to be playing a significant role in explaining price dynamics.

Overall, the results broadly support the existence of four core conduits in transmitting monetary policy shocks in the Sri Lankan economy despite their relative strength being different. Hence it can be argued that an unanticipated increase in short-term interest rate (a restrictive monetary shock) causes reductions in real GDP and consumer price levels via interest rates, credit, exchange rates and asset prices. Nevertheless, it is important to investigate each channel more closely and extensively in order to completely understand the mechanism of propagation of monetary policy shocks in Sri Lanka. In particular, as seen in recent research into the Sri Lankan context, for example, Perera, Ralston and Wickramanayake (2014), sub-channels of broad credit channel need to examined extensively.

6. Summary and Conclusions

This study finds that interest rate pass-through in Sri Lanka is not complete. Despite the fact that short term lending rates, particularly prime lending rates show some speedy and complete adjustment, a majority of interest rates report sluggish and incomplete adjustments. This calls for the need for implementing policies to further develop the financial and banking sector in Sri Lanka while promoting competition among financial intermediaries. Also, it is observed that prime lending rates and 3-months fixed deposit rate of commercial banks have a strong association with money market interest rates. It may therefore be argued that using short-term rates would be much appropriate when assessing the effectiveness of monetary policy. Nevertheless, as the 3-months fixed deposit rate is based on the stock of deposits, it is important to compile the same based on new deposits to reflect the current interest rate environment.

In the second part of the empirical analysis, it is observed that an unanticipated increase in short-term interest rate (a restrictive monetary policy shock) causes reductions in real GDP and consumer price levels. In particular, both recursive and non-recursive VAR models provide robust and consistent results in relation to the impact of (restrictive) monetary policy shocks on (declining) output and prices. Also, it is noted that an unanticipated increase in the short-term interest rate (a restrictive monetary policy shock) causes reductions in real GDP and consumer price levels via interest rates, credit, exchange rates and asset prices. The results show that the interest rate channel remains the most important transmission channel in Sri Lanka though the other channels also help to propagate monetary policy shocks. From the CBSL's perspective, these results provide implications, which are consistent with the Bank's move towards a monetary policy framework focusing on indirect instruments of monetary policy. Moreover, as the reaction of target variables has been substantially enhanced, i.e. prices are more responsive to interest rate shocks, it provides a strong justification for moving towards an inflation targeting framework, which is considered as an appropriate monetary policy framework for emerging market economies.[28/] It needs to be further validated by specific research into inflation targeting in Sri Lanka [for example, see Perera (2008)]. Hence, the need for conducting more research into monetary policy transmission in Sri Lanka is much pronounced.

28/ Mishkin (2000) argues that although inflation targeting is not a panacea, it can be highly useful for monetary policy in a number of emerging market economies.

Appendix I

The structural representation of the VAR model of order p takes the following general form:

$$A_0\, y_t \;=\; c_0 \;+\; \sum_{i=1}^{p} A_i\, y_{t-i} \;+\; \varepsilon_t \qquad \text{(A.1)}$$

where, y_t is a 7 x 1 vector of endogenous variables, *i.e.*, y_t = *(*$COMP_t$, $FEDR_t$, GDP_t, CPI_t, $M1_t$, MMR_t, EXR_t*)*, A_0 represents the 7 x 7contemporaneous matrix, A_i are 7 x 7 autoregressive coefficient matrices, ε_t is a 7 x 1 vector of structural disturbances, assumed to have zero covariance. The covariance matrix of the structural disturbances takes the following form $E\,[\varepsilon_t\, \varepsilon_t] = D \equiv [\sigma_1^2\ \sigma_2^2\ \sigma_3^2\ \sigma_4^2\ \sigma_5^2\ \sigma_6^2\ \sigma_7^2]$ x I. In order to get the reduced form of the structural model [Eq. (10)], both sides are multiplied with A_0^{-1} providing the following:

$$y_t \;=\; a_0 \;+\; \sum_{i=1}^{p} B_i\, y_{t-i} \;+\; e_t \qquad \text{(A.2)}$$

where, $a_0 = A_0^{-1}\, c_0$, $B_i = A_0^{-1}\, A_i$ and $e_t = A_0^{-1}\, \varepsilon_t$, *i.e.*, $\varepsilon_t = A_0\, e_t$. The reduced form errors e_t are linear combinations of the structural errors ε_t, with a covariance matrix of the form $E\,[e_t\, e_t] = A_0^{-1}\, D A_0^{-1'}$. The structural disturbances can be derived by imposing appropriate restrictions on A_0.[29/] Accordingly, the short-run restrictions applied in this model are the following:

$$\begin{bmatrix} \varepsilon_{comps} \\ \varepsilon_{fedrs} \\ \varepsilon_{gdps} \\ \varepsilon_{cpis} \\ \varepsilon_{m1s} \\ \varepsilon_{mmrs} \\ \varepsilon_{exrs} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 & 0 & 0 & 0 \\ a_{31} & 0 & 1 & 0 & 0 & 0 & 0 \\ a_{41} & 0 & a_{43} & 1 & 0 & 0 & 0 \\ 0 & 0 & a_{53} & a_{54} & 1 & a_{56} & 0 \\ a_{61} & 0 & 0 & 0 & a_{65} & 1 & a_{67} \\ a_{71} & a_{72} & a_{73} & a_{74} & a_{75} & a_{76} & 1 \end{bmatrix} \text{ x } \begin{bmatrix} e_{comp} \\ e_{fedr} \\ e_{gdp} \\ e_{cpi} \\ e_{m1} \\ e_{mmr} \\ e_{exr} \end{bmatrix} \qquad \text{(A.3)}$$

29/ Method suggested by Amisano and Giannini (1997), *i.e.,* the A-B model is employed to identify the SVAR. Innovations can be represented as $Au_t = Be_t$, where u_t represents the structural error and e_t is the reduced form shocks. This strategy imposes enough restrictions on both matrices.

where, *comps* is world commodity price shocks, *fedrs* is Federal funds rate shock, *gdps* is real output (income) shock, *cpis* is price shock, *m1s* is money supply shock, *mmrs* is interest rate (monetary policy shock) and *exrs* is exchange rate shock and all are structural disturbances. e_{comp} to e_{exr} are the residuals in the reduced form equations, which represent the unexpected movements (given information in the system) of each variable. The analysis concentrates on the interaction between monetary policy and output and price developments, identified based on the structural shocks that consist several blocks.

The first two rows in matrix given by Eq. (A.3) is the exogenous block, which represents the shocks originating in the external world, and is given by world commodity prices ($COMP_t$) and the Federal funds rate ($FEDR_t$). The global commodity price of the IMF ($COMP_t$) is used instead of oil prices to isolate negative external supply shocks and it is ordered first because commodity prices are unlikely to be affected contemporaneously by any other shocks except the commodity price (supply) shocks *per se*, while commodity price shocks are likely to affect all variables in the system contemporaneously. Since the monetary authority follows a feedback rule by reacting to information in the economy when setting its monetary policy, the model is also controlled for the systematic component of the policy rule in order to identify the exogenous monetary policy changes (Kim and Roubini, 2000). Accordingly, the Federal funds rate ($FEDR_t$) is used to isolate the exogenous monetary policy changes, *i.e.,* to control for the component of domestic monetary policy that is a reaction to foreign monetary policy shocks. The identifying restriction in the equations for commodity prices and for Federal funds rates [Rows 1 and 2 in Eq. (A.3)] considers these variables as being contemporaneously exogenous to any variable in the domestic economy.

Real output (GDP_t) and prices (CPI_t) in Row 3 and 4, respectively represent goods market equilibrium. A large number of zero restrictions in these rows is consistent with a model exhibiting nominal rigidities (Elbourne and de Haan, 2006). Hence, money, interest rates or exchange rates do not affect real activity and prices contemporaneously.[30/] However, commodity prices do enter this block, based on a cost mark-up rule for prices (Elbourne and de Haan, 2006). Furthermore, price levels respond contemporaneously to real activity as the equation for prices include, the impact of GDP on CPI. Hence, inflation reacts contemporaneously only to an income shock and a global shock (Kim and Roubini, 2000).

