Research Paper **Open Access**

AN ANALYSIS ON THE RELATIONSHIP BETWEEN SECTOR STOCK RETURNS AND FOREIGN EXCHANGE RATES IN SRI LANKA: EVIDENCE FROM ARDL APPROACH

Tharindu C. Ediriwickrama[1], Udeshika S. Pathirana[2]

[1](Department of Finance, University of Colombo, Sri Lanka)
[2](Department of Interdisciplinary Studies,Universityof Moratuwa, Sri Lanka)
Corresponding author: Tharindu C. Ediriwickrama

ABSTRACT : *The relationship between stock returns and exchange rates is a widely discussed topic among scholars across the world. However, there is no universal agreement in this regard and many researchers offer mixed evidence on the association of stock returns and exchange rates. This relationship can be twofold which are long run and short run. However, many researchers examined the association of overall market index of a particular country and exchange rates. There is a dearth of research on specific sector returns and exchange rates. But it is a general truth that some sectors are more exposed to exchange rate risk than other sectors. In this paper, we explore both short run and long run relationships between stock returns of 20 sectors in Colombo Stock Exchange, Sri Lanka and five selected exchange rates which are US Dollar (USD), Indian Rupee (INR), Japanese Yen (JPY), British Pound (GBP) and Euro (EUR). The Auto Regressive Distribution lag approach (ARDL) is used for this study. We found that all the sectors have a long run association with selected exchange rates using ARDL bound test. Further we found that there is no significant short run relationship between sector stock returns and exchange rates using the Wald test. We observe several weaknesses in our short run results which are significant error correction terms (ECT) with positive sign, unstable regressions revealed by Cusum test and the presence of serial correlation. ECTs with positive sign is mainly due to structural changes happened in the Sri Lankan economy and society throughout our study period from 2004 to 2019. More important structural changes are end of the armed conflict in 2009 and liberalization of the Balance of payment and foreign exchange management policy by the Sri Lankan Government. Future researchers have the opportunity to use the insights of our study by employing time series tests such as Chow break point test in order to overcome the problem of ECTs with a positive sign. Further our study will be useful to regulators to impose effective foreign exchange management practices and industry experts to understand and manage foreign exchange exposure to their industries in more meaningful manner.*

Key Words:*Exchange rates, Sector returns, ARDL approach, Colombo Stock Exchange (CSE), Sri Lanka*

I. INRODUCTION

Capital market performance and exchange rates are two important macroeconomic variables in any country. According to Bahmani-Oskooee and Saha (2015), increases in stock prices will lead to the increase in public wealth and demand for money. As a result of it, interest rates will rise and it will attract foreign direct investments to the country. This will appreciate the local currency. So, this relationship between stock returns and exchange rates can be both short run and long run. However, there are mixed results were reported on those relationships in international context. Bahmani-Oskooee and sohrabian (1992) found a short run relationship between US stock prices and effective exchange rate on US Dollar (USD). Similarly, Nieh and Lee (2001) found one day short run significant relationship between stock prices and exchange rates among G7 countries. However,

Amihud (1994); Bartov and Bohnar (1994) revealed the relationship between USD and US stock returns is not contemporaneous.

Similar to the short run relationship, long run relationship between stock prices and exchange rates show mixed results. Among many studies, Ismail and Isa (2009); Kutty (2010); Alagidede, Panagiotids and Zhang (2011); Buberkoku (2013) stated there is no long run relationship between exchange rates and stock returns. On the other hand, Tian and Ma (2010); Katechos (2011); Elta (2012); Aslam and Ramzan (2013) found long run relationship between stock returns and exchange rates. However, it should be noted that most of these studies carried out on overall market indices and not a specific industry or sector. Therefore, industry specific effects have been ignored in most of the prior studies. Further most of them used Johansen cointegration test and Granger causality test for their analysis.

