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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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Finance - Growth Nexus : Evidence from Sri Lanka[1]

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Abstract

This study investigates the relationship between financial development and economic growth of Sri Lanka using time series data from 1960 to 2008. Cointegration and causality tests are conducted to assess the finance-growth link by taking saving, investment, trade and real interest rate into account. The empirical results show that economic growth causes financial development in the long-run and there is no reverse causation. This conclusion of the study goes in line with the views expressed by Demetriades and Hussein (1996), Macri and Sinha (2001) and Abma and Fase (2003) but departs distinctively from the observations made by Ahmed and Ansari (1998), on the finance-growth link in relation to Sri Lanka. The results of this research also show that the investment causes the economic growth which in turn results in demand for financial services to follow the growth in the real sector of the economy. This study has further identified that Sri Lanka's financial system has shown some weaknesses in performing its tasks which would have been instrumental in the determination of causality pattern between financial sector development and economic growth of the country.

1. Introduction

The early literature on economic growth at both the theoretical and empirical levels, focused on several key variables such as physical and human capital, productive investments,

1/ This paper was developed on the basis of research undertaken by the author at the University of Kelaniya, Sri Lanka for M.Sc. in Management and Information Technology. The author wishes to thank Mr. Suren Peter and Dr. Ruwan Wickramarachchi of the University of Kelaniya for their guidance on the research and the anonymous referee for his/her invaluable comments on an earlier draft of this paper.

technology and fiscal and monetary policy stance as the sources of growth. However, some economists, particularly since 1970s, began to believe that a well developed, market oriented financial sector contributes to economic growth. Contemporary empirical and theoretical literature on the finance-growth nexus provides more insights into the potential role of financial sector in economic development. Much of this literature finds that a greater depth of financial sector development measured in terms per capita amount of financial services and institutions or the ratio of financial assets to GDP (financial deepening) is crucial for economic development. It is highly likely that many contemporary economists take this position for granted[2/]. Levine (1997), for instance, describes that a financial system is important in performing five basic tasks namely, (*i*). facilitating the trading, hedging, diversifying, and pooling of risk, (*ii*) allocating resources, (*iii*) monitoring managers and exerting corporate control, (*iv*) mobilizing savings, and (*v*) facilitating the exchange of goods and services.

Despite the fact that there is growing consensus among economists on the positive relationship between financial sector development and growth, there has been no consensus among them on causal relationship between these two variables. For instance, Kemal *et al.* (2007) identify four schools of thought on the finance-growth nexus, each of which views that finance promotes growth, hurts growth, follows growth or it does not matter for growth. Two competing hypothesis of interest are the possible causality running from finance to growth and growth to finance, labeled by Patrick (1996) as supply leading hypothesis and demand following hypothesis respectively. Supply leading hypothesis indicates that deliberate creation of financial institutions and markets increases real growth while the demand following hypothesis posits that economic growth creates demand for more financial services and as a result the financial systems will grow only in response to such economic expansions. The point of argument of the latter case is that increased economic activities will result in more demand for both physical and liquid capital. Therefore, the growth in the real sector induces the financial sector to expand, and thereby increases competition and efficiency of the financial intermediaries and markets.

In the above context, and considering the widened and deepened financial features of Sri Lanka's financial system particularly along with the liberalization of financial sector, this study attempts to ascertain whether financial development in Sri Lanka causes its economic growth or in contrast whether there exist any other causal relationships between these two areas of economic importance.

2/ World Bank (2001) data show that a financial depth indicator, asset capitalisation of financial system as a percentage of GDP of high income, upper middle income, lower middle income and low income countries was 155, 72, 58 and 32 respectively, during 1990s and this status-quo itself is very much supportive for economists to believe that financial development promotes economic growth.

The remainder of this study is organized as follows. Section 2 provides a theoretical and empirical literature review. An overview of the financial sector development in Sri Lanka is presented in section 3. Data and research methodology are explained in section 4. In section 5, the empirical results are presented and analyzed. Section 6 draws policy implications and concludes the paper.

2. Review of Theoretical and Empirical Literature

A large and diverse body of theoretical and empirical literature has investigated the relationship between financial sector development and economic growth. Much earlier work on this subject can even be traced as far back as to Bagehot (1873), who described how industrialization of England was facilitated by the availability of a large amount of money for "immense works". Earlier work also includes Schumpeter's (1932) study that goes to establish a view that a well functioning financial system would induce technological innovation by identifying, selecting and funding the entrepreneurs who would be expected to successfully implement their products and productive processes. However, in later years, growing acceptance of this one-way causality was questioned by some economists, asserting that financial development follows the development of an economy (demand following hypothesis) and not the vice versa. Robinson (1952) who has pioneered this view stresses the fact that *'where enterprise leads finance follows'*.

The views of McKinnon (1973) and Shaw (1973), which are referred to as the "McKinnon Shaw" hypothesis, received considerable attention as a leading theoretical presentation on positive effect of financial development on growth. According to this hypothesis, increased savings rate and thus the investment rate would raise size of savings and efficiency of investment leading to higher economic growth. In other words, a low or negative real interest rate discourages savings and reduces the availability of loanable funds for investment thereby lowering the rate of economic growth. The other essential tenet of this hypothesis is that any government restrictions on the banking system would impede the process of banking development and consequently, reduce economic growth. This implies that a more liberalized financial system induces an increase in savings and investment and thus, promotes economic growth. "McKinnon Shaw" hypothesis was popularized further by Fry (1988) and Pagano (1993). On the contrary, Lucas (1988), argues that financial factors can play a little role in the process of growth declaring that *'economists badly over-stress the role of financial factors in economic growth'*.

Table I provides an overview of some selected empirical studies which hold diverse views and conflicting predictions relating to finance-growth nexus.

Table I: Finance-Growth Nexus – An Overview of Selected Empirical Studies

Author(s) & Year	Financial Variables	Growth Variables	Control Variables/ Other Variables	Sample Period	Sample Coverage	Research Methodology
King & Levine (1993a)	Ratio of liquid liabilities of banks and non bank financial institutions to GDP Ratio of assets of commercial banks to assets of commercial banks plus central bank Ratio of private credit to total domestic credit Ratio of credit to non financial private sector to GDP	Real per capita GDP growth Rate of physical capital accumulation Ratio of domestic investment to GDP	Initial GDP School enrolment Literacy rate Innovation	1960 to 1989	About 80 developed and developing countries	Cross country regression analysis
Beck *et al*. (2000)	Ratio of private credit to GDP Ratio of liquid liabilities to GDP Ratio of credit by deposit banks to GDP	Real per capita GDP growth	Initial real per capita GDP Average years of schooling Inflation rate Ratio of govt. expenditure to GDP Exports and imports to GDP Black market premium to capture the degree of openness	1960 to 1995	About 70 developed and developing countries	Generalized method-of-moments (GMM) dynamic panel estimators and a cross-sectional instrumental variable estimator
Caldero´n & Liu (2003)	Ratio of broad money (M_2) to GDP Ratio of private credit to GDP	Real per capita GDP growth	Initial human capital Initial income level A measure of government size Black market exchange rate premium and regional dummies	1960 to 1994	109 developing and industrial countries	Panel analysis and Geweke decomposition test

Table I (Contd.)

Odedokun (1996)	Ratio of nominal value of the stock of liquid liabilities to the nominal annual GDP	Real GDP	Labour force Capital stock Ratio of investment to GDP Real export growth	Varying period that spans between 1960s to 1980s	71 developing and least developed countries	Regression equations for each country
Khan & Qayyum (2007)	Ratio of broad money to GDP Ratio of bank deposit liabilities to GDP Ratio of money cleared through clearing house to GDP Ratio of private sector credit to GDP Ratio of stock market capitalisation to GDP Ratio of currency in circulation to GDP A financial index has been constructed using Principal Component Analysis (PCA)	Real output	Real deposit rate Impact of trade liberalisation on real output	1961 to 2005	Pakistan	Bound testing approach to cointegration within the framework of Auto-regressive Distributed Lag (ARDL) developed by Pesaran, *et al.* (2001)
Jung (1986)	Ratio of currency to the narrow money (M_1) Ratio of broad money (M_2) to nominal GNP/GDP	Real per capita GNP/GDP	None	At least 15 annual observations	19 industrial countries, 31 developing and least developed countries	Regression analysis and Granger's simple causality tests
Demetriades & Hussein (1996)	Ratio of bank deposit liabilities to nominal GDP Ratio of private credit to nominal GDP	Real per capita GDP	None	At least 27 annual observations for each country	16 developing and developed countries	Cointegration tests using Engle and Granger (1987) and Johansen (1988) methods

Table I (Contd.)

Ahmed & Ansari (1998)	Ratio of broad money (M_2) to nominal GDP Ratio of quasi-money (time and savings deposits) to nominal GDP Ratio of domestic credit to nominal GDP	Real GDP and real per capita GDP	Ratio of investment to GDP Population	1973 to 1991	3 South-Asian economies, namely, India, Pakistan, and Sri Lanka.	The standard Granger causality tests and regression equations estimated using the Cobb-Douglas production function framework
Macri & Sinha (2001)	Growth rate of money supply as a ratio of nominal GDP Growth rate of quasi-money as a ratio of nominal GDP Growth rate of domestic credit as a ratio of nominal GDP Growth rate of real money supply Growth rate of real domestic credit Growth rate of real broad money	Growth rate of real GDP Growth rate of real per capita income	Growth rate of real investment as a ratio of GDP Growth rate of population	Different series generally covering 1950s to 1990s	8 Asian countries	Regression analysis and multivariate causality tests
Abma, & Fase, (2003)	Balance sheet totals of the banking sector	Growth rate of GDP	Growth rate of investment	Annual observations vary between 49 and 25	9 Asian countries	Granger causality test and regression analysis

Table I (Contd.)

Ang & McKibbin (2007)	Ratio of liquid liabilities of the financial system (M_3) to GDP Ratio of commercial bank assets to commercial bank assets plus central bank assets Ratio of private sector credit (domestic) to nominal GDP A financial index has been constructed using PCA	Real per capita GDP	Ratio of gross domestic savings to nominal GDP Ratio of gross investment to nominal GDP Real interest rate Ratio of exports and imports to nominal GDP	1960 to 2001	Malaysia	Vector Auto-regressive (VAR) approach and cointegration tests
Liang & Teng (2005)	Ratio of domestic credit by banking institutions to GDP Ratio of total deposit liabilities of banking institutions to GDP	Real per capita GDP	Real interest rate	1952 to 2001	China	VAR approach
Kemal *et al.* (2007)	Six measures for financial sector development	Real per capita GDP	Initial stock of physical capital Initial stock of human capital Inflation rate Government consumption to GDP International trade openness	1970s to 2001 covering a minimum of 21 observations	19 high income countries	Methodology of Nair-Reichert and Weinhold (2001) for causality analysis in heterogeneous panel data

Note: The definitions for M_1, M_2 and M_3 are the same as those used by the *International Financial Statistics* of the IMF.

King and Levine (1993a), Beck *et al*. (2000), Caldero'n and Liu (2003), Odedokun (1996), Khan and Qayyum (1998) and Ahmed and Ansari (1998) described in the Table I have concluded that financial development promotes growth. Demetriades and Hussein (1996) have found only little support to the view that finance is a leading sector in the process of economic development. They believe that King and Levine findings are difficult to interpret in a causal sense, assert that such findings are useful only in understanding contemporaneous correlation between growth and financial development, and also highlight the fact that cross section nature of the techniques cannot capture the country specific causality patterns. Having adopted a methodology of Nair-Reichert and Weinhold (2001) for causality analysis in heterogeneous panel data, Kemal et al.(2007), indicate that finance does not matter in economic growth, supporting the view of Lucas (1998) on the finance-growth nexus.

The study by Jung (1986), based on data for 56 countries of which 19 are industrial economies, has found evidence for equal probability of causal relationship for both financial development to growth and growth to financial development. Jung (1986) study has however restricted to only 15 annual observations in some cases and used causality test under VAR framework in their levels raising some doubts over the validity of the results[3/]. His findings also contradict with Patrick's (1966) view which predicts the demand following hypothesis for the developed countries and the supply leading hypothesis for the least developed countries (LDCs). Caldero´n and Liu (2002), using pooled data of 109 developing and industrial countries from 1960 to 1994, find that financial deepening contributes more to the causal relationships in the developing countries than in the industrial countries to economic growth. However, these findings are contrary to those of Demetriades and Hussein (1996) who have produced their results after conducting cointegrated causality tests under the Error Correction Mechanism (ECM) representation.

It is appropriate to present some of the findings that have been arrived at in some individual country studies relating to finance-growth nexus analyses. Ang and McKibbin (2007), using time series data on Malaysia for the period of 1960-2001 show that economic growth causes financial development in Malaysia and that there is no feedback relationship. Ahmed and Ansari (1995) investigated the "McKinnon Shaw" hypothesis for Bangladesh and found some, although weak, support for their hypothesis while Khan and Hasan (1998) in their study involving Pakistan found strong support for the "McKinnon Shaw" hypothesis. Liang and Teng (2006), investigate the relationship between financial development and economic growth for the case of China over the period of 1952–2001 and their empirical results suggest that there exists a unidirectional causality from economic growth to financial development in china.

3/ Causality tests are valid when variables are stationary or they are cointegrated.

There are a couple of multi-country empirical studies where Sri Lanka has been included among other selected countries to analyze the causality relationship between financial development and economic growth. Demetriades and Hussein (1996) show that, Sri Lanka's economic growth causes financial development and to a lesser extent, financial development leads to its economic growth. Macri and Sinha (2001), using multivariate causality tests on first differenced variables which are stationary, suggest that there is hardly any evidence of causality between financial development and economic growth in any direction for Sri Lanka. Ahmed and Ansari (1998), have found that financial development causes economic growth in Sri Lanka, but they have conducted causality tests using variables in their levels. The methodology adopted by Macri and Sinha (2001) has addressed this issue before conducting causality tests. Abma and Fase (2003) have investigated how the financial intermediation matters for growth for 9 selected Asian countries using Granger causality test and regression analysis. They have found non-significant relationship between finance and growth for Sri Lanka.

The present study examines the heterogeneity of country specific variables extensively and follows a methodology similar to that of Ang and McKibbin (2007) who have performed an ECM based causality tests for their study.

3. Overview of Financial Sector Development in Sri Lanka (1960-2008)

3.1 Structure and Asset Composition

A financial system comprises financial institutions (FIs) and financial markets as well as financial instruments and financial infrastructure consisting of the payments and settlement systems and the legal framework. The contemporary financial system of Sri Lanka comprises of all these aspects. The financial widening (expansion of financial services and growth of financial institutions) and financial deepening in Sri Lanka have improved with the gradual evolving of financial sector comprising particularly the financial institutions and agents, regulations, transactions, financial instruments and market practices.

The formal financial sector institutions in Sri Lanka can be broadly classified into two groups, namely, the financial institutions regulated by the Central Bank of Sri Lanka (CBSL) and financial institutions/entities not regulated by the CBSL. The former group encompasses licensed commercial banks, licensed specialized banks, registered finance companies and other institutions such as Employees' Provident Fund (EPF) while the latter group constitutes deposit taking institutions, contractual savings institutions and other specialized financial entities.

The commercial banks dominate in terms of assets of the financial sector and the provision of financial services to the public. As shown in the Table II, there are a variety of other institutions engaged in catering to various financial needs of the people. Considering the fact that the commercial banks have been active in virtually all aspects of financial needs of the people, there is a greater need of analyzing how these banks contribute to the economic growth of the country.

Table II: Assets of Financial Sector Institutions as at End 2008

Financial Institution	Assets (Rs.Bn.)	As a % of Total Financial Assets	As a % of GDP
Central Bank of Sri Lanka (CBSL)	**598.4**	**12.49**	**13.57**
Institutions Regulated by the CBSL	**3,741.2**	**78.07**	**84.82**
Deposit-taking institutions	2,889.8	60.30	65.52
Licensed commercial banks	2,277.0	47.52	51.63
Licensed specialized banks	437.2	9.12	9.91
Registered finance companies	175.6	3.66	3.98
Other financial institutions	851.4	17.77	19.30
Employees' Provident Fund (EPF)	655.3	13.67	14.86
Primary dealers	86.2	1.80	1.95
Specialized leasing companies	109.9	2.29	2.49
Institutions not Regulated by the CBSL	**452.5**	**9.44**	**10.26**
Deposit-taking institutions	44.5	0.93	1.01
Co-operative rural banks	39.3	0.82	0.89
Thrift and credit cooperative societies	5.2	0.11	0.12
Contractual savings institutions	374.9	7.82	8.50
Employees Trust Fund	92.4	1.93	2.09
Private provident funds	108.0	2.25	2.45
Insurance companies	155.1	3.24	3.52
Public Service Provident Fund	19.4	0.40	0.44
Other specialized financial institutions	33.1	0.69	0.75
Venture capital companies	1.1	0.02	0.02
Unit trusts	6.8	0.14	0.15
Stock broking companies	3.2	0.07	0.08
Credit rating agencies	0.1	0.00	0.00
Other	21.9	0.46	0.50
Total Assets	**4,792.1**	**100.00**	**108.65**

Source : Central Bank of Sri Lanka

3.2 Salient Features of Evolution of the Financial System

At the time of establishment of CBSL in 1950, the financial system of the country had not developed systematically. There were 10 foreign commercial banks, operated through their branch offices accounting for nearly 60 per cent of total assets and 2 domestic banks, accounting for the rest of assets. The banking density[4/] was very low (0.0365) implying that one bank branch had to reach as many as 275,000 people. Nearly, 90 per cent of the advances was in the form overdrafts and a large part of deposits was invested abroad. Non-bank financial institutions such as savings banks and long-term lending institutions were virtually absent during this time. This is a reflection of the non-existence of diversified economic activities due to low expansion of the economy and the limited requirements for banking needs of the people. At the beginning of 1950s, activities of two domestic banks were also largely limited to urban areas and they were mostly financing the short-term trading activities including export and import trade.