Money supply ($M1_t$) and the money market rate (MMR_t) in Row 5 and 6, respectively, represent money market equilibrium. The money demand equation in Row 5 indicates that demand for real money balances is dependent on real income, prices and the interest rate. This indicates that money is responsive to income, price and monetary policy

30/ Kim and Roubini (2000) assume that real activity responds to prices and financial signals only with a lag.

shocks (Chatziantoniou, Duffy, and Filis, 2013). The money market rate, *i.e.,* equation in Row 6 represents the reaction function of the monetary authority that depends on global commodity prices, monetary aggregates and nominal exchange rates (Kim and Roubini, 2000). Following Sims and Zha (1998), it is assumed that monetary policy does not respond contemporaneously to output or prices since relevant data are not available contemporaneously. Also, the reaction function of the monetary authority does not depend on current values of the Federal funds rate. One justification for this assumption is that, contemporaneously, monetary authorities care more about unexpected changes in the exchange rate (for example, against the US dollar) rather than unexpected changes in (for example, the US) interest rates per se or contemporaneously, (the US) interest rate does not have additional information for other (non-US) monetary authorities after they consider their exchange rate against foreign currency (Kim and Roubini, 2000). By including the commodity price and the exchange rate in the reaction function, it is controlled for current systematic responses of monetary policy to the state of the economy.[31/]

Finally, Row 7 is based on an arbitrage equation describing the exchange rate market and it considers the effects of identified monetary shocks on the value of domestic currency. This equation allows the exchange rate to respond contemporaneously to all variables considering the assumption that exchange rate is a financial variable, *i.e.*, a forward looking asset price, which reacts immediately to information and hence has contemporaneous effects generated by all variables (Kim and Roubini, 2000; Elbourne and de Haan, 2006).

31/ The assumptions of Kim and Roubini (2000) for exchange rates are still valid for an emerging market economy like Sri Lanka. On the one hand, similar to many other countries, Sri Lanka has been implicitly and explicitly concerned about the effects of a depreciation of domestic currency on the developments in inflation. On the other hand, by controlling for components of interest rate movements that are systematic responses to a depreciation of the domestic currency, it is possible to identify interest rate innovations that are exogenous contractions in monetary policy and that should lead to a currency appreciation.

Appendix II

Table A.1: Estimates of 7-Variable Structural VAR Model

This table presents the estimates for 7-variable SVAR model for quarterly data for the period March 1996–December 2012). Short-run restrictions are given in matrix A. C(1) to C(12) are estimated coefficients. LR statistic is used to test for over-identification.

Model: Ae = Bu where E[uu']=I

Restriction Type: short-run pattern matrix

A =

1	0	0	0	0	0	0
C(1)	1	0	0	0	0	0
C(2)	0	1	0	0	0	0
C(3)	0	C(7)	1	0	0	0
0	0	C(8)	C(10)	1	C(14)	0
C(4)	0	0	0	C(12)	1	C(16)
C(5)	C(6)	C(9)	C(11)	C(13)	C(15)	1

B =

C(17)	0	0	0	0	0	0
0	C(18)	0	0	0	0	0
0	0	C(19)	0	0	0	0
0	0	0	C(20)	0	0	0
0	0	0	0	C(21)	0	0
0	0	0	0	0	C(22)	0
0	0	0	0	0	0	C(23)

(Contd.)

	Coefficient	**Std. Error**	**z-Statistic**	**Prob.**
C(1)	-0.865189	0.421009	-2.055037	0.0399
C(2)	-0.038896	0.017777	-2.187993	0.0287
C(3)	-0.102516	0.026439	-3.877503	0.0001
C(4)	0.178616	4.364433	0.040925	0.9674
C(5)	0.093286	0.042359	2.202275	0.0276
C(6)	-0.004591	0.010005	-0.458852	0.6463
C(7)	0.032250	0.178029	0.181152	0.8562
C(8)	0.010603	0.456265	0.023239	0.9815
C(9)	0.518216	0.248207	2.087836	0.0368
C(10)	0.012305	0.199297	0.061742	0.9508
C(11)	-0.303184	0.170573	-1.777449	0.0755
C(12)	-46.629860	129.3019	-0.360628	0.7184
C(13)	-0.074215	0.379333	-0.195646	0.8449
C(14)	0.012854	0.021184	0.606795	0.5440
C(15)	0.000129	0.005575	0.023103	0.9816
C(16)	-40.409900	54.72498	-0.738418	0.4603
C(17)	0.071399	0.006262	11.40175	0.0000
C(18)	0.242349	0.021255	11.40175	0.0000
C(19)	0.010233	0.000898	11.40175	0.0000
C(20)	0.014688	0.001288	11.40175	0.0000
C(21)	0.024948	0.016112	1.548445	0.1215
C(22)	1.968424	2.053040	0.958785	0.3377
C(23)	0.019505	0.003312	5.889142	0.0000

Log likelihood	674.35		
LR test for over-identification:			
Chi-square(5)	8.673	Probability	0.1395

Estimated A matrix:

1.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
-0.865189	1.000000	0.000000	0.000000	0.000000	0.000000	0.000000
-0.038896	0.000000	1.000000	0.000000	0.000000	0.000000	0.000000
-0.102516	0.000000	0.032250	1.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.010603	0.012305	1.000000	0.012854	0.000000
0.178616	0.000000	0.000000	0.000000	-46.62986	1.000000	-40.4099
0.093286	-0.004591	0.518216	-0.303184	-0.074215	0.000129	1.000000

Estimated B matrix:

0.071399	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.242349	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.010233	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.014688	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.024948	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	1.968424	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.019505

Table A.2: Variance Decomposition for 7-Variable Structural VAR Model

This table presents forecast error variance decomposition of commodity price index (COMP); Federal funds rate (FEDR); output (SRI_GDP); prices (SRI_CPI); narrow money (SRI_M1); short-term interest rate (SRI_MMR); and nominal exchange rate (SRI_EXR) for the 7-variable SVAR model. These shocks are represented as Shock 1 to Shock 7 as given in the table. Period is given by number of quarters.

Variance Decomposition of COMP:

Period	S.E.	Shock1	Shock2	Shock3	Shock4	Shock5	Shock6	Shock7
1	0.0665	100.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.1030	83.78	0.01	0.82	7.11	4.79	0.03	3.46
3	0.1289	62.24	1.85	2.89	9.95	11.69	0.68	10.70
4	0.1421	51.48	7.18	2.60	9.84	15.37	2.40	11.13
5	0.1528	44.88	12.15	2.69	8.67	14.87	6.95	9.79
6	0.1627	40.38	13.61	2.89	7.68	13.53	12.34	9.58
7	0.1691	37.98	13.66	2.75	7.27	13.39	15.83	9.11
8	0.1737	36.31	13.47	2.62	7.39	15.17	16.41	8.64
9	0.1782	34.63	13.17	2.52	7.65	18.13	15.69	8.22
10	0.1821	33.22	12.87	2.46	7.76	20.76	15.05	7.88
11	0.1849	32.36	12.60	2.49	7.77	22.43	14.70	7.65
12	0.1864	31.91	12.40	2.59	7.79	23.31	14.48	7.53
13	0.1873	31.63	12.33	2.67	7.86	23.72	14.33	7.47
14	0.1881	31.38	12.46	2.68	7.99	23.84	14.22	7.44
15	0.1887	31.17	12.70	2.66	8.13	23.78	14.13	7.42
16	0.1892	31.03	12.98	2.66	8.22	23.67	14.06	7.39

Variance Decomposition of SRI_GDP:

Period	S.E.	Shock1	Shock2	Shock3	Shock4	Shock5	Shock6	Shock7
1	0.0106	8.28	0.00	91.72	0.00	0.00	0.00	0.00
2	0.0133	15.68	0.87	75.02	1.18	0.48	0.59	6.18
3	0.0159	15.86	2.25	54.05	3.05	4.50	1.26	19.04
4	0.0192	12.07	3.40	41.01	6.24	8.56	0.87	27.85
5	0.0219	9.86	4.11	32.65	8.88	9.87	1.06	33.58
6	0.0243	8.52	4.22	26.43	11.29	10.69	1.39	37.46
7	0.0270	7.40	3.88	21.66	14.12	11.86	1.73	39.35
8	0.0295	6.58	3.50	18.27	16.81	12.69	1.89	40.25
9	0.0316	6.13	3.25	15.99	19.01	12.97	1.88	40.77
10	0.0331	5.90	3.10	14.56	20.83	12.93	1.85	40.84
11	0.0342	5.81	3.01	13.71	22.33	12.70	1.86	40.58
12	0.0349	5.82	2.96	13.22	23.50	12.37	1.92	40.22
13	0.0354	5.90	2.94	12.95	24.37	12.06	1.98	39.81
14	0.0358	6.02	2.94	12.84	24.96	11.82	2.03	39.39
15	0.0361	6.14	2.96	12.85	25.28	11.73	2.05	38.98
16	0.0363	6.23	3.03	12.92	25.36	11.83	2.06	38.58

Variance Decomposition of FEDR:

Period	S.E.	Shock1	Shock2	Shock3	Shock4	Shock5	Shock6	Shock7
1	0.2568	6.50	93.50	0.00	0.00	0.00	0.00	0.00
2	0.4965	3.20	79.10	0.77	1.77	11.19	2.38	1.60
3	0.7376	1.53	66.44	2.53	2.21	23.46	1.65	2.18
4	0.9362	0.98	59.59	4.20	1.95	30.47	1.33	1.48
5	1.1137	0.77	53.59	5.61	2.16	35.79	0.94	1.14
6	1.2822	0.61	46.74	7.20	2.93	40.34	0.86	1.32
7	1.4467	0.48	39.97	8.28	4.24	43.91	0.92	2.20
8	1.6021	0.39	34.31	8.72	5.80	46.14	0.96	3.68
9	1.7353	0.34	30.20	9.12	7.22	47.08	1.00	5.06
10	1.8341	0.32	27.52	9.74	8.33	47.07	1.07	5.96
11	1.8975	0.32	25.90	10.44	9.16	46.50	1.19	6.48
12	1.9334	0.35	24.98	11.08	9.75	45.74	1.35	6.74
13	1.9514	0.37	24.53	11.59	10.13	45.09	1.48	6.81
14	1.9596	0.38	24.34	11.93	10.29	44.71	1.56	6.78
15	1.9656	0.39	24.23	12.09	10.28	44.67	1.58	6.75
16	1.9753	0.40	24.04	12.07	10.18	44.89	1.57	6.85

Variance Decomposition of SRI_CPI:

Period	S.E.	Shock1	Shock2	Shock3	Shock4	Shock5	Shock6	Shock7
1	0.0151	16.75	0.00	0.00	83.12	0.00	0.13	0.00
2	0.0211	23.94	5.77	0.08	69.72	0.07	0.42	0.00
3	0.0248	25.09	4.84	2.45	61.72	0.08	5.67	0.14
4	0.0272	25.61	4.40	3.36	54.70	0.60	10.22	1.12
5	0.0299	23.80	4.97	2.95	45.58	3.00	9.89	9.82
6	0.0330	20.69	5.55	2.56	37.40	5.24	9.58	18.98
7	0.0357	18.18	6.24	2.70	32.07	5.51	10.64	24.65
8	0.0380	16.41	7.41	2.79	28.49	4.88	11.38	28.64
9	0.0401	14.91	8.91	2.63	25.63	5.34	11.53	31.03
10	0.0422	13.46	10.39	2.40	23.08	7.84	11.35	31.48
11	0.0445	12.12	11.43	2.19	20.79	12.25	10.72	30.49
12	0.0468	11.00	11.77	2.01	18.83	17.90	9.84	28.65
13	0.0492	10.05	11.39	1.89	17.28	24.03	8.97	26.39
14	0.0515	9.21	10.59	1.80	16.22	29.91	8.18	24.08
15	0.0538	8.48	9.72	1.70	15.66	34.88	7.50	22.06
16	0.0559	7.89	9.04	1.61	15.52	38.47	6.96	20.52

Variance Decomposition of SRI_M1:

Period	S.E.	Shock1	Shock2	Shock3	Shock4	Shock5	Shock6	Shock7
1	0.0231	0.04	0.00	0.32	0.30	64.04	35.30	0.01
2	0.0346	1.87	1.51	0.71	6.07	73.43	15.90	0.52
3	0.0460	1.93	3.47	0.73	9.77	73.45	9.08	1.58
4	0.0543	1.44	4.73	0.56	10.28	75.02	6.55	1.42
5	0.0596	1.76	5.33	0.72	10.12	75.35	5.53	1.18
6	0.0625	2.15	5.05	1.02	10.19	75.04	5.43	1.12
7	0.0646	2.21	4.78	1.14	10.71	74.46	5.65	1.06
8	0.0663	2.11	5.00	1.09	11.60	73.62	5.57	1.02
9	0.0677	2.03	5.53	1.09	12.47	72.55	5.35	0.99
10	0.0686	1.99	6.19	1.19	12.94	71.46	5.25	0.99
11	0.0692	1.96	6.89	1.37	12.95	70.27	5.21	1.34
12	0.0701	1.91	7.61	1.68	12.63	68.72	5.10	2.35
13	0.0716	1.83	8.26	2.16	12.15	66.71	4.89	3.99
14	0.0736	1.74	8.76	2.86	11.67	64.36	4.63	5.98
15	0.0759	1.64	9.03	3.77	11.29	61.83	4.38	8.06
16	0.0782	1.55	9.06	4.80	11.06	59.23	4.18	10.13

Variance Decomposition of SRI_EXR:

Period	S.E.	Shock1	Shock2	Shock3	Shock4	Shock5	Shock6	Shock7
1	0.0214	10.08	0.61	4.36	0.92	8.11	0.79	75.13
2	0.0364	7.42	0.72	2.22	6.49	18.48	0.63	64.04
3	0.0473	7.69	1.21	1.50	10.08	23.24	0.37	55.90
4	0.0559	6.67	1.66	1.48	12.11	24.10	0.30	53.69
5	0.0629	5.51	2.15	1.41	13.77	23.10	0.69	53.36
6	0.0679	4.83	2.49	1.80	15.27	21.81	1.42	52.38
7	0.0717	4.51	2.64	2.33	16.71	20.49	2.12	51.20
8	0.0748	4.40	2.74	2.49	18.12	19.31	2.51	50.43
9	0.0771	4.41	2.94	2.54	19.29	18.39	2.63	49.80
10	0.0787	4.49	3.36	2.65	20.06	17.72	2.62	49.10
11	0.0798	4.57	4.01	2.78	20.45	17.24	2.61	48.34
12	0.0806	4.64	4.82	2.90	20.54	16.91	2.62	47.56
13	0.0813	4.69	5.76	3.03	20.46	16.63	2.66	46.78
14	0.0820	4.71	6.82	3.15	20.29	16.34	2.70	45.99
15	0.0828	4.71	8.01	3.27	20.06	16.06	2.72	45.16
16	0.0837	4.66	9.29	3.41	19.77	15.87	2.73	44.26

Variance Decomposition of SRI_MMR:

Period	S.E.	Shock1	Shock2	Shock3	Shock4	Shock5	Shock6	Shock7
1	1.4425	0.41	0.00	0.36	0.26	62.39	36.57	0.01
2	2.0010	0.22	0.45	0.19	0.57	65.25	30.67	2.65
3	2.1952	0.31	1.85	0.94	0.58	60.16	29.49	6.67
4	2.2989	0.55	4.74	1.80	0.53	55.54	26.90	9.95
5	2.4416	0.51	10.56	1.99	0.83	49.23	25.02	11.86
6	2.6139	0.51	16.61	1.73	1.60	43.17	22.70	13.67
7	2.7629	0.59	20.68	1.81	2.22	39.53	20.43	14.74
8	2.8741	0.60	22.79	2.14	2.24	39.18	18.89	14.17
9	3.0088	0.55	23.05	2.40	2.10	41.60	17.30	13.00
10	3.2108	0.48	21.70	2.65	2.48	45.18	15.23	12.27
11	3.4493	0.42	19.77	3.01	3.30	48.12	13.22	12.16
12	3.6699	0.38	18.02	3.49	4.22	49.72	11.72	12.44
13	3.8434	0.39	16.66	4.08	5.10	50.12	10.79	12.87
14	3.9668	0.42	15.67	4.67	5.91	49.74	10.30	13.30
15	4.0479	0.43	15.05	5.12	6.65	49.00	10.07	13.68
16	4.0957	0.43	14.79	5.40	7.25	48.23	9.95	13.95

Shock1: COMP shock
Shock2:FEDR shock
Shock3: GDP shock
Shock4: CPI shock
Shock5: M1 shock
Shock6: MMR shock
Shock7: EXR shock

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Determinants of External Demand for Textiles and Garments of Sri Lanka

Niluka Ekanayake[1/]

Abstract

This paper evaluates the determinants of export demand for textiles and garments of Sri Lanka, using quarterly data from 1999 to 2013. A long run relationship is found between export demand and explanatory variables. The empirical results reveal that the depreciation of the real exchange rate does not increase the demand for Sri Lanka's textiles and garments, as this industry is found to be heavily dependent on imported raw materials. World GDP which proxies the income of buyers is also a major determinant of export demand. It is also found that the GSP plus (Generalised System of Preferences-plus) and MFA (Multifiber Arrangement) had a positive and significant impact on the demand for textiles and garments of Sri Lanka as they provided duty free access to major textile and garment markets such as USA and EU particularly when the global financial crisis and debt crisis had a negative impact on world demand for textiles and garments. It is surprising to observe that trade openness which proxies the level of trade restrictions between Sri Lanka and the rest of the world shows a negative relationship with export demand for textiles and garments from Sri Lanka.

JEL Classification: C51, F14, F53

Key Words: *External Demand, Textiles & Garments, Co-integration, Export Volume, Error Correction Model, Vector Auto Regressions.*

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Correspondence: niluka_p@cbsl.lk.

1. Introduction

As one of the key drivers of Sri Lanka's economy, the export oriented textiles and garments industry has played a major role during the five decades of its existence. The history of ready-made garment exports can be traced back to the 1960s, where the first garment exports from Sri Lanka were to Russia. After 1977 under open economic policies, the export oriented ready-made garment industry grew at a rapid pace. Under the Multifibre Arrangement (MFA)[2/] quota regime which was active from 1974 till 1994 and the Agreement on Textiles and Clothing (ATC)[3/] which was active from 1995 till 2004 as a replacement for MFA, Sri Lanka became an attractive destination for the textiles and garments manufacturing. Owing to the investment incentives offered by the government, coupled with the low cost of production due to the availability of a highly skilled and trainable workforce at lower cost, a high level of foreign investments were attracted in to the export oriented garment industry. However, on January 1, 2005, the worldwide system of textile and apparel quotas was discontinued leading to a major shift in global trade and production trends. Industries in the textiles and clothing sector, which provide the backbone to many developing economies, were faced with many challenges afterwards as they had to operate in a quota free environment amidst intense competition and increasing cost of production. In 2005, the Generalized System of Preferences (GSP) plus system came into operation. The scheme had three core objectives, namely, poverty reduction, promoting sustainable development and promoting good governance. Fifteen countries including eleven Latin American countries, Moldova, Georgia, Mongolia and Sri Lanka benefited from the GSP plus scheme. Sri Lanka benefited much from the scheme as the GSP plus extended a greater proportion of concessions to readymade garments to enter into European Union (EU) market. This is evidenced as the readymade garment exports from Sri Lanka to EU increased from 36.2 per cent of total garment exports in 2005 to 48.8 per cent in 2008, while the share of Sri Lanka's readymade garment exports to USA decreased from 59.4 per cent in 2005 to 45.2 per cent in 2008 in the absence of the MFA. However, the removal of GSP plus in 2010 brought many challenges to Sri Lanka as the country had to compete with fourteen other GSP plus recipients who also obtained the duty free access to the EU market and other competitors such as India, who already had preferential and free trade agreements with the EU.

2/ An international trade agreement on textile and clothing that was active from 1974 till 1994. The agreement imposed quotas on the amount that developing countries could export in the form of yarn, fabric and clothing to developed countries. This provided for the application of selective quantitative restrictions when surges in imports of particular products caused, or threatened to cause, serious damage to the industry of the importing country.

3/ In 1995, the MFA was replaced by the WTO Agreement on Textiles and Clothing (ATC), which set out a 10-year transitional process for removal of the quotas set under MFA. For this study, the abbreviation MFA is used to mean both the MFA and the ATC.

As per available data, between 2005 and 2011, the value of global apparel exports rose by 48 per cent. In 2011, the value of global apparel exports were US dollars 412 billion. As per Aid for Trade and Value Chains in Textiles and Apparel (2013), the top ten developing countries' (Table 1) suppliers account for around 58 per cent of global apparel exports, with China taking 37 per cent of global apparel exports. Since 2000, China has topped the list of apparel exporters to the USA and EU. Sri Lanka has also joined the top fifteen apparel exporters to the USA since 1980 and EU since 2000 (Table 2 and Table 3).

Table 1 : Developing Country Suppliers and the Global Apparel Markets

Exporter	2005 USD Mn	2011 USD Mn	Percentage change (2005–2011)	% of total exports in 2011
China	74,162	153,773	107%	37.00%
Bangladesh	6,889	19,938	189%	4.80%
India	8,738	14,364	64%	3.50%
Turkey	11,833	13,947	18%	3.40%
Viet Nam	4,680	13,153	181%	3.20%
Indonesia	4,958	8,045	63%	1.90%
Mexico	7,305	4,637	-36%	1.10%
Malaysia	2,478	4,567	84%	1.10%
Pakistan	3,603	4,549	26%	1.10%
Cambodia	2,210	4,050	83%	1.00%
World Total	278,000	412,000	48%	

Source : WTO database

Table 2 : Top 15 Apparel Exporters to the United States

Rank	1970	1980	1990	2000	2008	2011
1	Japan	Hong Kong	Hong Kong	China	China	China
2	Hong Kong	Other Asia	China	Mexico	Vietnam	Vietnam
3	Other Asia	Korea	Korea	Hong Kong	Indonesia	Indonesia
4	Korea	China	Other Asia	Korea	Mexico	Bangladesh
5	Italy	Mexico	Philippines	Dominican Rep.	Bangladesh	Mexico
6	Philippines	Philippines	Italy	Honduras	India	India
7	Canada	Japan	Dominican Rep.	Indonesia	Honduras	Honduras
8	United Kingdom	Italy	Mexico	Other Asia	Cambodia	Cambodia
9	Mexico	India	India	Bangladesh	Thailand	Italy
10	Israel	Singapore	Indonesia	Thailand	Italy	Thailand
11	Germany	France	Singapore	India	Pakistan	Pakistan
12	France	Macao	Malaysia	Philippines	Hong Kong	El Salvador
13	Spain	Dominican Rep	Thailand	Canada	**Sri Lanka**	Malaysia
14	Austria	**Sri Lanka**	Bangladesh	Italy	El Salvador	**Sri Lanka**
15	Singapore	United Kingdom	**Sri Lanka**	El Salvador	Malaysia	Nicaragua

Source : Aid for Trade and Value Chains in Textiles and Apparel (2013)

Table 3 : Top 15 Apparel Exporters to the European Union

Rank	2000	2004	2008	2011
1	China	China	China	China
2	Turkey	Turkey	Turkey	Turkey
3	Hong Kong	Bangladesh	Bangladesh	Bangladesh
4	Tunisia	India	India	India
5	Bangladesh	Tunisia	Tunisia	Tunisia
6	India	Morocco	Morocco	Morocco
7	Morocco	Hong Kong	Vietnam	Vietnam
8	Indonesia	Indonesia	Indonesia	Pakistan
9	Thailand	Pakistan	**Sri Lanka**	**Sri Lanka**
10	Korea	Thailand	Pakistan	Indonesia
11	Pakistan	**Sri Lanka**	Thailand	Thailand
12	**Sri Lanka**	Vietnam	Hong Kong	Cambodia
13	Vietnam	Korea	Switzerland	Malaysia
14	Malaysia	Switzerland	Malaysia	Switzerland
15	Mauritius	Malaysia	Cambodia	Macedonia

Source : Aid for Trade and Value Chains in Textiles and Apparel (2013)

The garment industry in Sri Lanka has become an important driver of the economy in terms of its contribution to industrial production, foreign exchange earnings and direct and indirect employment generation. Being the country's largest industry, it accounts for nearly 25 per cent of industrial production and 40 per cent of export earnings while generating nearly 300,000 of direct employment opportunities and nearly 600,000 of indirect employment opportunities. The USA and the EU are the largest destinations for garment exports of Sri Lanka, with the USA accounting for around 42 per cent of exports while the share of EU is around 46 per cent. However, a gradual improvement is observed in textiles and garment exports to other countries such as Canada, Japan, South Korea and China over the period showcasing the efforts taken by the industry for market diversification. Over the years, Sri Lanka's textiles and garments industry performed well and Sri Lanka's strength in textile and garment manufacturing lies in its ability to produce high quality garments at competitive prices, combined with an industry structure which is flexible and uniquely capable of servicing the leading international brands. By utilising specialised ethical production processes acquired by the industry to cater to niche markets, the textile and garment industry targets an increase in exports to more than US dollars 5 billion by 2015.