There was an increase in demand for financial services starting from 1960s. During the 1960s and 1970s, an emphasis was given by the government to increase presence of domestic banks in the country and expand the financial institutions into remote areas. With the entry of People's Bank in 1961, two state banks were called upon to promote development banking, particularly for financing agriculture and industry. The two state banks expanded their activities rapidly with the government support, gradually getting their dominance in the banking sector over expatriate banks which mainly met the financial requirements of the foreign trade sector and the working capital requirements of the plantation sector. Direct government intervention over economic activity gave no room for private sector involvement in financial activities during this time. Under a policy package that consists of administrative controls, regulations and restrictions, foreign banks functioned at a low key while two state banks flourished possessing over 60 per cent of total assets of the banking sector. By 1970, two state banks accounted for 71 per cent of total deposits and 72 per cent of advances of the commercial banks of the country.

Sri Lanka saw a complete turnaround in the country's economic policy beginning 1977 with the introduction of a market-oriented policy package replacing government control over many economic activities. The liberalised economic policies adopted, necessitated commensurate changes in the financial system for which a series of financial sector reform programmes was also introduced after 1977. During the period of 77–83, a total of 14 new branches of foreign banks were established with two representative offices in the country. Banking density increased to 0.4230 by 1989 with each branch requiring to serve only 23,600 people. Interest rate and exchange rate controls were relaxed to some extent and new financial instruments came into existence. Technological and other changes were

4/ (No. of bank offices*10,000) / Total population effective in reducing the cost of financial intermediation. There was a strengthening of the legal, accounting and regulatory frameworks of financial institutions for improving financial sector management.

A liberal regime for establishing new institutions facilitated the private sector to create new special financial institutions, including finance companies, merchant banks, leasing companies, unit trusts and foreign currency banking units. Financial markets representing money, foreign exchange and capital markets were allowed to introduce new financial instruments and services in line with the emerging financial requirements of the economy and technological developments. By 2008, there were 22 commercial banks (11 locally incorporated banks and 11 branches of foreign banks), 14 licensed specialized banks and 34 registered finance companies operating in the country. Today, the banks are active in virtually all aspects of financial services, with some of them having subsidiaries or affiliates engaged in insurance and capital markets activities.

3.3 Behaviour of Selected Financial Variables (1960–2008)

Table III indicates that assets of CBSL and commercial banks in relation to total assets of the financial system has been decreasing over the years. A substantial part of this change is accounted for by the increase in asset base of the EPF and National Savings Bank (NSB).

Table III: Assets of the CBSL and Commercial Banks

Year	Assets of CBSL (Rs. Bn.)	Assets of Cbks (Rs. Bn.)	Total Assets of CBSL plus Cbks (Rs. Bn.)	Total Assets of All Financial Institutions (Rs. Bn.)	Assets of CBSL plus Cbks as a % of Total Assets	Assets of CBSL plus Cbks as a % of GDP
1960	1.2	1.1	2.3	2.9	77.4	34.0
1965	2.1	1.6	3.7	5.1	73.2	45.6
1970	3.1	2.7	5.8	8.8	66.7	42.8
1975	4.4	4.4	8.8	12.7	69.5	33.1
1980	26.4	22.2	48.6	67.7	71.7	72.9
1985	52.2	54.9	107.1	171.9	62.3	65.9
1990	71.6	115.9	187.5	357.7	52.4	58.2
1995	165.7	328.6	494.3	880.3	56.2	74.0
2000	209.1	597.9	807.0	1,459.3	55.3	64.2
2005	435.2	1,257.1	1,692.3	2,979.4	56.8	69.0
2006	490.1	1,536.3	2,026.4	3,462.0	58.5	69.0
2007	559.6	1,822.4	2,382.0	4,311.2	55.3	66.6
2008	585.5	1,963.1	2,548.6	4,790.4	53.2	57.8

Note: Cbks = Commercial Banks

Source: International Financial Statistics and Author's Calculation.

The increase in assets of other institutions such as insurance companies and finance companies have also contributed for this change. The pace of increase in financial assets in financial intuitions other than commercial banks has been high, but the point of interest is that how such assets have been instrumental in contributing for economic growth of the country. By looking at the percentage of assets of CBSL and commercial banks to GDP, which has shown an increasing trend over the period of 1960 to 2008, it can be deduced that rate of increase in GDP, the denominator of the ratio is slower than the rate of increase of numerator variable. Owing to this phenomena, this study considers it's appropriate to take commercial bank assets into account in analyzing the efficiency of the financial sector.

Table IV presents a summary view on three measures of financial development used in this research for the computation of one proxy indicator of financial development, adopting PCA. Private sector credit by commercial banks to nominal GDP as a percentage has shown an increasing trend, with the lowest of 7.3 per cent reported in 1960 and the highest of 34.0 per cent reported in 2006. However, the M_2 as a percentage of nominal GDP has fluctuated between 18.0 per cent and 33.8 per cent during the period of 1960 to 2008. The increase of assets of commercial banks as a percentage of assets of commercial banks plus CBSL, from 48.4 per cent in 1960 to 77.3 in 2008, is remarkable.

Table IV: Selected Financial Variables

Year	Credit to Private Sector (Rs. Bn.)	Broad Money (M_2) (Rs. Bn.)	Credit as a % of GDP	M_2 as a % of GDP	Assets of Cbks to Assets of CBSL plus Cbks
1960	0.5	1.6	7.3	23.5	48.4
1965	0.7	2.3	9.2	28.2	43.6
1970	1.6	3.1	11.7	22.8	45.9
1975	3.4	4.8	12.7	18.0	49.8
1980	11.4	19.9	17.2	29.9	45.6
1985	33.6	48.4	20.7	29.8	51.3
1990	63.1	90.5	19.6	28.1	61.8
1995	207.5	228.5	31.1	34.2	66.5
2000	362.6	404.7	28.8	32.2	74.1
2005	806.9	822.9	32.9	33.6	74.3
2006	998.3	993.2	34.0	33.8	75.8
2007	1,190.1	1,147.7	33.3	32.1	76.5
2008	1,276.6	1,282.2	28.9	29.1	77.3

Note: Cbks = Commercial Banks

Source: International Financial Statistics and Author's Calculation.

3.4 Factors Affecting the Efficiency of Financial Sector in Sri Lanka

The financial sector growth may be analysed in terms of its capability in mitigating risks and transactions costs, and mobilizing and allocating resources efficiently within the economy, among other things in measuring financial sector contribution to the economic performance. In light of this, it is necessary to assess country-specific issues relating to the development of financial sector, which is measured in terms of financial variables discussed in Table III and Table IV.

In general, from 1960 to 1977, Sri Lanka did not witness any attempt by the concerned authorities to maintain a competitive environment in the financial sector, making it difficult for commercial banks to perform financial intermediation efficiently. Continued intervention by the government in economic matters also allowed no impetus for financial sector growth. In the absence of intensive private sector involvement in financial sector, two state banks dominated and survived along with some other weaker banks at the expense of financial system efficiency.

Since from 1977 to date the country’s financial sector has undergone considerable changes in its structure and performance but there are issues which are related to efficient performance of financial sector. For instance, two state owned banks continued to concentrate on their lending to the government sector. Exposure of these banks in their total loan portfolio to government and state-owned enterprises such as Ceylon Petroleum Corporation and Ceylon Electricity Board increased as high as 50 per cent at sometimes after 1977, and remained over 30 per cent in many years. The gravity of this problem in economic development is obvious as two state banks represent nearly 60 per cent of total advances of the country while the credit to several large public corporations by these banks has to be accommodated with less attention being paid to prudential lending policy. Further, the oligopolistic nature of Sri Lanka’s commercial banking system, in which two state banks dominate the business, militates against smooth functioning of financial markets in the country.

Sri Lanka’s money market is still narrow and the spectrum of available instruments is limited. A long-term corporate bond market is virtually missing in the country. If the development of financial institutions and financial instruments is driven by economic progress, any factor that determines the economic progress is to be blamed for the low progress in the financial sector. Hence, steps needed to develop the long-term bond market may lie with some other complementary factors such as political stability, investor friendly atmosphere, and fiscal sector efficiency which are necessary conditions for economy to perform well, among other things. For instance, the expansionary pressure exerted on the money supply by the need to finance large government deficits (Government borrowing from the market at the expense of crowding-out effect and the government making use of virtually all money held by Employees Provident Fund (EPF) would also have diminished the overall efficiency in resource allocation in the economy) and the political instability prevailed until recently would have caused adverse impact on overall efficiency of financial sector resulting in poor expansion in corporate bond and debt markets in the country. Such structural weaknesses provide no room for financial intermediaries to exert a significant control on firms through their actions.

The high cost of borrowings to entrepreneurs remains a crucial factor that determine the magnitude of investment in the country. The spread between deposit and lending rates has been high by any international standards and weaker banks continue to perform and exist, passing substantial part of their operating expenses to the borrowers in terms of interest rate charges. Through the expansion of a range of financial instruments and use of technology in providing financial services to general public, the commercial banks in Sri Lanka could be geared to function viably while maintaining a lower spread between deposit and lending rates for the benefit of both the savers and the borrowers.

4. Data and Methodology

4.1 Data Source

Data for this research were collected from the *International Financial Statistics* (2009) of the International Monetary Fund, *World Development Indicators* (2009) of the World Bank and *Annual Reports* of the Central Bank of Sri Lanka. Annual data covering the period of 1960–2008 were used in the study.

4.2 Measuring Financial Development

The review of literature in section 2 (Table I) indicates that economists have been adopting various indicators capable of describing different aspects of the development of a financial system. The selection of measures of financial development for this study is based on those indicators reviewed in section 2.

It appears that monetary aggregates such as M_2 and M_3 as a ratio of nominal GDP, have been widely used in measuring financial deepening. This is because liquid liabilities of financial intermediaries, such as currency, demand deposits, savings and time deposits of commercial banks and savings of other financial institutions measured against GDP (nominal) provide some indication of the overall size of the financial intermediaries of a financial system. This study uses the logarithmic ratio of M_2 to nominal GDP (M) as one of the proxy for measuring financial development but ignores M_3 as a ratio to nominal GDP considering the inadequacy of data points and the types of financial assets added to construct M_3.

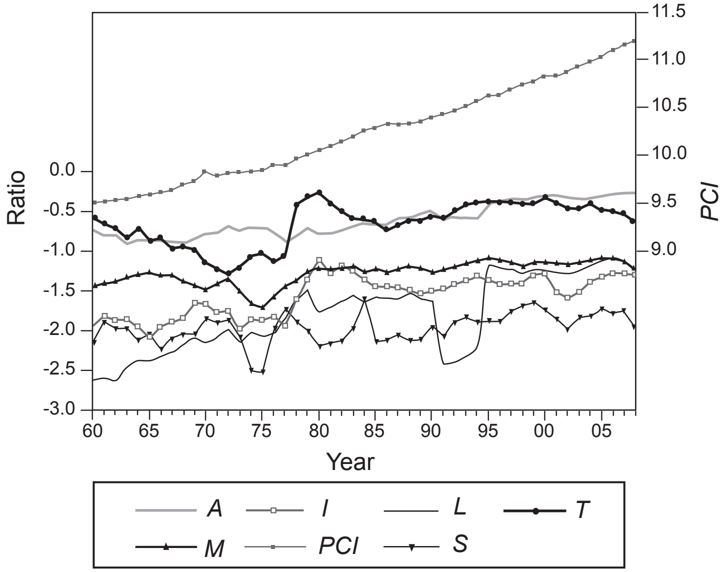
The logarithmic ratio of private sector credit by financial intermediaries to nominal GDP (L) is used as a second proxy in measuring financial sector development. When financial deepening is measured, it is necessary to observe the ability of financial intermediaries in reducing information and transaction cost and assisting market participants to take risks while channeling savings to productive purposes in an efficient manner. Commercial banks credit to private sector reflects a better view in measuring these aspects. Exclusion of credit to the public sector is necessary in measuring efficient resource allocation, considering the fact that public sector loans have been granted with less attention being paid to prudential lending requirements of banks. (see Demetriades and Hussein, 1996 and Ang and McKibbin, 2007).

The third measure used in this study is the logarithmic ratio of commercial bank assets to the sum of assets of both commercial banks and the Central Bank (A). This measure has been widely used in the literature, after it was first introduced by King and Levine (1993). This indicator is useful in measuring the relative importance of commercial banks involvement in developing the financial sector. Further, it represents the degree to which commercial banks allocate resources of the economy in comparison with that of the Central Bank. The usual intuitive judgment behind this measure is that commercial banks are efficient in resource allocation through its ability to identify risks of the projects, monitor mangers, and fund only viable ventures whereas the Central Bank role usually differs from that of the commercial banks.

4.2.1 Constructing an Index of Financial Development

Each of the financial variables selected has its own merits and demerits and provide some support in measuring various aspects of financial development. However, more often these financial indicators are complement to each other rather than substitutes. If a high correlation exists among the three variables, it might imply the presence of some form of causality among them. A single index of financial development is thus preferred and this index resolves the problem of multi-collinearity and the over-parameterization problem likely to occur under VAR framework satisfactorily. The PCA which is adopted to reduce a large set of correlated variables into a few number of uncorrelated variables can be employed for this purpose. This study therefore, examines correlation of key variables before the application of PCA to construct a single composite index which will reflect financial development of Sri Lanka.

Figure I : Behaviour of Key Variables



Note:

A	=	logarithmic ratio of commercial bank assets to commercial bank assets plus central bank assets
M	=	logarithmic ratio of liquid liabilities (M_2) to nominal GDP
L	=	logarithmic ratio of private sector credit to nominal GDP
PCI	=	logarithm of per capita real GDP
T	=	logarithmic ratio of exports and imports to nominal GDP
I	=	logarithmic ratio of gross investment to nominal GDP
S	=	logarithmic ratio of gross domestic savings to nominal GDP

Figure I shows the pattern of changes in *PCI* and other key variables in logarithmic form over the period of 1960-2008.

The correlation matrix[5/] given in Table V shows that three financial proxies are substantially correlated. This correlation justifies the adoption of PCA to construct a single composite index for three financial proxies to represent financial development in the

5/ logarithm of real per capita GDP (*PCI*) has a significant correlation with three financial proxies, *A, L* and *M*. In particular, logarithmic ratio of the assets of commercial banks to assets of both Central Bank and the commercial banks (*A*) has a very high correlation with *PCI*. However, the correlation does not reveal exact nature of causality present in underlying variables.

country. Accordingly, a new financial development proxy, denoted as *F* is created using PCA of which details appear in the Table VI.

Table V : Correlation Matrix

	A	*L*	*M*	*PCI*	*I*	*S*	*T*
A	1.000000						
L	0.786997	1.000000					
M	0.637232	0.587258	1.000000				
PCI	0.942178	0.821362	0.725570	1.000000			
I	0.610998	0.680681	0.720535	0.747020	1.000000		
S	0.493398	0.411824	0.529580	0.502866	0.351711	1.000000	
T	0.575686	0.516685	0.770674	0.621272	0.740048	0.320622	1.000000

Note : See Note under Figure I for the definition of Acronyms

Table VI : Principal Component Analysis for a Financial Depth Index

Eigenvalues: (Sum = 3, Average = 1)

PCA	Value	Cumulative Value	Proportion	Cumulative Proportion
1	2.344737	2.344737	0.7816	0.7816
2	0.446213	2.790950	0.1487	0.9303
3	0.209050	3.000000	0.0697	1.0000

Eigenvectors (loadings):

Variable	PC 1	PC 2	PC 3
A	0.600775	-0.291242	-0.744479
L	0.588080	-0.469816	0.658358
M	0.541509	0.833338	0.110980

Table VI summarises the results obtained from the PCA. The eigenvalues and eigenvector loadings are presented for 3 principal components. The eigenvlaue of the 1st principal component explains about 78 per cent of the standard variance while the 2nd principal component explains another 15 per cent. The 1st principal component which captures most of the information, and explains the variations of the dependent variable better than any other linear combination of explanatory variables, can be selected as the best measure of financial development of Sri Lanka. The linear combination of three proxies of financial development will be multiplied by the loadings relating to 1st principal component to arrive at the new series. The relative weights used for *A, L* and *M* were 34.7 per cent, 34.0 per cent and 31.3 per cent respectively.