The highly dynamic nature of the global apparel industry produces many challenges and opportunities such as frequently changing consumer preferences, the requirement of

intermediaries in the industry, intense competition and new technology that have to be faced by the firms. As garments are closely related to fashion industry it is necessary to be flexible as well as be able to meet the deadlines of the buyers. Consumers have become extremely price and quality sensitive as they are offered lot of choices by competitors. As explained by Fonseka and Fonseka (2004), when making the purchasing decision buyers seek value for money. This includes design, neatness, and excellence of workmanship for the price.

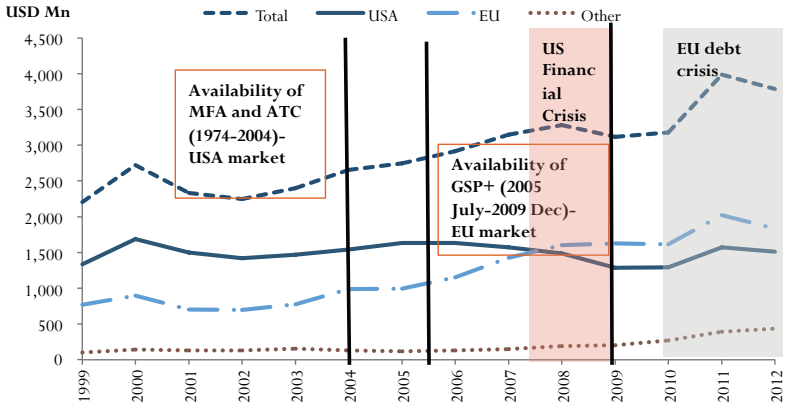
Accordingly, identifying the determinants of external demand for textiles and garments would be useful for pricing and other related decision making. This research intends to estimate the determinants of external demand for textiles and garments of Sri Lanka.

The paper is structured as follows. Section 2 presents the facts about the textiles and garments industry in Sri Lanka, Section 3 reviews the findings of previous empirical studies while Section 4 describes the theoretical framework and model, Section 5 discusses the methodology and empirical results and Section 6 discusses the findings followed by the conclusion and policy recommendations in Section 7.

2. Textiles and Garments Industry in Sri Lanka

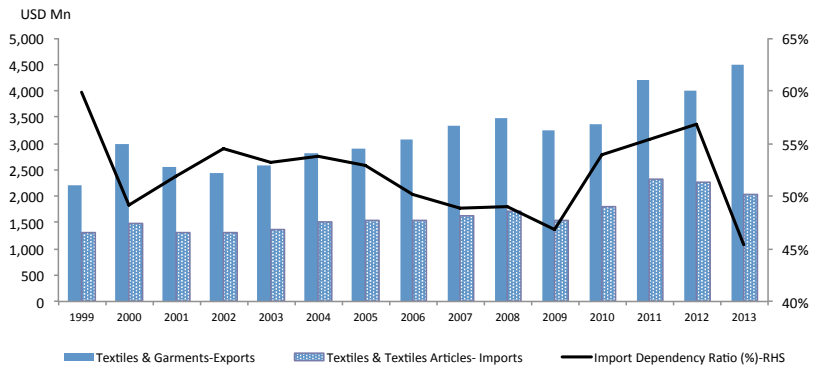
As individual countries, the USA and the UK have historically been the largest buyers of Sri Lankan apparel through the decades while the USA and the EU been the largest markets. Being the main foreign exchange earner, Sri Lanka's textiles and garments industry has faced many challenges and opportunities (Figure 1). However, it has emerged as a major driver of the economy.

Figure 1 : Textile and Garments Exports of Sri Lanka



Sources : Sri Lanka Customs, Central Bank of Sri Lanka

Figure 2 : Textiles and Garment Industry: Import Dependency Ratio (%)



Sources : Sri Lanka Customs, Author's own calculations

Initially, Sri Lanka's garment industry was engaged in the assembling of garments. However, it has now moved towards positioning itself as a 'fashion' industry. The continuous investment on research and development coupled with the acquisition of expert knowledge has helped the industry to move to high quality, fashionable products. Traditionally, the garment industry was found to be heavily dependent on imported raw materials (Figure 2). However, having recognised the importance of backward integration, the industry is taking continuous efforts to reduce the import dependency ratio, thereby increasing the value addition of the industry through local production of raw materials.

Generally, the buyers placing garment orders have the choice of selecting fabric and accessories from any part of the world to be brought to Sri Lanka for conversion into finished apparel. Further, there is an advantage in sourcing garments from Sri Lanka due to its location, which provides the shortest shipping times to Europe. At present, Sri Lanka is producing garments for reputed international brands. However, most of these items are handled via buying offices. The maintenance of safety and other international standards with regard to labour has helped the textile and garment industry in Sri Lanka to face the strong competition in international markets. Apart from these, the availability of a highly literate and skilled workforce has contributed for the rapid development in the garment industry.

However, Sri Lanka's garment industry faces many challenges. The high cost of production led by the high labour cost is a major challenge for Sri Lanka's garment industry. High utility charges and transportation costs also had adversely affected the competitiveness of the industry. These difficulties have coupled with delays and inefficiencies in documentation preparation, processing and inland transportation and handling.

Even though the industry has taken steps to improve backward integration, it is still at the initial levels. In order to be competitive in the fast growing and rapidly changing international fashion industry which has a very short life span, producers have to lower the lead time by lowering the procurement and production cycles. Hence backward integration would lower the procurement and production cycles by increasing domestic sourcing of fabrics and other accessories.

3. Review of Literature

The determinants of export demand, especially for small economies, have been extensively studied. Understanding these determinants is essential in policy decision making with regard to external trade. Even though, the literature is available at aggregate level examining the determinants of export demand, at the disaggregate level would give more insights into the formulation of policies. This paper contributes to the literature by adding empirical evidence of the determinants of export demand for Sri Lanka's key export, *i.e.*, textiles and garments.

Several studies have estimated import and export functions to ascertain the determinants of exports and imports elasticities. In most of the studies, when formulating the export demand function, factors such as real income of foreign trading partner/s, price of exports (or relative price), nominal (or real) exchange rate, exchange rate volatility, population and dummy variables to represent structural changes were considered.

Moreover, many recent studies which focused on the export and import demand functions suggested that income is the principal determinant of exports and imports. In the study carried out by Haideret *et al*. (2011) estimating the import and export demand functions revealed that income is the principal determinant of foreign trade while exchange rate also plays a major role in determining the demand for exports and imports.

Similarly, Siddiqi *et al*. (2012) examined the determinants of export demand of textiles and the clothing sector of Pakistan using annual data for the period 1971–2009 using the Johansen and Juselius methodology of maximum likelihood cointegration technique. As discussed in their paper, world income is the major determinant of export demand for textiles and the clothing sector of Pakistan. Trade openness which is used as a proxy of trade restrictions is the second major determinant of export demand. Other variables such as the price of textiles in the export market and the exchange rate were also found to be significant determinants of export demand.

In order to evaluate the prospects of a free trade area in the SAARC[4/] region by member nations, a study was carried out by Suhail and Sreejesh (2011) using a multiple regression model to analyse the export demand function. In this study, the impact of bilateral trade agreements on export performance of SAARC nations was analysed with special reference to the India-Sri Lanka bilateral free trade agreement. Accordingly, it was found that variables such as GDP and population were significant with positive coefficients while price was not a significant determinant of exports of India and Sri Lanka.

The impact of exchange rate volatility on the export quantity has also been analysed in the literature. As discussed in Clark *et al*. (2004), the volatility of exchange rate was found to have a negative impact on trade volumes. This was further studied by Jantarakolica and Chalermsook (2012) using panel data analysis comparing nine products in the textile and garment sector for the period from first quarter of 2000 to the first quarter of 2011. They found that in the case of Thailand, exports of textile and garment products were significantly influenced by the export price as well as the exchange rate. Accordingly, higher exchange rate volatility caused a decline in export volumes.

Hooy and Choong (2010) conducted a similar study to examine the impact of exchange rate volatility on export demand within SAARC members. Data on bilateral exports on a monthly basis from January 1980 to January 2010 for four members of SAARC (*i.e.,* Bangladesh, India, Pakistan and Sri Lanka) for which data are available were analysed using a multivariate asymmetric CCC-GARCH model applying a bound testing approach on the standard trade model framework. The results showed that foreign income, real exchange rate and exchange rate volatility affected exports in the region. Further, it was found that real exchange rate volatility had a significant and negative impact on the export demand of most of the SAARC countries.

As empirical studies suggest for small economies like Sri Lanka and Bangladesh the export demand is price inelastic. According to Choudhury (2001), there is evidence that for small economies, the devaluation of the currency does not have a significant impact on the demand for exports. Therefore, the exchange rate itself did not influence the demand decisions thus requiring some non-price policies to stimulate external demand.

A summary of empirical evidence on export determinants is given in Appendix I.

4/ The South Asian Association for Regional Cooperation (SAARC) is an economic and political organization of eight countries in Southern Asia namely India, Bangladesh, Pakistan, Sri Lanka. Nepal, Maldives, Bhutan and Afghanistan.

4. Theoretical Framework and the Model

As explained by Dornbusch (1988) and Hooper and Marquez (1993), there are two main determinants of export demand. The first is foreign income, which shows the purchasing power of the foreign buyer. This implies that an increase in real GDP of the importing country would increase the volume of exports. This is known as the income effect. The second major determinant is the relative price. The appreciation of the real exchange rate will cause domestic goods to become less competitive than foreign goods, thereby increasing imports while decreasing exports. This is referred to as the price effect. Apart from that, as explained in the literature, exchange rate fluctuations, level of trade restrictions and preferential arrangements on bilateral and regional basis, national attitude towards foreign goods, taste, quality and technology are other determinants of export demand. In order to identify the most representative set of explanatory variables which determine the external demand for textiles and garments of Sri Lanka, prior empirical studies were reviewed. This paper broadly followed the approach of Siddiqi *et al*. (2012) and Hooy and Choong (2010). Such determinates are export price, exchange rate, world real GDP/ world income, trade openness and the availability of preferential access to markets *e.g*. MFA (Multifibre Arrangement), GSP + (Generalised System of Preferences).

Although all these variables would better represent the external demand function for textiles and garments of Sri Lanka, as a result of the possibility of loss of degrees of freedom due to a higher number of variables with fewer numbers of observations, and considering the suitability and the relevance to the Sri Lankan economy, selected variables were used for this study: importing country's income, real exchange rate and level of trade restrictions are being used as independent variables whereas two dummy variables are introduced in order to accommodate the effect of major changes in the consumption pattern of buyers during the sample period if any. As Khan and Ross (1977) and Salas (1982) suggest, in modeling the export demand function, the log-linear specification is preferred to a liner function. Therefore, the log-linear specification is used in the study.

This study consists of quarterly data from the first quarter of 1999 to the first quarter of 2013. The dependent variable is the natural log of Sri Lanka's external quantity index (*lndemand*) for Textiles and Garments as a proxy for the external demand for textiles and garments. In order to incorporate the income effect on external demand, this study uses the log of world GDP (*lnwgdp*). As the real exchange rate represents Sri Lanka's competitiveness and as it captures the change in exchange rate, which is important for a highly imported input dependent industry, the study uses the log of quarterly average Real Effective Exchange Rate (REER 24[5/]) index (*lnreer*24). Further, trade openness

5/ REER 24 index is prepared by the Central Bank of Sri Lanka (CBSL) for 24 trading partners and competitor countries. The use of export price index in place of REER 24 does not change results of the study significantly.

is used to proxy the level of trade restrictions between Sri Lanka with the rest of the world (*lntopen*). Trade openness is measured by the sum of total exports and imports as a percentage of gross domestic production of Sri Lanka. An increase in trade openness indicates a decrease in trade restrictions with the rest of the world. The effect of MFA and GSP+ on export demand for textiles and garments is captured by the dummy variable 1 (*D*1). Further, during the sample period, consumers were faced with some challenges such as the global financial crisis and debt crisis. Dummy variable 2 (*D*2) is presented to capture the changes in consumption pattern due to such challenges. Data sources and data descriptions are given in Appendix II).

The study uses the following export demand function incorporating the factors described above:

$$lndemand_t = \alpha + \beta_1\, lnwgdp + \beta_2\, lnreer24 + \beta_3\, lntopen + \beta_4 D1 + \beta_5 D2 + \varepsilon_t \qquad (1)$$

where,

α = constant
lnwgdp = Natural log of world GDP
*lnreer*24 = Natural log of Real Effective Exchange Rate index (REER, (2010=100))
lntopen = Natural log of trade openness
*D*1 = a dummy variable to capture the effect of MFA and GSP+
*D*2 = a dummy variable to capture the effect of financial crisis and debt crisis
ε = error term

An increase in income level of buyers is expected to increase the real demand for goods and services due to the improvement in purchasing power. Hence, a positive relationship is expected between world income and quantity demanded for textiles and garments. As explained by Haider *et al*. (2011), the real effective exchange rate is used as an indicator of the country's external competitiveness, where an appreciation of REER indicates loss of competitiveness while a depreciation of REER indicates an increase in the competitiveness. Therefore, the expected sign of the coefficient of the real effective exchange rate is negative. Trade openness is used as a proxy for the trade restrictions. An increase in trade openness indicates a reduction in trade restrictions between Sri Lanka and the rest of the world. Therefore, a positive relationship is expected between trade openness and the quantity of external demand for textiles and garments. The dummy variable 1 (*D*1) is expected to have a positive coefficient as the availability of MFA or GSP+ would certainly enhance the competitiveness of Sri Lanka's textiles and garments resulting in an increase of trade volume. Dummy variable 2 is expected to have a negative impact on the real income of foreign countries and thus on external demand.

5. Econometric Methodology and Empirical Results

Several methods have been proposed for testing co-integration in the literature. As explained in Siddiqi *et al*. (2012), Johansen and Juselius multivariate analysis is more appropriate in determining demand factors when prices are endogenously determined. Further, as explained by Kalyoncu and Huseyin (2006), when the study involves more than two variables, the Johansen and Juselius method of co-integration analysis provides more robust results.

The time series properties of the economic variables were examined using unit root tests such as the Augmented Dickey-Fuller (ADF) test and Phillips-Perron (PP) test. Since the data is quarterly, lags up to 4 are included for correction of autocorrelation as proposed by the Akaike Information Criteria (AIC). These unit root tests are performed on both level and first differences. Summary results of the ADF test and PP test are given in Table 4 below.