4.3 The Model and Econometric Methodology

The relationship of financial depth and growth nexus can be presented in following model.

$$F = f\,(PCI,\, Z) \qquad \text{……….} \ (1)$$

where *F* refers to the composite index of financial development and *PCI* is logarithm of real per capita GDP. *Z* is a conditioning variable which is used to avoid specification bias of the model. According to theoretical considerations and empirical studies, a few variables which can be used as possible candidates for *Z* are the ratio of gross domestic savings to nominal GDP (*S*), ratio of gross investment to nominal GDP (*I*), real interest rate (*R*) and ratio of exports and imports to nominal GDP (*T*), all represented in logarithmic values except (*R*).

This study employs econometric techniques called VAR and constructs a 3-variable VAR model for estimation purpose. The VAR is a framework used for modelling multivariate relationships. Its variables called endogenous variables (*k*), are described as a linear function of only their past evolution for a given sample period (t = 1, ..., T). This approach helps to view finance-growth relationship both as a dynamic manner and as an autoregressive process. With the inclusion of lagged values of the endogenous variables, it is expected to eliminate the bias associated with simultaneity and serial correlation.

The VAR models with control variables of *S, I, T* and *R* will be constructed initially, as a first step towards the analysis of causal relationship between the financial development and growth. This approach would be extended to the employment of Vector Error Correction Mechanism (VECM), if the variables in the underlying regressions are found to be cointegrated.

4.3.1 Testing for Unit Roots

It is important to observe whether the data variables are stationary before application of standard estimation procedure in a dynamic time series model. This is because, regressing a nonstationary variable Y_t upon another nonstationary variable X_t may lead to a so-called spurious regression, in which estimators and test statistics are misleading. Augmented Dickey Fuller (ADF) and Phillips–Perron (PP) tests are used to examine the presence of unit roots in the data series. The ADF test is employed for the regression in following form

$$\Delta Y_t = \alpha_1 + \alpha_2 t + \Theta Y_{t-1} + \gamma_i \sum_{i=1}^{m} \Delta Y_{t-1} + \varepsilon_t \qquad \text{………. (2)}$$

where, ΔY_{t-1} is the number of lagged difference terms (m) to include in the regression so that error term in equation (2) would be serially independent. α_1 is the drift coefficient while t represents the deterministic trend. ε_t represents a sequence of uncorrelated stationary error terms with zero mean and constant variance. The ADF test suggests that a time series has a unit root if Θ is not significantly different from zero, and it is stationary if Θ is significantly different from zero ($\Theta < 0$). The PP test built on (2) where $\gamma = 0$, makes a non-parametric correction to the t-test statistics. The PP unit root tests are robust to serial correlation and time dependent heteroskedasticity.

4.3.2 Testing for Cointegration

Data series will be tested for cointegration if the nonstationarity is found in each data series by the unit root tests. The presence of cointegration is tested using Johansen (1988) maximum likelihood procedure.

The VAR(P) model for a k-dimensional vector Y_t can be reformulated into a Vector Error Correction (VEC) form as follows.

$$\Delta Y_t = \Pi Y_{t-1} + \sum_{j=1}^{k-1} \Gamma_j \Delta Y_{t-j} + \delta_0 + \varepsilon_t ,\ \varepsilon_t \text{ is } NID\,(0, \Sigma) \qquad \text{………. (3)}$$

Where

$\Pi \quad = \sum_{j=1}^{k} \Theta_j - I$, $\quad I$ is the identity matrix

$\Gamma_j \quad = -\sum_{i=j+1}^{k} \Theta_i \quad$ and

$\Delta Y_t \quad = Y_t - Y_{t-1}$, $\quad \Delta$ is the differencing operator

The rank of Π in equation (3) is equal to the number of cointegrating vectors (r). Two types of tests are employed to determine r;

$H_0 : r \leq r_0$ versus the alternative $H_1 : r_0 < r \leq k$ can be tested using the statistic

$\lambda_{trace}(r_0) = -T \sum_{j=r_0+1}^{k} ln(1 - \hat{\lambda}_j)$. This is the so-called trace test. It checks whether

the smallest $k- r_0$ eigenvalues are significantly different from zero. Furthermore, we can test $H_0 : r \leq r_0$ versus the more restrictive alternative $H_1 : r_0+1$ using the statistic

$\lambda_{max}(r_0 \leq r_0+1) = -T\ ln\ (1- \hat{\lambda}_{r_0+1})$. This is called the maximum eigenvalue test as it tests

whether the estimated $(r_0+1)^{th}$ largest eignevalue is significantly different from zero.

Further, if the cointegrating relationship is found, it could be concluded that there is some long-term relationship among the variables of the data series. If variables are linked by some long-run relationship, from which they may deviate in the short-run but will return to the long-run relationship, residuals will be stationary. Conversely, when variables diverge without bound there will be nonstationary residuals with no equilibrium relationship.

4.3.3 Error Correction Mechanism (ECM)

According to Engle and Granger (1987), if the variables in a regression are cointegrated, then there exists a valid error-correction representation of the data. As stated earlier, a set of data variables that are cointegrated, has a long-run equilibrium relationship but there is a need to correct the short-run disequilibrium that may exist between the variables in order to maintain consistency with the long-run equilibrium. This long-run equilibrium corresponds to a steady state growth path.

Matrix Π in equation (3) which has rank r can be decomposed as $\alpha\beta'$.

Thus $\Pi = \alpha\beta'$ where α is a (nxr) matrix and implies the speed of adjustments towards the long-run equilibrium when there are short-run deviations from its equilibrium (where a larger α suggests a faster convergence towards the long-run equilibrium). β' is a (nxr)' matrix of cointegrating vectors that include the long-run coefficients in the VECM.

For example, when $r = 1$ and $n = 3$, α and β take the form

$$\alpha = \begin{bmatrix} \alpha_{11} \\ \alpha_{21} \\ \alpha_{31} \end{bmatrix} \text{ and } \quad \beta' = (\beta_{11} \;\; \beta_{21} \;\; \beta_{31})$$

This study is a 3-variable case and the VECM with one cointegarated relationship could be written as follows.

$$\nabla F_t = \mu_1 + \alpha_{11}\, ECT_{t-1} + \sum_{j=1}^{p-1} A_{1j} \nabla F_{t-j} + \sum_{j=1}^{p-1} A_{1j} \nabla PCI_{t-j} + \sum_{j=1}^{p-1} \Psi_{1j} \nabla Z_{t-j} + \varepsilon_{1t}$$

$$\nabla PCI_t = \mu_2 + \alpha_{21} ECT_{t-1} + \sum_{j=1}^{p-1} A_{2j} \nabla F_{t-j} + \sum_{j=1}^{p-1} A_{2j} \nabla PCI_{t-j} + \sum_{j=1}^{p-1} \Psi_{2j} \nabla Z_{t-j} + \varepsilon_{2t}$$

$$\nabla Z_t = \mu_3 + \alpha_{31} ECT_{t-1} + \sum_{j=1}^{p-1} A_{3j} \nabla F_{t-j} + \sum_{j=1}^{p-1} A_{3j} \nabla PCI_{t-j} + \sum_{j=1}^{p-1} \Psi_{3j} \nabla Z_{t-j} + \varepsilon_{3t}$$

Where Z is the conditioning variables (S, I, T or R), ε_t' s are Gaussian residuals and

$ECT_{t-1} = F_{t-1} + (\beta_{21} / \beta_{11})\, PCI_{t-1} + (\beta_{31} / \beta_{11})\, Z_{t-1}$ is the normalized equation.

From the above equations, two sources of causation can be found *i.e.,* through the *ECT,* if $\alpha \neq 0$, or through the lagged dynamic terms. The *ECT* measures the long-run equilibrium relationship while the coefficients on lagged difference terms indicate the short-run dynamics. The statistical significance of the coefficients relevant to *ECT* provides evidence of an error correction mechanism that drives the variables back to their long-run relationship. The VECM approach would be useful in finding the direction of causality among variables and distinguishing between the short-run and long-run of such causality. All the variables in the VECM are considered endogenous and thus clears the problem of endogeneity as well.

5. Empirical Results

5.1 Unit Root Tests

Table VII shows the results of the ADF and PP tests for variables, *F, I, S, T* and *PCI* and the first differences of these variables.

Table VII : ADF and PP Unit Root Tests

Variable	Augmented Dickey Fuller		Phillips-Perron	
	τ_μ	τ_t	τ_μ	τ_t
F	-1.179229	-2.580963	-1.153051	-3.221846
I	-1.952500	-2.024272	-1.867447	-2.680222
S	-2.505500	-2.992211	-2.822737	-2.278126
T	-1.781905	-1.781905	-1.742635	-2.471992
R	-2.259286	-2.155820	-2.340276	-2.294414
PCI	1.747088	-1.425336	2.358265	-1.473550
ΔF	-4.619103*	-4.545473*	-6.262118*	-6.184895*
ΔI	-4.517948*	-4.467295*	-6.348521*	-6.277036*
ΔS	-5.934634*	-5.858460*	-6.936366*	-6.856128*
ΔT	-4.090368*	-4.004910	-5.592769*	-5.517829*
ΔR	-6.234788*	-6.287012*	-10.020470*	-9.998190*
ΔPCI	-2.861208**	-3.566524**	-7.261605*	-8.046042*

Note: Test results are reported from the ordinary least square estimation of the autoregression, as described under the section 4.3.1. τ_μ , is the *t* statistic for testing the significance of Θ when time trend is not included while τ_t is the *t* statistic for testing Θ when time trend is included in the equation. Δ denotes the first difference of each variable. Number of lags was selected using the *Akaike's Information Criterion* (AIC). (*) and (**) signify rejection of the unit root hypothesis at the 1% and 5% significance levels, respectively.

ADF and PP test statistics suggest that all variables have unit roots at 05 per cent significance level. All differenced terms of these variables are stationary at 05 per cent significance level, suggesting that these variables in levels are integrated of order one, I(1) {*i.e.*, the first differences of all variables are integrated of order zero, I(0)}.

5.2 Evidence from Cointegration and Causality Tests

Having observed that all nonstationary variables in their levels become stationary in first difference, the next step of this analysis involves the employment of a test (Johansen approach) to see whether there is any cointegrating relationship among these variables. Before application of the Johansen approach, the optimal lag length (p) of each model was selected by a series of nested likelihood ratio tests conducted on first-differenced VARs. Table VIII reports the results of Johansen's multivariate cointegration test based on the Trace test and maximum Eigenvalue test.

Table VIII: Johansen Cointegration Tests

Model	Trace Statistics (λ_{trace})			Maximum Eigenvalue Statistics			Lags (p)
	Hypothesized No. of Cointegrating Equations			Hypothesized No. of Cointegrating Equations			
	$r = 0$	$r \leq 1$	$r \leq 2$	$r = 0$	$r \leq 1$	$r \leq 2$	
A: (F,PCI,I)	34.13499*	14.23707	3.027333	29.89792*	11.20974	3.027333	2
B: (F,PCI,S)	42.70001*	13.89286	2.765998	24.80715*	14.12686	2.765998	2
C: (F,PCI,T)	37.39478*	13.29097	3.469936	24.10381*	9.821039	3.469936	2
D: (F,PCI,R)	28.38270	9.628151	1.972416	18.75455	7.655735	1.972416	2
Critical value at 5%	29.79707	15.49471	3.841466	21.13162	14.26460	3.841466	

Notes: * indicates rejection of the null hypothesis of no-cointegration at 5% level of significance

Source: Author's calculation

Trace test and Eigenvalue test agree and indicate that there exists a maximum of 1 cointegrating relationship in each of the model A, model B and model C at 05 per cent level of significance. No cointegration is found in the model D. These test results indicate that finance and growth variables show a long-run equilibrium relationship when any one of the control variables *I, S,* or *T* is used in the test. It is therefore necessary to extend this research further under model A, model B and model C.

Table IX: Cointegrated Equations

Model	LM Test Statistic 1/	Joint Jarque-Berra Test Statistic 2/	Cointegrated Equations	α_{11} 3/
A: (*F,PCI,I*)	9.287	6.666	$F_{t\text{-}1}$ = -29.315 + 2.688 $PCI_{t\text{-}1}$ - 1.162 $I_{t\text{-}1}$ (-6.450*) (2.225**)	-0.385 (-3.140*)
B: (*F,PCI,S*)	6.392	14.122	$F_{t\text{-}1}$ = 28.240 + 0.108 $PCI_{t\text{-}1}$ + 11.591 $S_{t\text{-}1}$ (-0.125) (-5.288*)	-0.008 (-0.166)
C: (*F,PCI,T*)	4.033	58.856	$F_{t\text{-}1}$ = -23.846 + 2.409 $PCI_{t\text{-}1}$ + 1.234 $T_{t\text{-}1}$ (-12.395*) (-3.466*)	-0.835 (-5.241*)

Notes: *, ** indicate 1% and 5% level of significance respectively.

1/ Lagrange Multiplier test statistic for measuring serial correlation in the residual (Ho: no serial correlation)

2/ Joint Jarque-Berra test statistic is normal distribution in residual testing (Ho: residuals are multivariate normal is not rejected at 1% level of significance)

3/ α_{11} is the loading factor which measures the speed of adjustment when there is a deviation from the long-run equilibrium

Source: Author's calculation

Table IX shows the relationship between economic growth and financial development. Lagrange Multiplier (LM) test which is performed to find serial correlation in the residuals shows that there is no serial correlation in the residuals. Jarque-Berra test suggests that residuals are Gaussian for all models (multivariate normal). By normalizing the coefficients of $F_{t\text{-}1}$ to one, the long-run cointegrated equations show that coefficients *PCI* and *I* in the model A are statistically significant at the 01 percent level and the 05 percent level respectively. In the model B, the *PCI* is not statistically significant but the *S* is significant at the 01 per cent level. According to the model C, coefficients *PCI* and *T* are statistically significant at the 01 per cent level. The long-run relationship show that real output and finance are positively related when control variables of *I* or *T* is used in the regression. Investment variable *I* is positively related to output while *T*, the trade openness is positively related to finance (*F*). In the two equations given under the model A and the model C, loading factors which measure the speed of adjustment back to the long-run equilibrium value, are significant at 01 per cent level. The loading factor is not significant in the model B.

Having established that the variables follow the same order of integration I(1), the causal relationship among these variables can be tested using first differenced series or ECM based Granger causality tests. As the VECM has already been employed due to the presence of cointegration of the variables in the underlying regression, causality will be tested using the Granger causality tests for the model A, the model B and the model C.

The *PCI* is correctly signed in the three models and the causality results are presented in respect of all models despite the fact that the relation between *PCI* and *F* is not statistically significant in the model B.

Table X: VEC Granger Causality Test- Model A

Model A : (*F,PCI,I*)

Included observations: 46

Dependent variable: D(*F*)

Excluded	Chi-sq	df	Prob.
D(*PCI*)	6.429398	2	0.0402
D(*I*)	0.487563	2	0.7837
All	6.888769	4	0.0719

Dependent variable: D(*PCI*)

Excluded	Chi-sq	df	Prob.
D(*F*)	0.358718	2	0.8358
D(*I*)	4.274014	2	0.0980
All	4.604855	4	0.3303

Dependent variable: D(*I*)

Excluded	Chi-sq	df	Prob.
D(*F*)	0.705785	2	0.7027
D(*PCI*)	3.376980	2	0.1848
All	3.902913	4	0.4193

The results given in the Table X indicate that the output growth influences the financial development as the estimated χ^2 values are statistically significant at 05 per cent level. However, no feedback relationship between *F* and *PCI* is found in this model. Although, the growth of investment is insignificant for influencing growth of finance, jointly the D(*PCI*) and the D(*I*) cause positive impact on D(*F*) at the 10 per cent level of significance. The important finding is that the causal link is running only from output to finance. Therefore, it can be concluded with statistical significance that the financial development had not been a causal factor in the economic growth of Sri Lanka. The causal relationship of finance and growth of this model agrees with the view of Robinson (1952) and others who stress the fact that enterprises in any economy play a leading role in growth process and finance only follows the growth in enterprises.

Table XI: VEC Granger Causality Test - Model B

Model B : (*F, PCI, S*)

Included observations: 46

Dependent variable: D(*F*)

Excluded	Chi-sq	df	Prob.
D(*PCI*)	1.737411	2	0.4195
D(*S*)	0.470997	2	0.7902
All	2.543057	4	0.6369

Dependent variable: D(*PCI*)

Excluded	Chi-sq	df	Prob.
D(*F*)	0.236302	2	0.8886
D(*S*)	0.399128	2	0.8191
All	0.678652	4	0.9539

Dependent variable: D(*S*)

Excluded	Chi-sq	df	Prob.
D(*F*)	1.058696	2	0.5890
D(*PCI*)	0.390466	2	0.8226
All	1.351844	4	0.8525

The model B tested using the control variable *S* provides results that have no any statistical significance. Hence, we could disregard this model for measuring the causal link between output and financial development. These results are obviously in compatible with the respective cointegrated equation of which coefficients of *PCI* and α_{11} were also reported statistically insignificant.