Table 4 : Results of Unit Root Test

Variable	Indicator	ADF		PP	
		Level	**1st Difference**	**Level**	**1st Difference**
lndemand	Statistic	-1.4741	-7.2686	-10.1277	-74.1405
	P-Value	0.5389	0.0000	0.0000	0.0001
lnreer24	Statistic	-0.3271	-5.8649	-0.5620	-5.8897
	P-Value	0.9137	0.0000	0.8703	0.0000
lnwgdp	Statistic	-1.4395	-4.1708	-1.7142	-4.1344
	P-Value	0.5564	0.0017	0.4187	0.0019
lntopen	Statistic	-2.7967	-4.5880	-2.8155	-19.8144
	P-Value	0.2050	0.0029	0.0625	0.0001
D1	Statistic	-1.6841	-7.2313	-1.4900	-8.2713
	P-Value	0.4337	0.0000	0.5314	0.0000
D2	Statistic	-0.8640	-7.4162	-0.8640	-7.4162
	P-Value	0.7924	0.0000	0.7924	0.0000

At levels, the null hypothesis of "the series has a unit root" is failed to reject at 5% significant level. Accordingly, all the variables are non-stationary at levels or all these variables are I(1) variables.

As empirical evidence suggests, a Johansen (1995) multivariate co-integration analysis is carried out to check whether these I(1) variables are co-integrated in the long-run.

Table 5 : Co-integration Test Results

Null Hypothesis	λ- Trace	λ- Trace 5% Critical Value	λ- Max	λ- Max 5% Critical Value
r = 0	105.74	95.75	42.86	40.08
r ≤ 1	62.89	69.82	25.15	33.88

As per the results shown above (Table 5), both the Trace statistics and Maximum Eigenvalue statistics confirm the existence of one co-integrating vector between the variables. Once the existence of one co-integrating relationship is established, the next step is to estimate the Error Correction Model to identify the normalised co-integrating coefficients with respect to export demand of textiles and garments. Table 6 shows the results of the Error Correction Model.

Table 6 : Normalised Co-integrating Coefficients

	lndemand	*lnwgdp*	*lnreer24*	*lntopen*	*D1*	*D2*
β Coefficient	1	-0.3926	-0.9962	0.5498	-0.2590	0.1157
Standard Errors		0.1884	0.3130	0.1793	0.0660	0.0882
T-Statistics		-2.0836*	-3.1828*	3.0660*	-3.9255*	1.3120

* Significant at 5% level

Accordingly, the t-statistics confirm that, *lnwgdp* (world GDP), *lnreer*24 (REER 24 index), *lntopen* (trade openness with rest of the world) and *D*1 (GSP+ and MFA) are significant at 5% level. As per the results, the expected signs of variables other than REER (*lnreer*24) and trade openness hold true. However, as these two variables are significant at 5% level, it could not be dropped from the model.

Table 7 : Error Correction Model

	D(*lndemand*)	D(*lnwgdp*)	D(*lnreer24*)	D(*lntopen*)	D(*D1*)	D(*D2*)
α Coefficient	-0.4916	0.0053	0.0312	-0.3023	0.8271	-0.1685
Standard Errors	0.1498	0.0111	0.0485	0.1741	0.3845	0.2620
T-Statistics	-3.2817*	0.4760	0.6427	-1.7361	2.1510*	-0.6431

* Significant at 5% level

The coefficient of Error Correction Term of D(*lndemand*) as shown above, is -0.4916. This indicates that 49% of the deviation from the equilibrium is corrected within a quarter, taking around 2 quarters to reach the equilibrium.

Accordingly, the determinants of external demand for Sri Lanka's Textiles and Garments can be specified as follows:

$$lndemand_t = 1.44 + 0.39\ lnwgdp + 0.99\ lnreer24 - 0.55\ lntopen + 0.26D1 - 0.12D2 \qquad (2)$$

As per the estimated equation above, a 1 per cent increase in the real GDP of buyers would increase the export demand for Sri Lanka's textiles and garments by 0.39 per cent, while a 1 per cent appreciation (increase) in REER would increase the export demand for textiles and garments by 0.99 per cent and demand for textiles and garments will decline by 0.55 per cent when trade openness is increased by 1 per cent. As shown by the findings, MFA and GSP+ had a positive effect of 0.26 per cent on demand. The occurrence of financial and debt crisis had a negative effect of 0.12 per cent on the demand for textiles and garments of Sri Lanka in the world market.

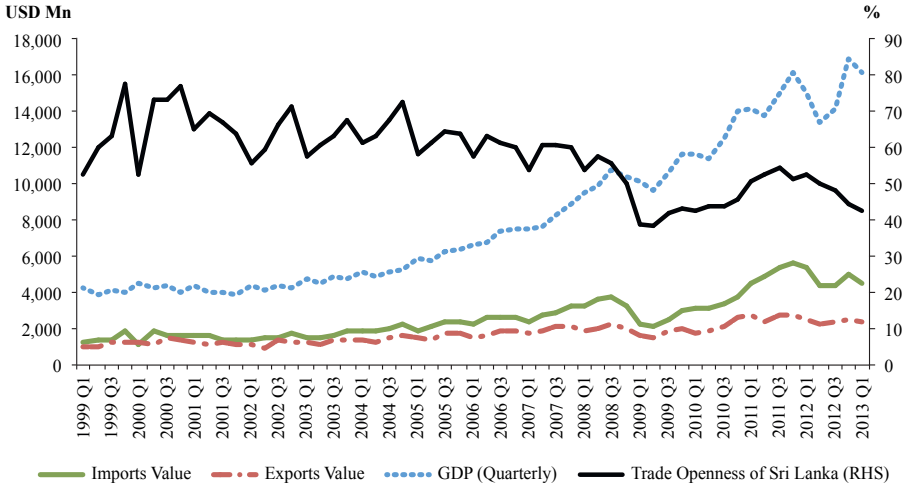
The residual tests were carried out for the model and it was found that the model is free from autocorrelation and heteroskedasticity. Results of alternative models which were carried out to check the robustness of the study is given in the Appendix III. As an alternative to REER 24, export price index for textiles and garments was used in the alternative analyses. Accordingly, it is also found that the income of foreign buyers has a positive and significant impact on the demand for textiles and garments while price of textiles and garments has a negative and significant impact. Trade openness shows a negative relationship with the demand for textiles and garments in all three alternative analyses.

6. Discussion of Findings

Findings of the study confirm that the variables, income of foreign buyers and availability of preferential arrangements such as MFA and GSP+ have a positive effect on the external demand for textile and garments as expected. The results indicate that the income elasticity of world demand for Sri Lanka's textiles and garments is 0.39 per cent. Similar results were found in previous studies, for instance, Hooy and Choong (2010) which estimates the export demand of SAARC economies for the sample period 1980–2010 reports 0.26 per cent of average income elasticity of export demand. However, the trade openness and REER 24 have an opposite impact on demand to what is expected. Therefore, it is necessary to examine the causes for such results and to examine whether it is true in real circumstances. When the facts are analysed, as shown in figure 3, it is evident that both total exports and imports increased during the period under consideration, showing increasing integration with the rest of the world. However, trade openness measured as a percentage of GDP is decreasing due to the fact that, the GDP of Sri Lanka has risen

more than the increase in international trade. As the results of the study suggest, trade openness has decreased during the period under consideration even though the demand for textiles and garments increased showing a negative relationship. However, since the liberalization of the economy in 1977, trade restrictions have been removed gradually and the tariff structure also has been simplified. Hence, the decline in trade openness since 2005, (as shown in figure 3), could be due to the change in the development strategy of the government which has placed more emphasis on infrastructure development and import substitution.

Figure 3 : Trade Openness



Source : Author's Estimates

When analysing the reasons for the change in expected sign in REER 24 in the model, several reasons were found as described in empirical studies. As explained in Alam (2010) there was no causality from real depreciation of the Taka to export earnings of Bangladesh. Further, he explains that the depreciation of currency may coincide with greater exchange rate volatility and uncertainty and such uncertainty may have an adverse impact on exports. Telak and Yeok's (1998) findings may have more relevance for small economies whose exports are highly dependent on imported raw materials and intermediate inputs. The study uses Singapore data and finds that due to high import content, exports are not adversely affected by currency appreciation as the lower import price due to appreciation reduces the production cost of exports. Further, they have highlighted the importance of analysing the negative impact of depreciation on other sectors of the economy before

taking any policy that helps depreciation. Dozovic and Pripuzic (2013) found that real effective exchange rates reflect the development of the relative price of the economy and hence they only relate to one aspect of international competitiveness and that does not capture all relevant aspects. Further, they state that as the REER is based on aggregate indicators like aggregate price or cost indices, it neglects differences that can exist between industries. They suggested using REER indices at industry level which is based on trade weights calculated at industry level and corresponding producer price indices, in order to reflect price competitiveness of particular industry more realistically. Therefore, as found in the analysis, the positive relationship between the real effective exchange rate and the export demand for textiles and garments of Sri Lanka could be due to a collective outcome of all these factors. Accordingly, appreciation in the real exchange rate of the Sri Lanka rupee has not dampened the demand for textiles and garments in international markets.

7. Conclusion and Policy Implications

As in many developing countries, the export oriented textile and garment industry is found to be one of the main drivers of the economy of Sri Lanka. The garment industry in Sri Lanka has become an important industry of the economy in terms of its contribution to industrial production, foreign exchange earnings and direct and indirect employment generation. Hence, identification of the determinants of external demand for textiles and garments is important both for the industry as well as policy makers.

This study attempts to identify the determinants of external demand for textiles and garments in international markets. According to the empirical findings, external demand of textiles and garments in the international market was determined by GDP of importing countries, appreciation/depreciation in exchange rate and trade openness with the rest of the world.

As in many studies in the literature, income of foreign buyers has a significant impact on the demand for textiles and garments. However, this study finds that the appreciation of exchange rate does not have a negative impact on the demand for textiles and garments. This could be due to the high dependency of the textile and garment industry of Sri Lanka on imported inputs, on average which is around 45 per cent. Therefore, it is evident that the depreciation of the exchange rate does not bring the expected favourable benefit in enhancing exports of textiles and garments. It suggests the importance of non-price factors such as innovation and quality improvements that may have an influence on the decisions of foreign buyers of textiles and garments. Further, as supported by the findings, the availability of the MFA and GSP+ had a positive and significant effect on the demand for Sri Lanka's textiles and garments in the international market as Sri Lanka enjoyed duty

free access to the main markets. During the financial and debt crisis, external demand for Sri Lanka's textiles and garments had dampened due to the liquidity shortage and lower spending capacity of the buyers.

Accordingly, for the betterment of the textiles and garments industry of Sri Lanka several initiatives could be recommended. Among such initiatives, product diversification through vertical integration which will broaden the product base, market diversification to reduce the dependency on key markets thereby minimising concentration risk could be considered as important factors. Further, with the maturity of the industry, import dependency for raw materials could be reduced through backward integration where inputs are produced domestically. Other measures such as enhancing efficiency and reducing the lead time in delivery through improving the processes at ports and airports should be emphasised. Further, innovation through research and development for technological enhancements could also be considered as important.

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Appendix I : Summary of the Empirical Evidence

Authors	Scope	Methodology	Key Findings
Jahanzaib Haider, Muhammad Afzal and Farah Riaz (2011)	Annual data of Pakistan with all the trading partners from 1973 to 2008 for the following variables– i. imports and exports ii. real GDP iii. CPI iv. Bilateral exchange rate of Pakistan with ten trading partners	Johansen technique to test long run relationship The lag order of VAR is determined by (SIC) Schwarz Information Criterion, (FPE) Final prediction Error and AIC (Akaike Information Criterion) for both import and export models.	The results revealed that income is the principle determinant of foreign trade while exchange rate also plays a major role in determining the demand for exports and imports (Pakistan)
Wasif Siddiqi, Nawaz Ahmed, Abdul Aziz Khan and Kamran Yousef (2012)	Annual data from 1971-2009 for the following variables i. Export volume is used as export demand. ii. Consumer price index of textiles and clothing sector of Pakistan iii. World real per capita income iv. Trade openness v. Nominal Exchange rate for Pakistan rupee against US dollar	Johansen and Juselius methodology of maximum likelihood co-integration technique to test long run relationship	Results show that world income is the major determinant of export demand as it shows high coefficient of income for export demand of textiles and clothing sector. Trade openness is second major determinant of export demand (Pakistan).
Suhail P and Sreejesh S (2011)	Annual data from 1999–2007 for the following variables i. Export volume is used as export demand. ii. Price of exports of India and Sri Lanka iii. GDP iv. Population v. Dummy variable for the free trade agreement between India and Sri Lanka	Multiple regression model has been used for the analysis	It was evidenced that the variables like GDP and population have positive and significant coefficients while the price is not a significant determinant of export of India and Sri Lanka.

Tatre Jantarakolica and Porjai Chalermsook (2012)	Quarterly data from 2000 Q1 to 2011 Q1 for the following variables – i. Thai's Export quantity index ii. Weighted average of GDP of importing counties iii. Thai's export price index of textiles and garments iv. Exchange rate for Thai Baht per US dollar	Three models to measure exchange rate volatility– i. Natural log of quarterly variance ii. Univariate GARCH model iii. Bivariate GARCH model	Export price index is the factor that has significant negative impacts on export quantity of textiles and garment. Exchange rate does not directly influence exports but its impacts are caused through the exchange rate risk determined by exchange rate volatility The results confirm that Thai textiles and garments export products are sensitive to income; therefore the income effect turns out positively significant.
Chee-Wooi Hooy and Chee-Keong Choong (2010)	Monthly data from January 1980 to January 2010 for the four members of SAARC (Bangladesh, India, Pakistan, Sri Lanka) for the following variables– i. Bilateral exports ii. Income of trading partners iii. Real Exchange rates iv. Nominal exchange rate volatility	Multivariate asymmetric CCC-GARCH model and applied the bound testing approach on the standard trade model framework	The results showed that the foreign income, real exchange rate and exchange rate volatility does affects exports in the region. Further, it was found that real exchange rate volatility have a significant and negative impact on the export demand of most of the SAARC countries.
Choudhury (2001)	Data on the following for the 15 trading partners of the Bangladesh for the period 1972/73 to 1997/98 – Total exports and exports to fifteen trading partners – Export prices – GDP	Multiple regression model has been used for the analysis	It is evidenced that for small economies, the devaluation of local currency, does not have a significant impact on the demand side of exports

Appendix II : Data Definitions and Sources

Quarterly data on world GDP, export and import values and GSP of Sri Lanka were obtained from IMF e-library for International Financial Statistics. Quarterly data relating to Sri Lanka's export volume index and REER 24 index were obtained from CBSL's Annual Reports (various years) and CBSL data bases. Details of the sources are given below.

Variable	Definition	Source
lndemand	Export volume index for textiles and garments (in log) 2010=100	Database of Central Bank of Sri Lanka
lnwgdp	Quarterly world GDP as a proxy for the income of buyers (in log)	International Financial Statistics,IMF
lntopen	% of trade openness with rest of the world [(Value of exports + value of imports) / GDP] *100 - on quarterly basis (in log)	International Financial Statistics, IMF
lnprice	Export price index for textiles and garments (in log) 2010=100	Database of Central Bank of Sri Lanka
*lnreer*24	Quarterly average REER index for 24 currency basket (in log)	Database of Central Bank of Sri Lanka
*D*1	Dummy variable to show facility of MFA/ATC and GSP+ Value 1 for the period 1999 Q1 to 2004 Q4 and again for the period 2005 Q2 to 2009 Q4	
*D*2	Dummy variable to show the impact of global financial crisis and debt crisis in the EU. Value 1 for the period 2007Q2 to 2009 Q4 and again for the period 2010 Q1 to 2013 Q1	

Appendix III : Robustness Check (Alternative Models)

In order to check the robustness of the results following alternative models were analysed.

Variable	Model 1	Model 2	Model 3
lnwgdp	+0.3926	+ 1.2991	+1.2819
	(-2.0836)	(-5.1088)	(-8.5971)
*lnreer*24	+0.9963		
	(-3.1828)		
lntopen	-0.5498	-0.2984	-0.6401
	(3.0660)	(2.4947)	(7.5561)
*D*1	+0.2590		+0.1461
	(-3.9255)		(-3.6567)
*D*2	-0.1157 (1.3120)	+0.0708	+0.0346
		(-1.5716)	(-1.1996)
lnprice		-0.9612	-0.7866
		(4.1730)	(5.0624)
c	1.4411	2.3164	1.61236
R Squared	0.9538	0.9594	0.9692
F Statistics	63.5483	90.2571	32.7022