Table XII: VEC Granger Causality Test - Model C

Model B : (*F, PCI, T*)

Included observations: 46

Dependent variable: D(*F*)

Excluded	Chi-sq	df	Prob.
D(*PCI*)	4.209181	2	0.0919
D(*T*)	6.187976	2	0.0453
All	10.66022	4	0.0307

Dependent variable: D(*PCI*)

Excluded	Chi-sq	df	Prob.
D(*F*)	0.125002	2	0.9394
D(*T*)	0.758704	2	0.6843
All	1.352109	4	0.8525

Dependent variable: D(*T*)

Excluded	Chi-sq	df	Prob.
D(*F*)	2.486358	2	0.2885
D(*PCI*)	3.561593	2	0.1685
All	4.891986	4	0.2986

The results given in the Table XII in respect of the model C which uses D(*T*) as the control variable show that D(*PCI*) and D(*T*) have a causal relationship with D(*F*) at the 10 per cent and 05 per cent level of significance respectively. When these variables taken jointly, the causal link is significant with *F* at the 05 per cent level. However, no feedback relationship is found between output and financial development in this model as well. The development in finance causes no impact on growth of trade openness in the country according to the results given in the Table XII.

6. Policy Implications and Conclusions

A large number of empirical studies on the finance-growth nexus have found a positive correlation between the financial development and the economic growth. This research also finds a strong positive correlation between financial sector development and economic growth for Sri Lanka. Since the establishment of the causality has policy implications on the formulation of appropriate financial sector policies, this research has focused on identifying causal relationship of the finance-growth nexus relating to Sri Lanka. The cointegration and ECM based Granger causality tests were conducted and analysed for this purpose.

The cointegration results show that there is a long-run relationship between real output and finance when investment (*I*) or trade openness (*T*) is used as a control variable in the regression. The investment is positively related to output while the trade openness is positively related to finance (*F*). The causality test results show that the economic growth causes the financial development of the country but there is no feed-back relationship between these two variables. This finding falls into the school thought of Robinson (1952), which believes in that the financial sector development takes place only in response to the economic growth of a country. Further, this conclusion is in line with the views expressed by Demetriades and Hussein (1996), Macri and Sinha (2001) and Abma and Fase (2003) but basically disagrees with the observations made by Ahmed and Ansari (1998), on the finance-growth link relating to Sri Lanka. Ahmed and Ansari (1998) have tested causality using variables at their levels, the procedure of which the results are valid only if the underlying variables are stationary or they are cointegrated. The current study has recognized these aspects and accordingly checked the presence of stationarity and cointegration of the variables, using appropriate econometric tests before conducting causality tests.

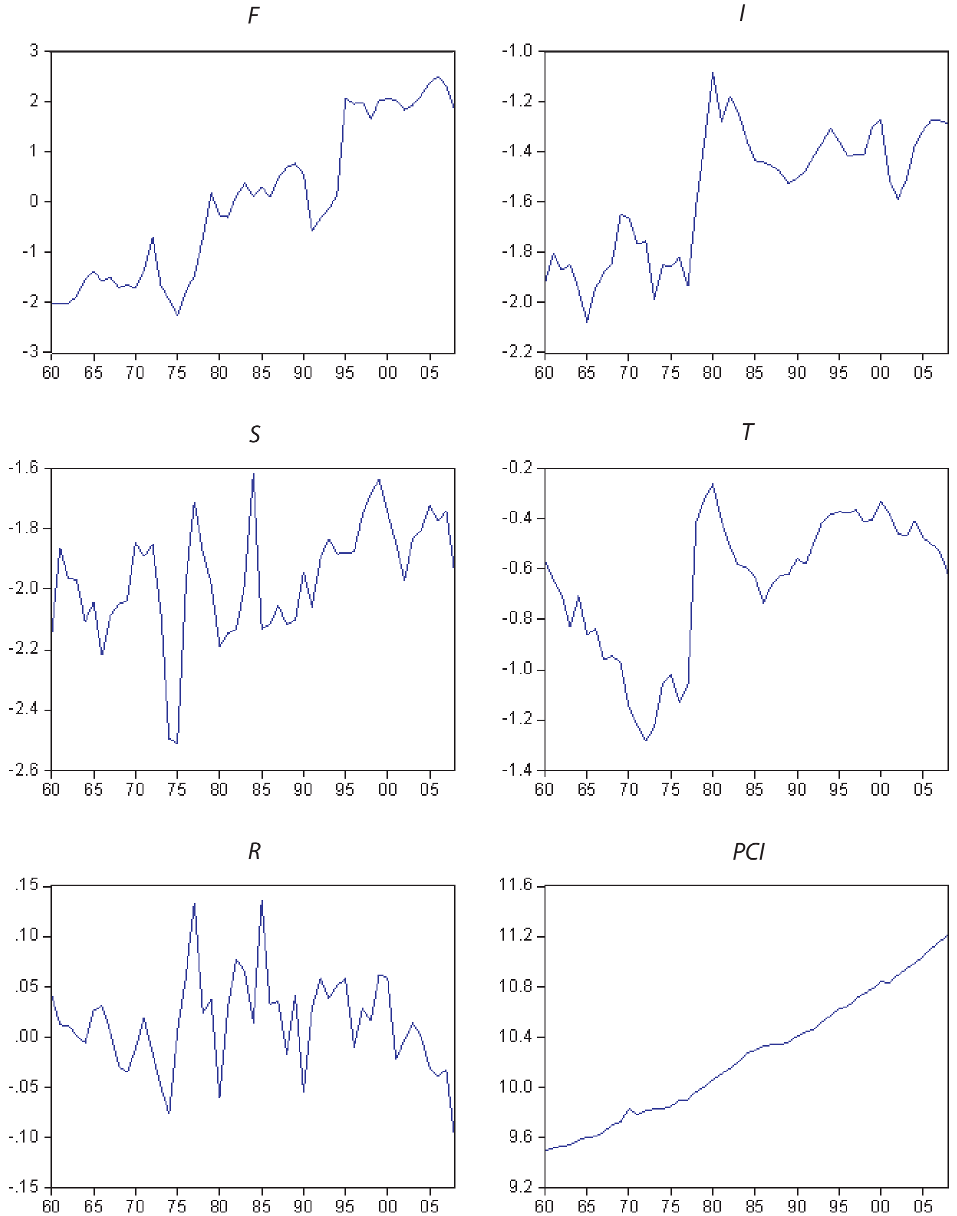
Further, the causality tests of this research also suggest that the increase in investment causes economic growth while the increase in investment and economic growth jointly cause the financial sector development. It is also evident that increase in trade individually and together with economic growth causes the improvement in the financial sector. With some degree of statistical significance, it is also possible to deduce that there is a causal impact running from the economic growth to export and import trade of the country. In summary, the financial sector development of the country is dependent upon its economic growth, investment and trade but there is no feed-back relationship running from financial development to any of these variables.

The main finding of this research which supports the demand following hypothesis rather than any other relationship including the most competing view, the supply leading hypothesis, implies further that the economic growth of the country is mainly influenced by other variables such as investment. As far as the policy implications are concerned, this finding indicates that relevant authorities need to focus on investment in achieving higher economic growth. It is also observed that financial markets and institutions of the country grow in response to the demand created by growing economy and increase in investment and trade. This process, in turn, would facilitate the financial sector of Sri Lanka to achieve efficiency through financial widening and deepening as predicted by the theory and empirical evidence.

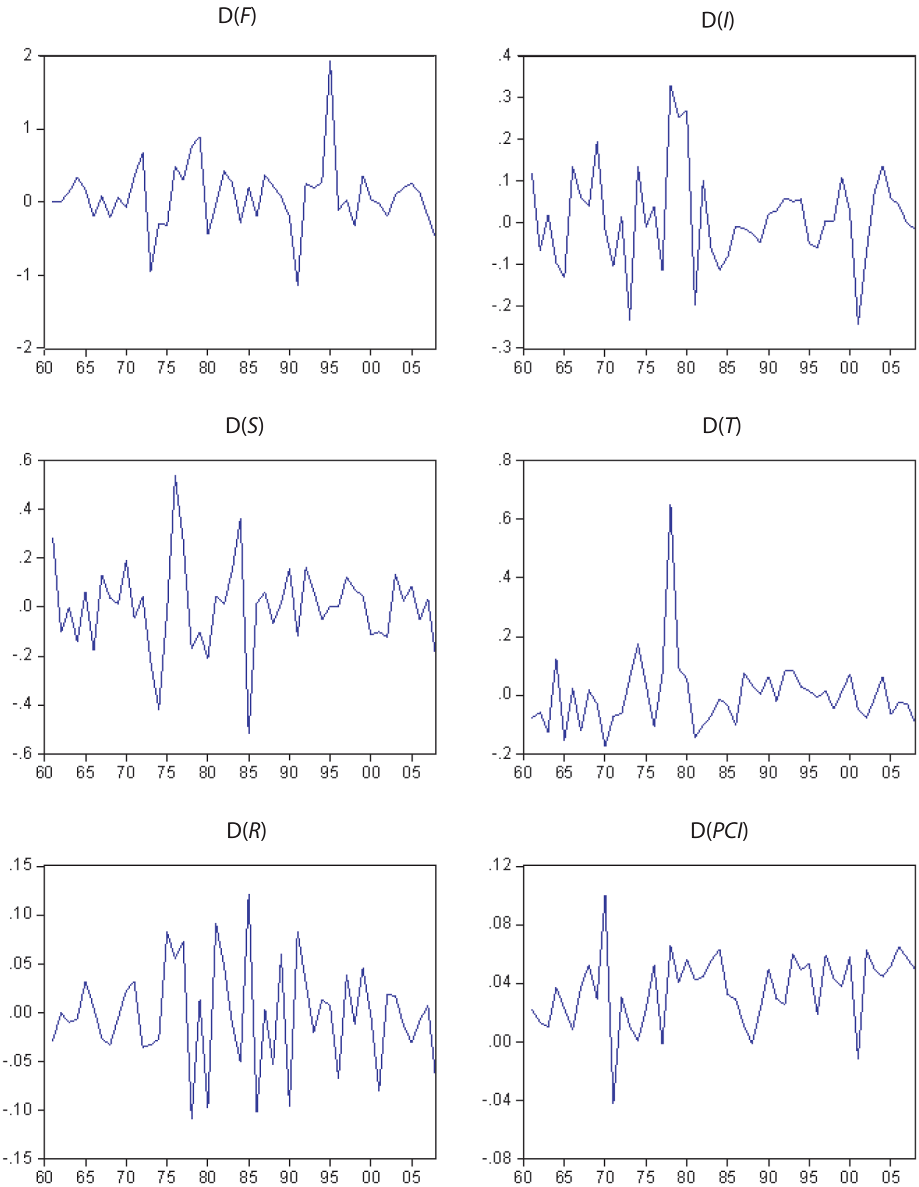
As discussed in the literature review, Jung (1986), Demetriades and Hussein (1996), Macri and Sinha (2001), Ang and McKibbin (2007), Liang and Teng (2006) and Kemal et al. (2007) have expressed views that go entirely or partially in line with the demand following hypothesis. Some of these research studies have also highlighted that the financial development has not caused higher economic growth due to the effect of country specific conditions including the unavailability of efficient financial systems. These aspects in relation to Sri Lanka have been assessed briefly in section 3. However, the finance-growth nexus may be viewed further in relation to the effectiveness of financial system of Sri Lanka in performing its tasks that would have been instrumental in the determination of causality pattern between the financial sector development and the economic growth of the country.

Appendix 1

Key Variables in Levels



Key Variables in First Difference



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Return Volatility and Asymmetric News Effect in Sri Lankan Stock Market

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Abstract

This paper studies daily and monthly returns in the Colombo Stock Exchange (CSE) in order to identify dynamics of return series and find out whether asymmetric volatility exists in the market. The study is carried out employing symmetric GARCH model, EGARCH model and GARCH-M model with a sample period from January 1998 to June 2009. It was found that daily return exhibits ARCH effect and it is not normally distributed. The monthly return series found to be normally distributed and it does not exhibit ARCH effect. In-depth analysis on daily return using symmetric GARCH model has supported the fact that the daily return shows time-varying volatility with high persistence and predictability. Asymmetric EGARCH model has found the presence of asymmetric volatility indicating that the market reacts more to a negative than shock a positive shock of the same size. It was also found that risk-return relationship is not statistically significant, though it was found to be positive. These findings would be useful to policy makers, stock brokers and the investors in pricing, hedging and portfolio management and these models could be used to estimate and forecast volatility for risk management decision making at CSE.

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Section 1

INTRODUCTION

Volatility in stock return is often perceived as a measure of risk, thus increasingly used in asset pricing, hedging, risk management and portfolio selection. Accurate modeling and forecasting of the variance receive a lot of attention in the investment community. Therefore, studying the stock market for identifying the persistence in volatility and its dynamics to the impact of news is worthwhile. Studies on this area generally focus on different properties of the return series such as volatility clustering, leptokurtosis and asymmetric news effect.

Though there are a number of studies on stock market volatility, studies focusing on emerging markets are very limited. A few studies have been carried out in South Asian regional stock markets, which have employed basic GARCH model and its variations to study the volatility and asymmetric news effects. This paper aims at studying the dynamics of stock return and conditional volatility in the Colombo Stock Exchange. The author attempts to find answers to the following questions:

- Does stock return volatility change over time?
- Does volatility persist for a long time?
- Is there an asymmetric volatility in stock return?, and
- What is the risk-return trade-off in the Sri Lankan Stock Market?

The study is carried out on the Colombo Stock Exchange with a sample period covering a long period of more than eleven years on daily basis starting from January 1998 to June 2009. All Share Price Index (ASPI) is studied for return volatility. In addition to the daily return, monthly return for the same sample period is also studied to examine whether daily returns and monthly returns show different properties. GARCH model is employed to determine the dynamics of the volatility series and EGARCH is applied for testing asymmetric news effect on volatility. Further, GARCH-M is used to study the relationship between expected risk and expected return.

This paper is organized as follows. Section 1 provides an overview of the research and Section 2 explains theoretical underpinnings and empirical evidences of the selected research area. Section 3 briefly describes the methodology. An in-depth analysis of the data is carried out in Section 4 followed by the conclusion in Section 5.

SECTION 2

REVIEW OF LITERATURE

2.1 Introduction

Return volatility is a measure of the intensity of unpredictable changes in asset returns. The task of volatility models is to explain the historical pattern of the volatility, estimate the parameters of the volatility and use these to forecast the volatility in the future. The majority of traditional economic models assume that the variance, as a measure of uncertainty, is constant over the time, while the empirical findings reject this. When the stock market is efficient the volatility in stock price should be related to the volatility in the variables affecting the stock price, mainly the dividend. However, empirical studies carried out in the past have proved that the volatility in dividend is not high as the volatility in stock prices. Thus, excessive volatility in stock prices is depended on the changes in discount rate also. Earlier researches on volatility assumed a constant discount rate. However since the discount rate is a measure of investors' preference for risk, which may change over time, the constant discount rate is therefore no longer valid. The research interest on stock market volatility thus have shifted from the dividend policies of corporate to investors' behavior and trading patterns in the market.

As noted by (Krainer, 2002) the volatility in stock return is not surprising: stock market volatility should depend on the overall performance of the economy and real economic variables themselves tend to display persistence in volatility. Volatility is a proxy for investment risk. Persistence in volatility implies that the risk and return tradeoff changes in a predictable way over the business cycle (Krainer, 2002). The persistence in volatility can be used to predict future economic variables in countries with advanced stock markets. For example, Campbell, *Et. al*. (2001) have shown that stock market volatility helps to predict GDP growth. Though, in countries like Sri Lanka, this might be unrealistic, because of relatively lower level of market capitalization to GDP. In Sri Lanka, though the market capitalization to GDP is relatively small compared to the advanced countries, the CSE is expanding and recording improved performance in the last few years. Therefore, though stock return volatility could not be considered as a predictor of economic performance in Sri Lanka, it provides some signal about the health of the financial markets and the economy.

2.2 Reasons for volatility

While there is a general consensus on what constitutes stock market volatility, there is far less agreement on the causes of changes in the stock market volatility (Mala and Reddy, 2007). They further quote Engle and Ng (1991), who attribute arrival of new and unanticipated information as the key cause for the volatility. Some of the others attribute changes in trading volumes and pattern driven by the changes in macroeconomic policies, shift in investor tolerance of risk and increased uncertainty as a cause for volatility. In addition, political changes, civil security situation and global events are also cited as causes of return volatility. The volatility in the stock return is often explained based on the time span. Long-term volatility is mainly cased by financial leverage, operating leverage and state of the economy (Schwert, 1990). Returns on shares of highly leveraged firms are subject to more volatility, as the investors have to bear more risk. Similarly, operating leverage too has an impact on long term volatility of stock returns. Firms with a considerable amount of fixed costs are more vulnerable to changes in economic conditions. For instance, in the times of economic slowdowns, profits of those firms having more fixed costs tend to suffer more than the firms operating with limited fixed costs. Macroeconomic performance of the economy also has an impact on the long-term volatility. There are sufficient evidences to prove that the volatility increases during economic recessions. Great depression and the current financial crisis have records of high volatility in stock returns in stock exchanges all over the world.

In addition to the above factors there are certain factors which influence stock volatility in the short-term. Attempts by many people to trade simultaneously in the same direction (either to buy or sell) cause volatility in the market (Schwert, 1990). Arrival of a new piece of information (positive or negative) tends to make investors to think the current price is too low or too high. If all investors feel that the price is too high they will try to sell their share holdings immediately. When there is no corresponding buying interest from other investors, the prices will fall sharply, causing a short-term volatility in the returns.

Moreover, as noted by Schwert (1990) investor perception about the persistence of current movement in share prices will also influence the future movements of the share price. For example, once the price starts falling and the investors believe that the fall will continue, they will be willing to sell the shares. If there are no hunters of under-priced shares, it will end up with a sharp fall in prices.

2.3 Volatility Modeling

Financial time series are found to depend on their own past value (autoregressive), past information (conditional) and exhibit non-constant variance (heteroskedasticity). Also, volatility in asset returns are found to be changing over time (time-varying) and exhibits positive serial correlations (volatility clustering) as cited by Bahadur (2008). Financial time series are said to have three main properties: volatility changes widely across the time (volatility clustering), leptokurtosis and leveraging effect. In the presence of these properties, employing constant variance models is inapt in financial time series. In most of the financial time series, variance of the error depends on the volatility of the errors in the recent past. Engle (1982) proposed Auto-Regressive Conditional Heteroskedasticity (ARCH) to deal with these situations. Empirical evidences suggest that high ARCH order has to be selected in order to capture the dynamics of the conditional variance. Bollerslev(1986) proposed a Generalised ARCH model (GARCH) for high order conditional variance. GARCH model as well as its variations has been employed by the majority of the researchers in this area.

There are mainly three reasons to model and forecast volatility. First, is to measure the risk of holding an asset (share). Second, is to obtain more accurate intervals by modeling the variance of the error, as forecast confidence intervals may be time-varying. Third, more efficient estimators can be obtained if heteroskedasticity in the errors is handled properly. ARCH models are specifically designed to model and forecast conditional variances. The term ‘conditional’ implies a dependence on the observations of the immediate past and the autoregressive and describes a feedback mechanism that incorporated past observations into the present. So that, ARCH and GARCH models are the mechanisms that included past variances and the past variance forecasts in the explanation and forecast of the future variances.

ARCH and GARCH models have become important tools in the analysis of time series data, especially the financial time series. The least square model, being the workhorse of applied econometrics was used to determine how much a variable will change in response to a change in other variables. However, when it comes to determine and forecast the size of the errors in a model, there should be some other tools. ARCH and GARCH are such tools to analysis and forecast the error (variability or volatility) in the models. The basic version of the lease square model assumes that the expected value of all the squared error terms (variance of error terms) is same at any given point. This property is known as *homoskedasticity*. But in general, there are some applications, in which the variance of error term is not equal and are expected to be large at some point or a range and small at some point or a range. This property is known as heteroskedasticity. In the presence of heteroskedasticity, the standard errors and the confidence intervals estimated conventionally by the least square model will be too narrow, though the regression coefficients are still unbiased

(Engle, 2001). The ARCH and GARCH model treat heteroskedasticity as a variance to be modeled, instead of considering it as a problem to be corrected.

ARCH (q) model was introduced by Engle (1982) assuming that the conditional variance depends on past volatility measured as a linear function of past squared values of the process. However, the linear ARCH model has certain shortcomings such as need for a long lag length q and the non-negativity conditions imposed in parameters (Jorge, 2004). Bolleslev (1986) generalized the ARCH (GARCH (p, q)) process by allowing the conditional variance to be a function of prior period's squared errors as well as its past conditional variances. Following the introduction of ARCH and GARCH models there have been numerous refinements of the approach to modeling conditional volatility to better capture the stylized characteristics of the data (Bahadur, 2008).

However, though several merits are identified in favour of ARCH/ GARCH models, there are certain shortcomings of these models, which make these models inferior to ordinary ARMA/ ARIMA models in some cases.

Volatility clustering is one of the important properties generally observed in financial time series. It is known as a situation, where large changes in prices tend to be followed by large changes, whether it is positive or negative, and small changes tend to be followed by small changes. In the presence of volatility clustering, the squared series should be highly autocorrelated. A shock in volatility may affect the riskiness of investor portfolios not for days but also month after month (Jacobsen and Dannenburg, 2003). They highlight that volatility clustering, contrary to widespread belief, is not only present in high-frequency financial data. Monthly market returns also can exhibit significant serial dependence.

Engle, Lto and Lin (1990, cited in Karmakar 2007) provide two possible explanations for the presence of volatility clustering in return series. First, if information arrives in clusters, for instant information on interest rate, dividend, money supply, oil price *etc*, returns may exhibit clustering though the market incorporates the information perfectly and immediately. Secondly, if market participants take time to digest the information shocks and to resolve their expectation differences, market dynamics can lead to volatility clustering.

In many empirical researches it was found that volatility in the returns are highly persistent, for instance Franses and Dijk (1996), Kumar and Singhe (2008), Bahabur (2008), Karmakar (2007) *etc*. In many empirical applications using high frequency data with a long sample period one produce extreme persistence in the conditional variance, so that in the standard GARCH (1,1) model the sum of ARCH (α) and GARCH (β) parameters is close to one; *i.e.*, ($\alpha + \beta \approx 1$) (Jorge, 2004). This is due to the presence of an approximate unit root in the conditional variance. The situation of the sum of parameters of α and β approaching unity is known as Integrated GARCH effect (IGARCH), which was proposed by Engle and Bollerslev. There are a number of studies focusing of IGARCH and validity of GARCH process with very strong persistence in volatility. IGARCH implies that the return series is not covariance stationary and multi-period forecast of volatility will trend upwards. Jensen and Lange (2007) argue that the estimation of GARCH (1,1) models on financial returns almost always indicate that α is small and β is close to unity and the sum of α and β is very close to one and approaches one as the sample is increased. Following the works of Lamoreax and Lastrapes(1990, cited in Morana,2002), it is accepted in the literature that IGRACH effects can be spurious and due to unaccounted structural change in the return series.

Most of the studies on volatility of stock return also find that the variance of a stock is leptokurtic, which means that the distribution of the returns is fat-tailed (relative high probability for extreme values). This means that most of the time the stock moves around somewhat randomly. But when it deviates from this random pattern it runs a lot further and a lot faster than what market expects. So that, probability function will have fat tail.

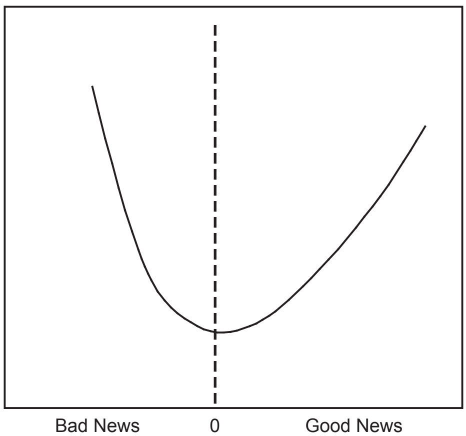
Risk- return relationship is another property widely studied in the past. Before the introduction of ARCH models, the studies on risk-return tradeoff were based on the unconditional distribution of returns. Merton (1980, cited in Karmakar, 2007) criticized the failure of the previous studies account for the effect of changes in the level of risk when estimating expected returns. It is thus important to consider heteroskedasticity in using realized returns. GARCH-in-mean (GARCH-M) model allows conditional variance (risk) to affect the mean (expected return). The basic GARCH model is based on the implicit assumption that the average risk premium is constant for the sample period. The GARCH-M model relaxes this assumption by allowing the velocity feedback effect to become operational (Karmakar, 2007). The researches on risk-return relation have mixed results with both positive, negative or zero relation. For instance, for the US market, French *et. al*. (1987) and Campbell and Hentschel (1992) report a positive relation whereas Nelson (1991) and Glosten *et. al*. (1993) found a negative relationship. Baillie and DeGennaro (1990) and Chan *et. al*. (1992) report no significant relation. Poon and Taylor (1992) found that returns have a positive, though not statistically significant, relationship with expected volatility in the UK market. Balaban and Bayar (2005) have found mixed result on the relationship between market return and forecast volatility in a study of 14 countries.

Both ARCH and GARCH models captured the volatility clustering and leptokurtosis. However, GARCH models have restriction in handling asymmetric shocks to the volatility. An asymmetric response of conditional variance to positive and negative shocks in errors is known as leveraging effect. In other words, distribution of stock returns can be skewed to left if there are more negative observations and *vice a versa*. The leveraging effect occurs when an unexpected drop in price (bad news) increases predictable volatility more than an unexpected increase in price (good news). Thus, symmetric ARCH or GARCH models can not deal with such skewness and the result from these models can be spurious.

The inability of GARCH models in capturing leveraging effect was discovered by Black (1976) and confirmed by French, Schwert and Stambaugh (1987), Schwert (1990) and Nelson (1991) and some other researchers. Several modifications were proposed by many academics to handle such asymmetric distributions. Nelson (1991) proposed an exponential GARCH (EGARCH) model, which is based on logarithmic expression of the conditional variability. Quadratic GARCH model (QGARCH) and Threshold ARCH (TARCH) are the other proposed models of this nature.

The leveraging effect is often illustrated graphically by a news impact curve. The new impact curve plots news scenarios (bad and good news) on the horizontal axis against the resulting volatility. This curve explains the different magnitude of the impact of good and bad news. Generally, the negative side of the curve is steeper than the positive side. A news impact curve for the stock return on an imaginary stock market is shown below.

Figure 2.1: News Impact Curve



Though, there were a large number of studies on the dynamics of stock return volatility, the studies focusing on emerging market are very few. There were some studies on the Indian stock market, Nepalese market and Chinese market. The author could not find any study done in the past on Sri Lankan stock return volatility. Karmakar (2007), Roy and Karmakar (1995), Goyal (1995), Reddy (1997-98) Kaur (2002, 2004), Pandey (2005) and Bahadur (2008) are some studies carried out on South Asian stock markets in the past. The findings of most of these studies confirm that the return series in these markets conform to the stylized features of the return series in general.

SECTION 3

METHODOLOGY

The study is carried out on the Colombo Stock Exchange with a sample period from January 1998 to June 2009. All Share Price Index (ASPI) is studied for return volatility. The daily data has been re-sampled to a 5-day week basis series (holidays during the weekdays are eliminated). The return is estimated as follows.

$$r_t = \log (P_t / P_{t-1})$$

Thus logarithmic daily return at time *t* is estimated by dividing the price index at time *t* by the price index on previous day.

Symmetric GARCH (1,1) model for daily stock is given below.

$$r_t = a + br_{t-1} + \varepsilon_t \qquad (1)$$

$$\sigma_t^2 = \omega + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 \sigma_{t-1}^2 \qquad (2)$$

The equation (1) is the mean equation and the equation (2) is the variance equation. The mean equation given in equation (1) is written as a function of previous day's return with an error term. Since σ_t^2 is the one-period ahead forecast variance based on past information, it is called the conditional variance. The conditional variance equation specified in (2) is a function of three terms:

(1) The mean: ω

(2) News about volatility from the previous period, measured as the lag of the squared residual from the mean equation: ε_{t-1}^2 (the ARCH term)

(3) Last period's forecast variance: σ_{t-1}^2 (the GARCH term)

It should be noted that these estimations works only if the sum of ARCH term and GARCH term is less than unity ($\alpha + \beta < 1$) and the weights of the parameters are positive ($\alpha_1 > 0, \beta_1 > 0, \omega > 0$).

The (1,1) in GARCH(1,1) is a standard notation in which the first number refers to how many autoregressive lags, or ARCH terms, appear in the equation, while the second number refers to how many moving average lags are specified (GARCH terms). Although this model is directly set up to forecast for just one period, it turns out that based on the one period forecast a two period forecast can be made and ultimately by repeating this step long horizon forecasts can be constructed (Engle, 2001). An ordinary ARCH model is a special case of a GARCH specification in which there are no lagged forecast variances in the conditional variance equation. The GARCH (1,1) is the simplest and most robust of the family of volatility models. This model can be extended and modified in many ways. The GARCH (1,1) can be generalized to a GARCH (*p,q*) model form for additional lag terms. In most applications, the simple GARCH (1,1) model has been found to provide a good representation of a wide variety of volatility processes (Bollerslev, Chou and Kroner, 1992, cited in Jorge, 2004). However, high order models are useful to estimate the parameters efficiently when a long span of data is used.

EGARCH model is employed to test the asymmetric effect in the stock return. EGARCH model was originally developed by Nelson (1991). The EGARCH (1,1) model is as follows. (only the variance equation is presented here, as the mean equation is same as in GARCH (1,1) model).

$$\log \sigma_t^2 = \omega + \beta_1 \log \sigma_{t-1}^2 + \alpha_1 \left| \varepsilon_{t-1} / \sigma_{t-1} \right| \gamma \varepsilon_{t-1} + \sigma_{t-1}$$

In this equation, the conditional variance is expressed in the log form. The parameter γ indicates the leverage effect. The exponential leverage effect is presented if $\gamma < 0$ (γ is expected to be negative in real applications). The shock is asymmetric if $\gamma \neq 0$.

GARCH-M model is used to figure out the risk-return relationship. The application of this model relaxes the assumption held in the past, such as linearity, independence and constant conditional variance (Karmakar, 2007). The general GARCH (1,1)-M model is explained as follows.

$$r_t = a + \delta \sigma_t^2 + \varepsilon_t$$

$$\sigma_t^2 = \omega + \alpha_1 \varepsilon_{t-1}{}^2 + \beta_1 \sigma_{t-1}^2$$

The variable a in the return equation can be considered as the risk free return in the CAPM and the $\delta \hat{\sigma}_t^2$ represents the market risk premium for the expected volatility. The risk-return trade-off parameter σ can take a positive, a negative or zero value depending on the nature of the selected markets. There were empirical evidences for all these types of trade-off. In the GARCH-M framework, when σ is statistically significant, then volatility (σ_t^2) contributes to the risk premium and the premia may differ from times of relative instability to times of stability.

SECTION 4

EMPIRICAL ANALYSIS

4.1 Trend Analysis and Descriptive Statistics

Before moving into in-depth econometric analyses it is more appropriate to carryout some fundamental statistical and historical trend analysis in order to better explain the properties of the selected data.

Table 4.1 and 4.2 give the 10 highest and 10 lowest daily and monthly returns, respectively, during the sample period. As noted, the highest positive returns of 20.1% and 25.3% have been recorded on daily and monthly basis, respectively, while the highest negative daily returns (lowest return) of 13.0% and 16.8%, respectively, were recorded during the sample period. It is shown from the tables that monthly return is more volatile than daily return. Overall, there are some evidences of existence of return volatility in the Colombo Stock Exchange.

Table 4.1: 10 Highest and Lowest Daily Return

Highest	%	Lowest	%
07-Dec-01	20.1	05-Nov-03	(13.0)
07-Nov-03	12.3	09-Feb-04	(10.5)
26-Jan-06	7.6	06-Apr-04	(9.5)
23-Mar-04	7.2	21-Nov-05	(7.3)
11-Oct-01	6.6	27-Dec-05	(7.1)
18-May-09	6.5	18-Nov-05	(6.9)
19-Nov-03	5.9	14-Nov-03	(6.8)
26-Jan-04	5.7	10-Nov-03	(6.2)
19-Jan-09	5.5	06-Dec-05	(6.0)
10-Dec-01	5.4	15-Jun-98	(5.2)

Table 4.2: 10 Highest and Lowest Monthly Return

Highest	%	Lowest	%
Oct-01	25.3	Aug-98	(16.8)
Jun-03	22.1	Dec-05	(16.2)
Jan-09	21.2	Oct-08	(15.0)
May-09	20.5	Jun-98	(14.9)
Sep-03	19.4	Nov-03	(14.8)
Dec-01	15.5	May-98	(12.7)
Nov-98	15.3	Nov-00	(12.1)
Jan-04	14.0	Dec-03	(12.0)
Sep-02	13.9	Sep-08	(11.1)
Sep-05	13.5	May-07	(10.8)

The summary statistics of logarithmic daily and monthly returns of ASPI is given in Table 4.3. The mean of both series are positive, indicating that overall the price indices have increased over the sample period. The return series shows a large gap between the maximum return and the minimum return. The standard deviation of monthly return is larger than the daily return, which confirms relatively high volatility in monthly returns. Statistics show

Table 4.3: Descriptive Statistics of ASPI Return

	Daily Return	Monthly Return
Mean	0.0005	0.0095
Median	0.0003	0.0077
Maximum	0.1829	0.2253
Minimum	-0.1389	-0.1842
Std. Dev.	0.0131	0.0768
Skewness	0.2996	0.0509
Kurtosis	30.6010	3.4950
Jarque-Bera	87,078.5	1.4578
Probability	0.0000	0.4824
Q^2 (36)	355.1900	34.2470
	(0.000)	(0.552)
Observations	2,742	137

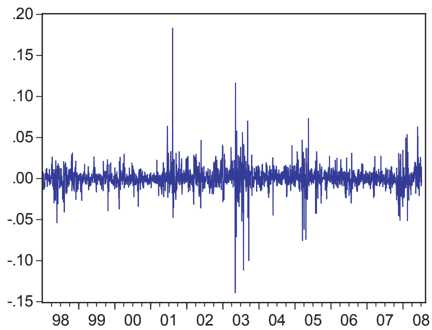
that the returns are positively skewed, or in other words series have long right tails. This property is somewhat different from the properties observed generally in stock returns, which is a negative skewness. However, the positive skewness is relatively lower in the monthly return. Further daily returns are leptokurtic of fat tailed, given its large kurtosis. The Jarque-Bera test of daily returns rejects the null hypothesis of normality proving that the daily return series is not normally distributed. However, it accepts the normal distribution of monthly return, though the kurtosis value is slightly above 3. Thus, the daily return series is not normally distributed, while the monthly return series is normally distributed.

4.2 Volatility Clustering

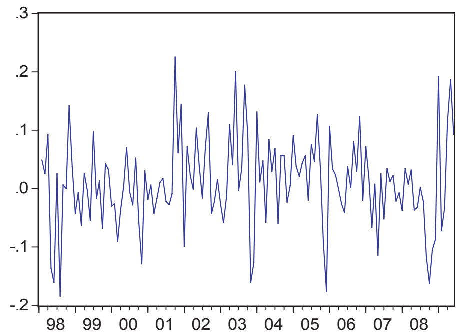
Statistically, volatility clustering implies a strong autocorrelation in squared returns. Large disturbances, positive or negative, become part of the information set used to construct the variance forecast of the next period's disturbances. The simple way to identify clustering is to calculate first-order autocorrelation coefficient in squared returns. If there is no serial correlation in the residuals, the autocorrelations (AC) and partial autocorrelations (PAC) at all lags should be nearly zero, and all Q^2-statistics should be insignificant with large *p*-values. Ljung-Box Q squared statistic at lag 36 and its *p*- values are reported Table 4.3. The Q^2-statistics at lag k is a test statistic for the null hypothesis that there is no autocorrelation up to order k (lag length). The Q^2 (36) for daily return reveal the presence of

Figure 4.1

Volatility Clustering of Daily and Monthly Returns on ASPI



Daily Return on ASPI



Monthly Return on ASPI

autocorrelation and hence volatility clustering in daily returns. The significance of autocorrelation coefficients gives evidence of ARCH effect in the daily return. However, the monthly return does not show evidence of clustering as the presence of autocorrelation and partial correlation is rejected. These characteristics are consistent with the characteristics of other financial time series. To conclude, the daily return series of ASPI is not normally distributed and exhibits ‘ARCH effect’, but monthly return is normally distributed and does not show ‘ARCH effect’. Therefore, the GARCH analysis is carried out only on daily return.

The presence of volatility clustering in daily return is further confirmed by the plots of returns. The Figures 4.1 portrays the movements of daily and monthly returns on ASPI. Accordingly, it appears that in certain time period the volatility of daily return is relatively high and in certain periods the volatility is relatively low and the volatility is clustered together. However, such clustering is not observed in monthly return.

4.3 Estimating Volatility Persistence using GARCH Model

In a financial context, an investor predicts this period’s variance by forming a weighted average of a long term average (the constant), information about volatility observed in the previous period (the ARCH term) and the forecasted variance from last period (the GARCH term). Symmetric GARCH (1,1) model is employed to measure the nature of volatility persistence in daily returns.

In the GARCH model the size of the parameters of α and β explains the dynamics of the volatility of the return series. Large GARCH error coefficient α means that volatility reacts very intensely to market movements and large GARCH lag coefficient β means the shocks to conditional variance take a long time to die out or in other words volatility is persistent (Karmakar, 2007). If $\alpha + \beta$ is close to unity shock at time *t* will persist for many future periods or volatility is persistent. In simple terms, it means that if there is any unexpected shock in the market, the resultant fluctuations will not die out immediately.

There are three basic assumptions of conditional error distribution in GARCH model: the Gaussian (normal) distribution, Student-t distribution and Generalized Error Distribution (GED). Though, the normal distribution is generally used in standard GARCH models, choosing appropriate assumption on the error distribution will give better result. Accordingly, in addition to the normal distribution the author tried the other two distribution assumptions also, such as Student-t and GED assumption. Based on the model selection criteria of minimum AIC value and maximum Log-L value, the student-t distribution is appeared to be more appropriate model.

Table 4.4 Garch Estimates for Daily Return on ASPI

Estimates	GARCH (1,1)	GARCH (2,1)	GARCH (2,2)	GARCH (4,4)
	0.0000089 (0.000)	0.0000066 (0.000)	0.0000015 (0.033)	0.0000088 (0.033)
α_1	0.3669 (0.000)	0.4318 (0.000)	0.4301 (0.000)	0.4202 (0.000)
α_2	–	-0.1496 (0.012)	-0.3620 (0.000)	0.3858 (0.000)
α_3	–	–	–	-0.1474 (0.023)
α_4	–	–	–	-0.2629 (0.000)
β_1	0.6327 (0.000)	0.7165(0.000)	1.3012 (0.000)	-0.2850 (0.074)
β_2	–	–	-0.3704 (0.000)	0.5675 (0.000)
β_3	–	–	–	0.3757 (0.000)
β_4	–	–	–	-0.0621 (0.433)
Q^2(36)	20.44 (0.983)	19.04 (0.99)	17.94 (0.995)	16.09(0.998)
Log-L	9,069.2	9,071.8	9,076.2	9,085.2
AIC	-6.613	-6.614	-6.616	-6.620
RMSE	0.013054	0.013054	0.013054	0.013054
MAE	0.007959	0.007959	0.007959	0.007959
MAPE	105.316	104.8334	104.6626	104.4379

Note: Numers in parentheses are the probability values; Log-L – Log likelihood statistic; AIC – Akaike info criterion; RMSE – Root Mean Squared Error; MAE – Mean Absolute Error; MAPE – Mean Abs.Percent Error

The result of the GARCH (1, 1) model, with Student-t assumption, is shown in the Table 4.4. According to the table the likelihood ratio statistic (Log-L) is large indicating the GARCH model is a suitable model representing the pattern of daily return series of ASPI, capturing temporal dependence of volatility(conditional volatility). The estimated GARCH lag coefficient β_1(0.6327) is higher than the GARCH error coefficient α_1(0.3669) explaining that the long lasting persistence of volatility. In other words, the lag effect of volatility is stronger than new innovations. The summation of α and β is close to unity (0.99), indicating a strong persistence of volatility or almost a permanent change in the volatility forecasting, which is very close to IGARCH property. If the volatility is highly persistent, then the volatility is predictable for the future period. High persistence of volatility (of around unity) was highly acceptable for high frequency data with longer period sample. This indicates that return series is not covariance stationary. It is suggested that either long memory or parameter changes in the data generating process can give the impression of this strong persistence (Jensen and Lange, 2007).

GARCH models with high orders were also tested to select the most suitable model, which captures the properties of the daily return of the Colombo Stock Exchange. Accordingly, the author tried various combinations of ARCH and GARCH lags and most appropriate 4 models are reported in the Table 4.4. With the model selection criteria of higher value of Log-l value and lower AIC value of the model as well as forecast result with lower values for RMSE, MAE and MAPE, the GARCH(4, 4) model found to be the most appropriate model to describe the properties of daily return.

4.4 Measuring the Asymmetric Volatility

Since symmetric ARCH or GARCH models failed to address the asymmetric responses in the returns several modifications were proposed by many academics to handle such asymmetric distributions. Exponential GARCH (EGARCH), Quadratic GARCH model (QGARCH) and Threshold ARCH (TARCH) are some of the proposed models of this nature.

This paper has employed EGARCH models with different lag levels to study the asymmetric properties of the stock return. The result of the EGARCH (1,1) and EGARCH (2,1) models are shown in Table 4.5. Also the author tried the EGARCH (2,2) and EGARCH (4,4) models, but these models provided insignificant asymmetric coefficients. The value of γ asymmetric coefficients are negative and significant at 95% confidence level. In other words, bad news tends to reduce the return more than the increase in return resulting from good news. Based on the findings of the models there is evidence

Table 4.5: EGarch Estimates for Daily Return on ASPI

Estimates	EGARCH (1,1)	EGARCH (2,1)
ω	-1.2575 (0.000)	-1.0702 (0.000)
α_1	0.5312 (0.000)	0.5908 (0.000)
α_2	–	-0.1126 (0.000)
β_1	0.9049 (0.000)	0.9210 (0.031)
γ	-0.0499 (0.032)	-0.0457 (0.039)
$Q^2(36)$	17.12 (0.99)	16.45 (0.99)
Log-L	9,066.4	9,068.5
AIC	-6.61	-6.611
RMSE	0.013056	0.013056
MAE	0.00796	0.00796
MAPE	101.995	102.059

Note: Numers in parentheses are the probability values; Log-L – Log likelihood statistic; AIC – Akaike info criterion; RMSE – Root Mean Squared Error; MAE – Mean Absolute Error; MAPE – Mean Abs.Percent Error.

of the presence of asymmetric volatility in daily returns. Based on the selection criteria of lower forecast errors EGARCH (1,1) is found to be a better model, though EGARCH (2,1) has a slightly higher value for Log-L.

4.5 Estimating Risk-Return Trade-off

GARCH-M model is employed to find out the risk-return relationship in daily returns. Empirical findings have examples of all types of relationship, such as positive, negative or zero, between expected risk and return. GARCH-M model with different lag levels have been tried to find out this relationship. All the models have found a positive, but not satistically significant relationship. It indicates that the expected return does not depend on the conditional variance. In other words, it shows the lack of risk-return trade-off over time. Karmakar (2007) and Jorge (2004) have found similar finding for Indian and Portuguese markets, respectively. Some papers suggest including asymmetric impact in the GARCH-M model to get a better result, *i.e.*, EGARCH-M. The finding of the EGARCH (2,1) model gives a better result among other asymmetric models. The result of the GARCH (4,4)-M model and EGARCH (2,1)-M model are presented in

Table 4.6: Garch-M and EGARCH-M Estimates for Daily Return on ASPI

Estimates	GARCH (4,4) - M	EGARCH (2,1) - M
ω	0.0000086 (0.005)	-1.0677 (0.000)
α_1	0.4218 (0.000)	0.5907 (0.000)
α_2	0.381 (0.000)	-0.1133 (0.029)
α_3	-0.0.1524 (0.016)	-
α_4	-0.2625 (0.000)	-
β_1	-0.2701 (0.094)	0.9212 (0.000)
β_2	0.5619 (0.000)	-
β_3	0.3714 (0.000)	-
β_4	-0.0584 (0.4575)	-
γ	-	-0.0436 (0.049)
δ	0.04854 (0.265)	0.01511 (0.716)
$Q^2(36)$	15.91 (0.99)	16.46 (0.99)
Log-L	9,086	9,086.43
AIC	-6.62	-6.61
RMSE	0.01313	0.01306
MAE	0.0081	0.008
MAPE	174.95	99.67

Note: Numers in parentheses are the probability values; Log-L – Log likelihood statistic; AIC – Akaike info criterion;RMSE – Root Mean Squared Error; MAE – Mean Absolute Error; MAPE – Mean Abs.Percent Error

Table 4.6. Though, Log-L value and AIC value of the GARCH (4,4)-M model is better than EGARCH (2,1)-M model, the forecast error in terms of MAPE has been largely reduced in the EGARCH (2,1)-M model along with small reduction in other forecast errors. Further, in the presence of asymmetric volatility in the daily return EGARCH-M models will be the most appropriate model. Thus, EGARCH (2,1)-M models has been chosen as the best model to explain the risk-return trade-off.

SECTION 5

CONCLUSION

This paper has studied the daily and monthly returns on All Share Price Index of the Colombo Stock Exchange for a period of around eleven years starting from January 1998 to June 2009. The study is mainly focused on identifying persistence in volatility, risk-return trade-off and asymmetric volatility in return. Symmetric GARCH model along with its variations; EGARCH and GARCH-M, have been employed to estimate the volatility parameters.

It was found in the preliminary analysis that the daily return does not follow a normal distribution and shows signs of presence of ARCH effect in the return series, whereas the monthly return is confirmed to be normally distributed. Further, volatility clustering was observed in daily return, but not in the monthly return. Also, the daily return exhibits time-varying conditional heteroskedasticity and leptokurtosis. These finding are supported by empirical evidence of some other studies.

Symmetric GARCH model estimation confirms that GARCH (4,4) is more appropriate model than GARCH (1,1) model. The estimated parameters show evidence of time-varying volatility exhibiting volatility clustering. High persistence in volatility and predictability was found in daily return.

Of the asymmetric models, EGARCH (1,1) was found to be the most representative model. The leveraging effect was found in the daily returns, which indicates that the stock market becomes more volatile when negative shock takes place than the positive shock.

The risk-return trade-off analysis using GARCH-M and EGARCH-M model has found that EGARCH (2,1)-M model is preferred to other models. It shows a positive but insignificant risk-return relationship, indicating that there is no significant impact of conditional volatility on the expected return.

In overall, the daily return in the Colombo Stock Exchange exhibits most of the empirically proven stylized characteristics of the return, such as time varying volatility, high persistence and predictability and asymmetric volatility responses. But, there is lack of evidence for a significant risk-return trade-off. These findings would be useful since there has been no research done in the past on the Colombo Stock Exchange focusing on this area. Thus, the understanding about these properties would be helpful to policy makers and market participant in pricing the securities, deciding on the hedging strategy and portfolio management. Given the shortcomings of traditional volatility measurement techniques in capturing stylized features of stock return volatility, such as clustering, asymmetry *etc*., for the purpose of calculating the return volatility, these models could be experimented at the Colombo Stock Exchange (CSE) in estimating and forecasting the volatility in order to use them for risk management decisions.

In terms of limitations, complete applicability of these models to a small market like CSE might be questionable. It is because of two main reasons. Firstly, financial decisions are not solely based on expected returns or return volatility as assumed in ARCH / GARCH models. Global as well as domestic economic and political volatilities could be weighted more on the decision making than actual volatility in stock returns. Secondly, ARCH/ GARCH models are parametric estimates. They perform well under stable or perfect market situations. Such characteristic are lacking in Sri Lankan stock market. Thus, these models could not be completely substituted for the simple techniques like moving average, ARIMA *etc*. This study is an attempt to examine whether ARCH and GARCH models could be experimented in Sri Lankan stock market to identify persistence of volatility in stock return and stock return series exhibit well-known stylized features of financial time series. Thus, these models could be used to improve the current volatility estimation and forecasting. Future researches on this area could concentrate on using these models to forecast volatility and check for accuracy of forecasts. Also, comparative performance of traditional volatility estimation models and ARCH / GARCH models could be examined to recommend the best model to suit the characteristics of stock return at CSE.

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Price and Income Elasticities of Disaggregated Import Demand in Sri Lanka

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Abstract

The purpose of this study is to investigate Sri Lanka's disaggregated import demand functions and their price and income elasticities, for the post-liberalization period of 1977-2007. Although there exist many studies examining aggregate import demand, there appears to be a dearth of studies on estimating price and income elasticities import demand functions of Sri Lanka at a disaggregated level. This study aims at filling this gap by estimating disaggregated price and income elasticities for three major categories of imports, viz. consumer goods, intermediate goods and investment goods. To this end, the paper employs standard characterizations of import demand functions extensively discussed in the literature. The econometric estimates reveal that relative price is inelastic for all categories of consumer goods, intermediate goods and investment goods, implying that consumers may be less price sensitive. Further, the paper also examines the effects of changes in national income and foreign exchange availability on the demand for imported goods in Sri Lanka during 1977-2007. Based on these results several policy implications could be derived with regard to dependence on foreign trade, international finance, foreign reserve management and exchange rates, public finance, particularly taxation, as well as the impact of import demand in the face of external shocks on domestic prices and inflation.

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1. Introduction

Foreign trade is one of the major determinants of a country's foreign exchange flow. While exports bring foreign exchange to the country, imports help in increasing the utility of consumers through raising the level and variety of goods and services consumed. At the same time, the government can source revenue through taxes on exports and imports. However, trade volume and hence the associated potential revenue generation from trade-based taxes depends on the price and income elasticities of exports and imports. Therefore, to formulate or implement a policy related to foreign trade, it is very important to have a clear picture on the export and import demand determinants and their elasticity. Correct identification of the determinants and their impact on export and import demand would be a great assistance to reap the expected results of an imposed trade policy.

Elasticity of import demand is useful to make policy decisions on optimal trade taxes, currency devaluation to improve the balance of trade, estimation of the government revenue from trade related taxes and estimation of the fiscal implications of trade liberalisation. Given its importance, the economics literature contains substantial research in the area. Studies range from cross-sectional work across countries to time-series research of individual countries on export and import demand functions. A number of studies have focused on estimating the aggregate import demand in several countries, while some researchers have estimated disaggregated[1/] import demand functions. Identifying the determinants and elasticity parameters of both the aggregate import demand and the individual import demand together is more useful than estimating only aggregated import demand elasticity parameters, in policy formulation. Estimating only the aggregated demand function could be misleading if the disaggregated functions behave differently.

A. Objective of the study

As mentioned above, elasticity of both aggregated and disaggregated import demand would be useful as a tool for policy measures and policy analysis. Studies on price and income elasticity of imports in Sri Lanka focus on aggregate demand [*e.g.*, Sinha (1995 & 1999), Emran and Shilpi (2001)]. There appears to be a dearth of studies on disaggregated import demand estimates of price and income elasticities of Sri Lanka. The objective of this study is to fill the above gap and identify disaggregated price and income elasticities, specifically for the three major categories of imports, *viz.* consumer goods, intermediate goods and investment goods.

1/ Disaggregated import demand function means estimating the import demand function for a single product or a product group.

After economic liberalization in 1977, over the past three to four decades, the composition of exports and imports has been changed, markedly. The composition of exports changed from domination by the agricultural sector to industrial sector while imports change to intermediate goods from consumer goods (See Appendix 1). This study will investigate Sri Lanka's demand for imports only during the post-liberalisation period, *i.e*., from 1977-2007, based on annual data.

B. Chapter Outline

The remainder of this paper is organized as follows. Chapter II provides a critical evaluation of existing literature of the field, by discussing findings related to Sri Lanka and other countries. Chapter III describes the model and econometric tools used in the paper, while Chapter IV anylises the results obtained, where by providing necessary interpretations. Finally, Chapter V concludes the discussion on determinants and elasticity of disaggregated import demand of Sri Lanka.

II. Theoretical Consideration and Review of Literature

The literature provides a substantial amount of research in this area. Many studies follow the co-integration analysis and estimate an aggregate import demand function (for example see, Carone (1996), Costas (1998), Dilip and Ahmed (1997, 2006), Tang and Nair (2002), among others). However, only a few studies attempts to invesitagate disaggregated import demand functions (Pattichis (1999), Fabiosa and Yekaterina (2000)). Overall, the import demand is modelled as a function of domestic economic activities and relative prices.

In 2002, Tang and Nair presented an empirical analysis of the aggregated import demand behaviour of Malaysia. To estimate the long run relationship between import demand and its determinants, they use an *Unrestricted Error Correction Model-Bound Test Analysis*. They estimate desired quantity of import demand, assuming that demand for import depends on income and the price, as shown in traditional import demand function. They consider real gross domestic product (GDP) for income and relative price defined as the ratio of the import price index to domestic price level. Their results show that estimated long-run elasticities of import demand with respect to income and relative price are 1.5 and -1.3, respectively, which lead to the conclusion that monetary, fiscal and exchange rate policies may be used as effective instruments to maintain favorable trade balance.

Dutta and Ahamed (1999) investigate the existence of a long-run aggregate merchandise import demand function for Bangladesh during 1974–1994, by employing cointegration and error correction modeling techniques. They convert all nominal variables in to real variables, thus the volume of real imports is determined by real import prices, real GDP and real foreign exchange reserves (export earnings, foreign assistance, and worker remittances).The nominal value of aggregated merchandise imports is deflated by the unite value index of imports in order to obtain real imports. Unit value indices of imports are deflated by domestic prices in order to obtain relative price of imports, foreign exchange reserves are deflated by GDP deflator to obtain real foreign exchange reserves.

They find a unique long-run or equilibrium relationship among real quantities of imports, real import prices, real GDP and real foreign exchange reserves. Thus, their results suggest that import demand is largely explained by real GDP which relates to general level of economic activity.

Sinha (1996) investigates the behaviour of aggregate imports in India and finds no empirical evidence in favour of the existence of any cointegrated relationship among the variables considered in the aggregate import demand function, during 1960–1992. However, Dutta and Ahamed (2006) reinvestigate the behaviour of aggregate imports in India, for the period 1971–1995 and find evidence that aggregate import volume may be cointegrated with relative import price and real GDP. Further, they report that import-demand may be largely explained by real GDP and it is generally less sensitive to changes in the import price. Their findings imply that a decarese of import prices through removal of tariff and non-tariff barriers will not lead to a proportionate rise in the flow of imports. This also reflects the noncompetitive nature of India’s imports. Thus, the finding that the quantity of imports is influenced largely by changes in real GDP than import prices is significant, in the sense that it reveals the ineffectiveness of exchange rate policy in influencing import demand. Their model includes a dummy variable to capture the effect of trade liberalisztion policies on import demand, and the estimate is very low implying a little effect of import liberalization policy on aggregate import demand in India during the period considered. However, some studies report contradictory results. For example, Senhadji (1998) assert that the price elasticity is both statistically and economically insignificant for India, reporting an estimate of elasticity as -0.13 with a t-statistic of -0.25. Similar results are reported by Caporale and Chui (1999) whose estimate of price elasticity is around -0.03, with a t-statistic of -0.08.

Milas (1998) examines import demand function in Greece and finds significant evidence in support of a long run relationship with domestic activity (Real GDP) and relative prices, with the latter being weakly exogenous for the long run parameters. While traditional import demand model consists of domestic income and relative price, some researchers attempt to include foreign exchange availability as an explanatory variable.

For example, Emran and Shilpi (1996) find that the estimated price elasticity of aggregate import demand of Bangladesh turns out to be positive, by including foreign exchange availability, determined by export earnings, remittances and disbursed foreign aid.

Having described above the international evidence of estimates of import demand faction, the remainder of this section focuses on the literature relating to estimating import demand function in Sri Lanka, among other countries. For example, Sinha (2001) investigates the price and income elasticities of imports and exports in Sri Lanka and other countries, namely India, Japan, the Philippines, and Thailand. They model import demand by including relative price (import price divided by domestic price) and income (which is proxy by real GDP), as explanatory variables. Results of the cointegration tests for the import demand functions are different, in the sense that, for example, there is one cointegrating vector for Japan and Sri Lanka but none exists for India and Thailand. Thus, they use a varity of techniques, such as Phillips-Hansen procedure, for Japan and Sri Lanka, to estimate the import demand function.

Emran and Shilpi (2001) examine foreign trade regime and import demand function. They argue that the changing trade and exchange rate policies have critical bearings on the econometric modeling of aggregate imports, as they determine a country's overall capacity to import. To analyze the aggregate imports of Sri Lanka, they use a structural econometric model of a two-good representative agent economy that incorporates a binding foreign exchange constraint at the administered prices of imports. They compare and contrast the results of the modified traditional model and the foreign exchange availability formulation. According to the modified traditional model the income coefficient has the correct sign, but it is statistically insignificant. The dynamic ordinary least squares (DOLS) estimates have the right signs but both the price and income elasticity estimates are statistically insignificant and implausibly small in magnitude. Their results clearly demonstrate that the traditional model is ill suited for estimating the elasticity parameters in the case of Sri Lanka. According to the foreign exchange availability formulation, the coefficient of foreign exchange availability is highly statistically significant with correct positive sign. Further, the mean of income elasticity estimates with GDP as the scale variable is: 0.96 (based on DOLS) and 1.09 (based on auto-regressive distributed lag -ARDL). The price elasticity estimates are identical at -0.78, regardless of the estimation technique used (ARDL or DOLS). However, it is found that the estimated price elasticity is much higher, compared to estimates in the literature, for example, Reinhart (1995) reports an estimate of price elasticity -0.30 which is about a two and-a-half times higher, and Sinha (2001) reports an estimate of -0.48.

lll. The Analytical Framework

This paper examines the import demand function of Sri Lanka by disaggregating the imports in to three main categories, namely, consumer goods, intermediate goods and investment goods. Further, the paper estimates income and price elasticities separately, instead of using an aggregate form, *i.e.*, including all goods in to one model, which may lead to biased results, given the composition of aggregate imports.

A. Methodology and the Model

This paper employs some standard characterization of models, extensively discussed in the literature. As explained above, it is standard to estimate a model for demand for import with income and relative prices (see for example, Bahmani-Oskooee(1986), Bahmani-Oskooee and Niroomand (1998), Senhadji, (1998), Sinha (1999, 2001), among others). However, some studies include foreign exchange availability as an explanatory variable, albeit, on an ad hoc basis, in order to reflect a binding foreign exchange constraint [see for example, Emran and Shilpi (2001), Mazeri (1995), Moran (1989)][2/]. herefore, in this study, we follow standard characterization of the model, which mainly include the variables; real income and relative price. However, we also attempt to incorporate the effects of other variables, such as foreign exchange availability.

As for the price variable, literature provides evidence for both relative and absolute price versions. For example, Sinha (2001) estimates export and import functions by using both relative and absolute price versions. Further, the theory of demand suggests that the quantity variable is more appropriate rather than the value, as dependent variable. Therefore, in this paper, an import volume index is employed as dependent variable. The quantity of imports depends upon the price of imports in domestic currency as well as the price of domestically produced substitutes. Since the data on price of domestically produced substitutes are not available, researchers tend to use a more general price indices, such as the wholesale price index, the consumer price index, the GDP deflator etc. Therefore, the range of goods covered in the domestic price index may differ substantially from those covered in the import unit value index (Dutta and Ahmed 2006).

According to the economic theory, it is expected that an increase in the income of the importing country will raise import demand substantially, if the income elasticity of import demand is high. Other things begin equal, this would lead to a deterioration of the balance of trade. However, this outcome is doubtful in the sense that an increase in income may lead

2/ Also, Some studies construct a log linear formulation in modeling aggregate import demand function [Khan and Ross (1977) and Salas (1982)].

to an increase in the production of many goods and services. In that case, one may expect imports to fall in the face of an increase in income (Sinha, 2001), which means that the relationship between volume of imports and income may be either negative or positive.

For import demand functions, the relative price is the ratio of import price to domestic price. An increase in the relative price is expected to lead to a fall in the quantity demanded of import. Therefore, it is expected that the relationship between volume of import demand and relative price to be negative. Further, foreign exchange availability consists of export proceeds, work remittances and disbursed foreign loans and aid. One may expect that a higher foreign exchange availability leads to more imports. Therefore, the relationship between volume of imports and foreign exchange availability may be expected to be positive.

Thus, this paper examines the disaggregated demand for imports in Sri Lanka, categorizing imports into three groups, namely, consumer goods, intermediate goods and investment goods. Following the economic theory and the literature, we employ a standard model for an import demand function, mainly with two variables, *i.e.*, income and relative prices. Further, we also model the effects of foreign exchange availability, as highlighted in the recent literature.

For estimation, we use ordinary least squares (OLS) procedure. Our data sample is from 1977-2007, based on annual data. As time series data often tend to be trended, we carry out some robustness checks of the data in order to avoid spurious results, in that. We test for stationarity of the all data series, using Augmented-Dicky-Fuller (ADF) tests. In cases, where we find evidence of non-stationarity *i.e.*, I(1) data series, we transform the series into first difference in logs. After all, using the first difference of log linear form seems to be more appropriate to estimate elasticity.

The Model

The import demand function for each category has the following form:

(i) Consumer Goods imports f (Real income, Relative price of Consumer Goods, Foreign Exchange Availability)

(ii) Intermediate Goods imports f (Real income, Relative price of Intermediate Goods, Foreign Exchange Availability)

(iii) Investment Goods imports f (Real income, Relative price of Investment Goods, Foreign Exchange Availability).

The Models in the log linear form are specified as follows, in that DLn refers to ‘first difference in logs’:

Model 1: $\mathbf{DL_n\ CON_t\ f\ (\beta_0 + \beta_1\ DL_n\ GDP_t + \beta_2\ DL_n\ RPCON_t + \beta_3\ DL_n\ FEX_t + e_t\ )}$

Model 2 : $\mathbf{DL_n\ INT_t\ f\ (\alpha_0 + \alpha_1\ DL_n\ GDP_t + \alpha_2\ DL_n\ RPINT_t + \alpha_3\ DL_n\ FEX_t + \varepsilon_t\ )}$

Model 3 : $\mathbf{DL_n\ INV_t\ f\ (\delta_0 + \delta_1\ DL_n\ GDP_t + \delta_2\ DL_n\ RPINV_t + \delta_3\ DL_n\ FEX_t + \mu_t\ )}$

Where,

CON is the quantity of consumer goods imports

INT is the quantity of intermediate goods imports

INV is the quantity of investment goods imports

GDP is Gross Domestic Product

RPCON is the relative import price of consumer goods imports, RPCON = (IMPCON/DP)

RPINT is the relative import price of intermediate goods imports, RPINT= (IMPINT/DP)

RPINV is the relative import price of investment goods imports , RPINV=(IMPINV/DP)

IMPCON is import price of goods consumer goods

IMPINT is import price of goods intermediate goods

IMPINV is import price of goods investment goods

DP is domestic price

FEX is foreign exchange availability.

In all the models described above, domestic price is proxied by CCPI, income is proxied by GDP at constant prices.

The log linear form of the import demand function means that β_1, α_1 and δ_1 are income elasticity of import demand, β_2, α_2 and δ_2 are relative price elasticity of import demand and β_3, α_3 and δ_3 are foreign exchange availability elasticity of import demand. The data source is various issues of Annual Reports of the Central Bank of Sri Lanka. Please see Appendix II for a detailed description of data.

lV. Analysis and Findings

The thrust of this study is to estimate disaggregated price and income elasticities, by examining import demand function for Sri Lanks during post-liberalization period, categorizing aggregate imports as consumer goods, intermediate goods and investment goods. This section presents the empirical findings of the study, first, the unit root test results, followed by estimates of the model.

A. Unite Root Test Results

Appendix III exhibits the dynamics of the variables considered in this study, for the sample period (1977–2007). It is standard to test for stationarity of the data series to avoid the spurious regression from time series data. If a data series is found to be stationary, it implies that the mean, variance, and autocovarience of the series are independent of time. Several unit root tests exist to examine stationarity of time series data. In this study, we carry out Augmented Dicky–Fuller (ADF) tests, which are used most commonly.

Table 1 – Unit Root Test Results (ADF Method)

Variables	Level (in logs)		First Difference (in logs)		Conclusion
	Included		Included		
	Constant	Constant & Trend	Constant	Constant & Trend	
	Statistics	Statistics	Statistics	Statistics	
Import Volume Index-Consumer goods	-1.051474	-2.852521	-5.650326*	-5.697949*	I (I)
Import Volume Index-Intermediate goods	-1.209485	-2.083422	-6.487813*	-6.500350*	I (I)
Import Volume Index-Investment goods	-3.001093**	-3.68726**	-4.542654*	-4.389357*	I (0)
Import Price Index-Consumer goods	-3.429459	-3.36575	-5.169096*	-5.259567*	I (I)
Import Price Index-Intermediate goods	-4.700943*	-7.788212*	3.592188*	-3.660836*	I (0)
Import Price Index-Investment goods	-3.035321**	-0.831174	-4.907688*	-5.457851*	I (0)
CCPI Index(1952=100)	-1.491084	-2.291937	-4.079503*	-4.174829*	I (I)
Relative price -Consumer goods	-3.232315**	-3.531017***	-5.777129*	-5.755194*	I (0)
Relative price -Intermediate goods	-3.403793**	-7.241608*	-4.302048*	-3.954360*	I (0)
Relative price -Investment goods	-3.183249**	-2.505259	-5.477726*	-5.247784*	I (0)
GDP (Constant -1996=100)	-0.304537	-2.330036	-4.316796*	-4.190959*	I (I)
Foreign Exchange Availability	-0.930424	-3.790496**	-5.787593*	-5.642049*	I (I)

Test critical values:	Constant	Constant & Trend
1% level (*)	-3.67017	-4.309824
5% level (**)	-2.963972	-3.574244
10% level (***)	-2.621007	-3.221728

If the data series is stationary at level, it is called I (0). If the series stationary in first difference or second difference, then they are referred to as integrated of order one, *i.e.*, I (1) and order two *i.e.*, I (2). First, we perform unit root tests at levels, and where necessary we carry out higher order tests. Table 1 confirms the existence of unit roots at levels for most of the variables at 5 per cent significance level. However, ADF tests confirm that all data series are stationary in first differences, at 5 per cent significance level.

B. Estimates of Models & Findings

In this section OLS estimates of the three models are presented. The models employed are as follows: Table 2 reports the estimates of the Model I, which describes the demand for consumer goods, Table 3 reports the estimates of Model II, which characterizes the demand for intermediate goods, while Table 4 reports the estimates of Model III, which accounts for the demand for investment goods.

Table 2: OLS estimates of the Model I – Demand for Consumer Goods Imports

Dependent variable: Demand for Consumer Goods Imports

$$DL_n\, CON_t = \beta_0 + \beta_1\, DL_n\, GDP_t + \beta_2\, DL_n\, RPCON_t + \beta_3\, DL_n\, FEX_t + \beta_4\, DL_n\, RPCON_{t-1} + \varepsilon_t$$

Independent Variables	**Coefficient**
Constant	0.019 (0.064)
DL_n GDP_t	4.96E-07 (1.97E-06)
DL_n $RPCON_t$	-0.997* (0.313)
DL_n FEX_t	-0.198 (0.442)
$RPCON_{t-1}$	-0.052 (0.241)
R-squared	0.353 (adjusted R-squared 0.244)
Durbin-Watson stat	1.957
F-statistic	3.277**
No. of Observations	29

Notes: Standard errors are parenthesis.

* implies 1% significance level.
** implies 5% significance level.
*** implies 10% significance level.

Results are rather striking, in that, only relative price of consumer goods is found to have a significant impact on consumer good imports. As Table 2 shows, the sign of the relative price variable is in line with economic theory, which implies a negative sign for the relative price elasticity. The coefficient value of the relative price of consumer good is recorded at -0.997, revealing that price elasticity of consumer goods is very close to one. Thus, results seem to suggest that when all other variables are held constant (citreous paribas), if import price increases by one percentage point, import volume would decrease nearly by same amount of the price increase. Although the coefficient value is very close to one, one may argue that as it is not equal one (without rounding up the estimate), it may refer to inelasticity. Thus, this estimate yields somewhat inconclusive results, in that, on one hand, it implies that the consumers strongly react to relative price of consumer goods, and on the other, demand for imported consumer goods seem to have some elements of inelasticity.

As for the rest of the variables in the regression, real income (GDP) and foreign exchange availability variables are found to be statistically insignificant at conventional significance levels. This implies that the explanatory power of real income and foreign exchange availability in determining the demand for consumer goods is minimal during the period 1977–2007.

The Durbun-Wotsan statistic is found to be close to two, suggesting that the presence of serial correlation in the residuals of the estimated regression is unlikely. However, the adjusted R-squared value was found to be about 0.24 while the R-squared value was found to be about 0.35.

F-statistics indicate that all coefficient values are not equal to zero at same time and at least one of them have explanatory power on import demand.

The estimates of Model II (see Table 3), which characterizes the import demand function of intermediate goods, reveals that the coefficient of relative price of intermediate goods is statistically significant at 5 per cent level, marked at -0.46. This indicates that if relative price of intermediate goods increases by one percentage point, the demand for intermediate goods may fall by 0.46 of a percentage point. Therefore, results suggest that relative price elasticity of intermediate goods is in the range of inelastic, i.e., demand for intermediate goods seems to be less price sensitive.

As for the rest of the variables in the Model II, the coefficient value of foreign exchange availability is marked at 0.497, which is statistically significant at 10 percent level, and it has the expected sign. This implies that if the foreign exchange availability increases by one percentage point, the demand for intermediate goods will increase by nearly half a percentage point. As coefficient of foreign exchange availability is less than

Table 3: OLS estimates of the Model II – Demand for Intermediate Goods Imports

Dependent variable: Demand for Intermediate Goods Imports

$$DL_n\, INT_t = \delta_0 + \delta_1\, DL_n\, GDP_t + \delta_2\, DL_n\, RPINT_t + \delta_3\, DL_n\, FEX_t + \delta_4\, DL_n\, RPINT_{t-1} + \delta_5\, DL_n\, FEX_{t-1} + \mu_t$$

Independent Variables	Coefficient
Constant	0.035 (0.045)
$DL_n\, GDP_t$	3.77E-07 (1.13E-06)
$DL_n\, RPINT_t$	-0.465** (0.176)
$DL_n\, FEX_t$	0.497*** (0.287)
$DL_n\, RPINT_{t-1}$	0.228 (0.139)
$DL_n\, FEX_{t-1}$	0.047 (0.271)
R-squared	0.297 (adjusted R-squared 0.145)
Durbin-Watson stat	2.104
F-statistic	3.104
No. of Observations	29

Notes: Standard errors are parenthesis.

* implies 1% significance level.
** implies 5% significance level.
*** implies 10% significance level.

one (*i.e.*, inelastic), it implies that the demand for intermediate goods is less sensitive to foreign exchange availability.

However, the coefficient of real income seems to be statistically insignificant during the period considered in the present study. The model also includes lagged terms of the relative price and foreign exchange availability, which would help to examine whether there is any lag effect of these variable on demand for imported intermediate goods. However, results imply that coefficients of both lagged terms are statistically insignificant at conventional levels. The Durbun -Wotsan Statistic is found to be close to two, suggesting no serial correlation in the residuals of the estimated regression.

The results of Model III (see Table 4), which characterizes the import demand function of investment goods, show that relative price of investment goods is statistically significant at 5 per cent level. The estimate is -0.753 which implies inelastic relative prices. Therefore,

Table 4: OLS estimates of the Model III – Demand for Investment Goods Imports

Dependent variable: Demand for Investment Goods Imports

$$DL_n\,INV_t = \delta_0 + \delta_1\,DL_n\,GDP_t + \delta_2\,DL_n\,RPINV_t + \delta_3\,DL_n\,FEX_t + \delta_4\,DL_n\,RPINV_{t-1} + \delta_5\,DL_n\,FEX_{t-1} + \mu_t$$

Independent Variables	Coefficient
Constant	-0.013 (0.063)
$DL_n\,GDP_t$	6.80E-07 (1.67E-06)
$DL_n\,RPINV_t$	-0.753** (0.278)
$DL_n\,FEX_t$	0.705*** (0.408)
$DL_n\,RPINV_{t-1}$	0.342 (0.231)
$DL_n\,FEX_{t-1}$	0.017 (0.346)
R-squared	0.407 (adjusted R-squared 0.279)
Durbin-Watson stat	2.038
F-statistic	3.169**
No. of Observations	29

Notes: Standard errors are parenthesis.
* implies 1% significance level.
** implies 5% significance level.
*** implies 10% significance level.

a one percentage point increase in import prices of investment goods would result in a fall in demand for investment goods by 0.75 of a percentage point. Accordingly, results indicate that the demand for investment goods may be fewer prices sensitive.

On the other variables in the model, the coefficient value of foreign exchange availability is significant at 10 per cent level, reported at 0.70. It shows that the elasticity of foreign exchange availability is inelastic, in that, a one percentage point increase in foreign exchange availability translates into an increase in the demand for investment good by less than proportionately. The coefficient value is also in the inelastic range.

However, the coefficient of real income variable turns out to be insignificant in the investment demand function in Sri Lanka during 1977–2007. Further, none of the lagged terms of relative price or foreign exchange availability variables are found to be statistically significant at conventional significance levels.

V. Summary and Conclusions

This paper investigates the disaggregate import demand functions in Sri Lanka during 1977–2007, categorizing aggregate imports to three groups, namely, consumer goods, intermediate goods and investment goods. The main aim of the paper is to estimate the disaggregated price and income elasticities of the demand for imported goods, in the post-liberalization period. The demand function is based on traditional import demand function. Nevertheless, following the literature [for example, Emran & Shilpi (1996, 2001) Dutta and Ahamed (1999)], the model is modified to include foreign exchange availability as an explanatory variable in the import demand function.

Results reveal that the coefficient on the relative price under each case, *i.e.*, consumer goods, intermediate goods and investment goods, is statistically significant. The relative price elasticity of the three categories is in the inelastic range, implying that the demand for consumer goods, intermediate goods and investment goods may be of less sensitive to changes in prices. However, comparing results between categories, results suggest that demand for consumer goods are more price sensitive than demand for intermediate and investment goods. The relatively higher elasticity of imported consumer goods compared to intermediate and investment goods reflects the tendency of imported consumer goods to be more non-essential in nature. On the other hand, it may be also due to be the availability of adequate domestic substitutes for the majority of imported consumer goods, particularly food items. Although foreign exchange availability is not statistically significant in the consumer goods demand function, it has a significant impact on the demand for intermediate and investment goods. For both categories, foreign exchange availability turns out to be inelastic, indicating less sensitivity of foreign exchange availability. Despite the perceived importance of real income (GDP) in the demand function, the coefficient value yields statistically insignificant results.

Accordingly, the results of the present study seem to bear out several policy implications, albeit, the results have to be interpreted rather cautiously. First, because of less price elasticity of consumer goods, intermediate goods and investment goods, marked at -0.99, -0.46, and –0.75 respectively, if government imposes a tax, it is highly likely that suppliers may pass a great deal of the tax burden on to consumers. However, this implication may be of little relevance for the demand for consumer goods, as the price elasticity is close to one. On the other hand, such a tax may be beneficial on the part of the government, as there would not be much of a decline in demand.

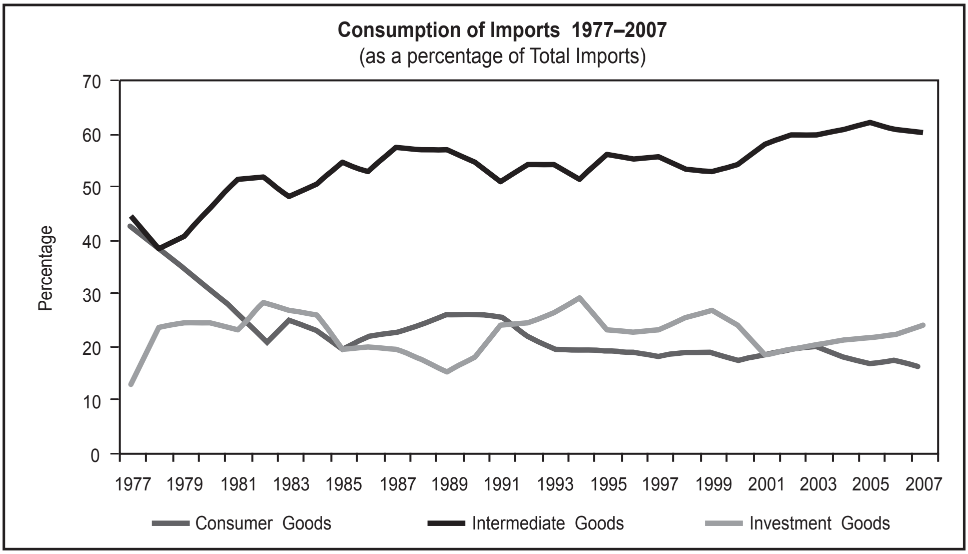
Further, our results are comparable with some of the findings in the literature. For example, Tang and Nair (2002) point out (using data from Malaysia, though) that relative price elasticity and the import volume are sensitive to increase in domestic price level, and any increase in domestic inflation rates will trigger a higher volume of imports. Hence, if the increase in the domestic prices is higher than that of import prices, relative price may decrease and this would encourage more imports of the respective goods. Further, it can be illustrated using the coefficient value that if the domestic inflation increases by certain percentage, imports of consumer goods may increase by more than that of investment and intermediate goods. This implies that if imports need to be curtailed, it would demand for lowering domestic inflation, which in turn implies that fiscal and monitory policy may be used as effective policy instruments to maintain domestic inflation at favorable levels to correct trade imbalances.

Second, findings of this study suggest that foreign exchange availability is a significant factor in determining the demand for intermediate and investment goods imports. This implies that, when export earnings, worker remittances and disbursed foreign aids increase, the import demand for intermediate and investment goods would increase, as well. This may have positive effects on the economy due to expansion of production capacity. Therefore, policies with regard to exchange rate stability, foreign employment etc. seem to play a significant role in maintaining the desired level of imports.

Finally, the work may be extended in several dimensions, such as carrying out a cointegration analysis, which will provide adequate inputs for another research paper.

Annexes

Appedix I – Consumption of Imports 1977–2007



Source : Central Bank of Sri Lanka

Appendix II – Description of Data

Following annual data used to conduct the analysis:

1. Imports Volume Indices

   (Volume index of consumer goods, intermediate goods and investment goods).

2. Import Price Indices in rupee term

   (Consumer goods, intermediate goods and investment goods) Employed indices for the sample period are available only rupee term. The indices do not base on one base year. Therefore it was converted one base year (Base year was 1978).

3. Domestic Price (CCPI used as a proxy) 1952=100.

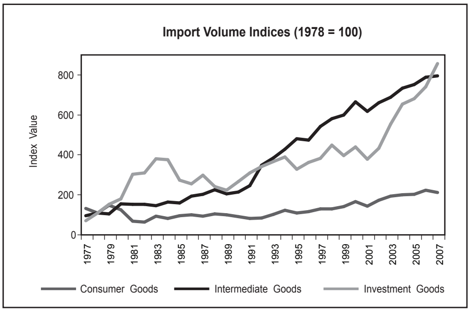
4. Relative Price (Import Price Index / Domestic Price Index).

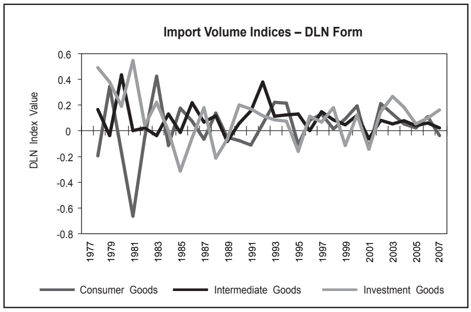
5. Gross Domestic Product in rupee term (Constant Price 1996=100).

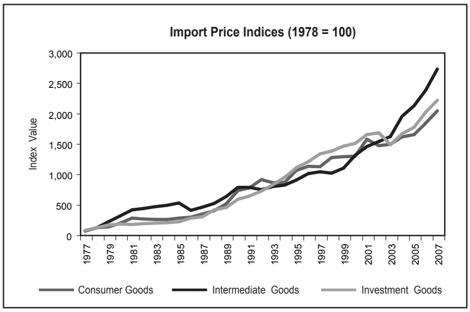
6. Foreign exchange availability in dollar term

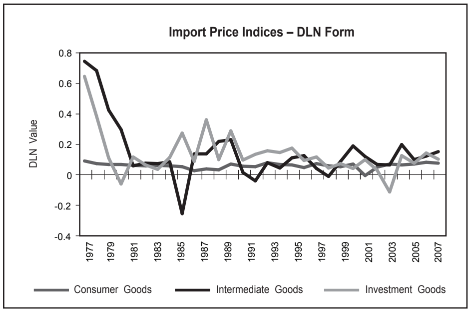
   (Export Earnings + Worker Remittances + Disbursed Foreign Aid)

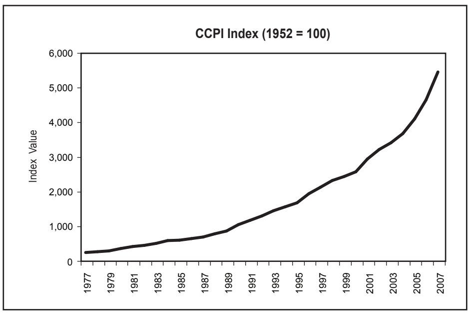
Appedix III – Dynamics of Variables during 1977–2007

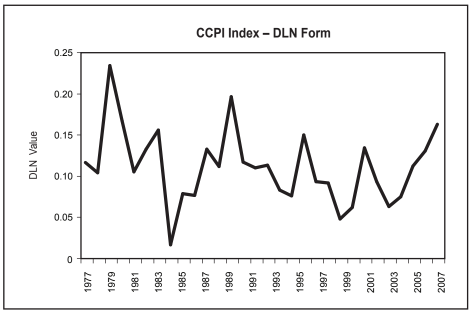




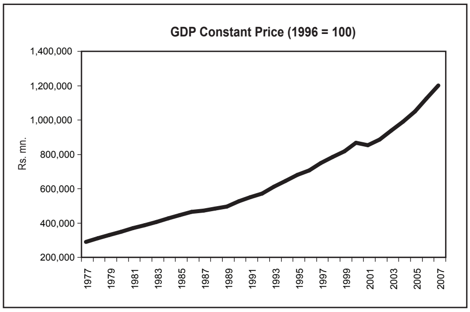


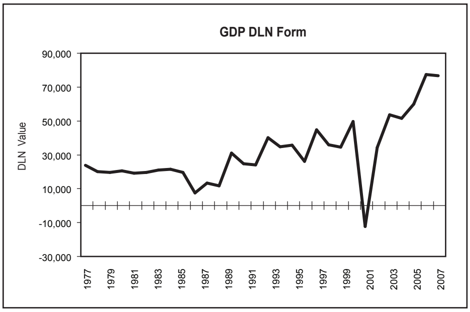


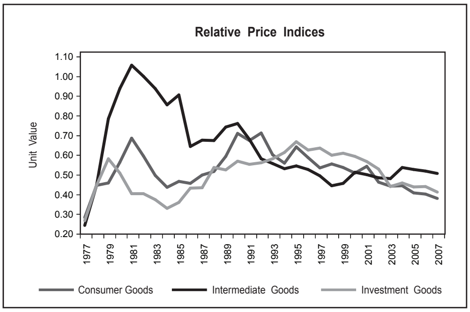


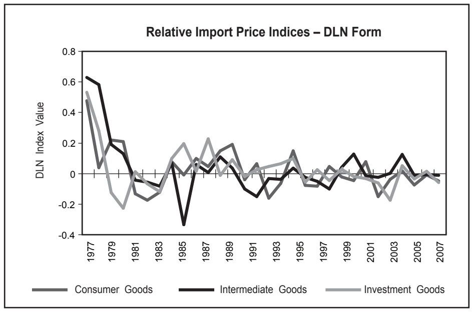


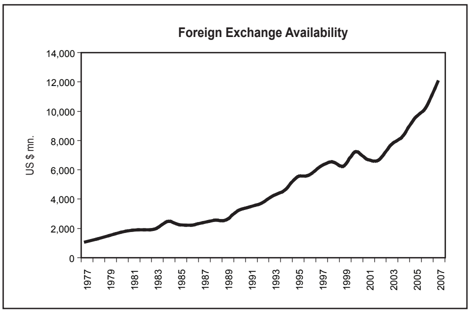
Source : Central Bank of Sri Lanka

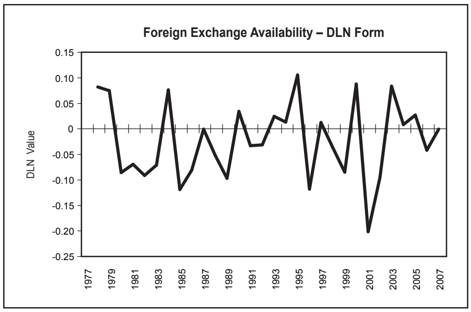












Source : Central Bank of Sri Lanka

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