Sri Lanka is a little island situated in Indian Ocean with per capita gross domestic product (at current market prices) of USD 3682 in 2020 according to the annual report of Central Bank of Sri Lanka (CBSL). Colombo Stock Exchange (CSE) is Sri Lanka's one and only equity exchange with a market capitalization of Sri Lankan Rupee (LKR) 2960.70 billion at the end of 2020 (CBSL, 2020). CSE had its own sector classification system (which we will refer as traditional sector classification of CSE hereafter) which includes 20 sectors[1] until December 2019. However, CSE moved to the Global Industry Classification System (GICS) from January, 2020 onwards. GICS includes 11 sectors[2] and CSE was able to overcome weaknesses in traditional classification due to the implementation of GICS. One such example is traditional plantations in Sri Lanka (tea, rubber and coconut) and oil palm cultivations in the East Asian countries under two separate sectors undermining the fact that both are commercial plantations. GICS classified them in to the correct sub sectors.

According to Cavoli and Rajan (2013), CBSL continues to conduct the monetary policy under an independently floating exchange rate regime. International Monetary Fund's (IMF) behavioral classification (as of April 2011) identified it as a soft peg-crawl like arrangement. Similar to the international context, there are mixed evidences on long run and short run relationship between stock returns and exchange rates in Sri Lanka. Wickremasinghe (2012) found both short and long run statistically significant relationships between CSE's All Share Price Index (ASPI) and exchange rates on four different currencies which are Indian Rupee (INR), Japanese Yen (JPY), British Pound (GBP) and USD. However, Amarasinghe and Dharmaratne (2014) mentioned that the stock return is not an effective factor in determining exchange rates. Further Kalainathan, Pratheepan and Selvamalai (2017) also stated that there is no long run relationship between stock returns and exchange rates. However, all these studies were conducted on overall market index (ASPI) and specific sector indices were ignored. Present study aims to identify the relationship between performance of sector indices and exchange rate of key foreign currencies. Foreign currencies considered in this study are USD, INR, JPY, GBP and Euro (EUR). Further this study intends to identify the short run and long run relationship of sector returns and exchange rates using Auto Regressive Distributed Lag model (ARDL). This study considers traditional sector classification of CSE mainly due to the unavailability of past data for GICS classification. This study covers a period from January, 2004 to the December, 2019 using daily data. The rest of the paper is organized as follows. Section two reviews the literature specifically related to the sectors in the traditional classification and their relationship with exchange rates. Section three outlines the data and methodology. Section four presents the analysis and section five concludes the paper.

II. LITERATURE REVIEW

This literature review is consisted major theories on foreign exchange dynamics and empirical evidences for the relationship between foreign exchange and stock returns. Empirical evidences are presented in the order of traditional sector classification of CSE.

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[1] The 20 sectors in the traditional classification are Banks, Finance and Insurance (BFI), Beverage, Food and Tobacco (BFT), Construction and Engineering (CE), Chemicals and Pharmaceuticals (CP), Diversified Holdings (DIV), Footwear and Textile (FT), Healthcare (HLT), Hotels and Travel (HT), Investment Trusts (INV), Information Technology (IT), Land and Property (LP), Manufacturing (MFG), Motors (MOT), Oil Palms (OP), Power and Energy (PE), Plantations (PLT), Service (SRV), Stores and Supply (SS), Telecommunication (TLC) and Trading (TRD).

[2] The 11 sectors in the GICS are Consumer Discretionary, Consumer Staples, Energy, Financials, Healthcare, Industrials, Information Technology, Materials, Real Estate, Telecommunication and Utilities.

2.1 Major theories on foreign exchange

Exchange rate is the rate at which one national currency is exchanged for another. There are theories in economics which describes how exchange rate is determined in the market (such as purchasing power parity (PPP), interest rate parity and international Fisher effect). The theory of purchasing power parity introduced by Cassel (1918) argued that two countries are in the equilibrium when a same basket of goods is priced the same in both countries. According to the theory of interest rate parity, interest rate differential between two countries is equal to the differential between the forward exchange rate and the spot exchange rate. International fisher effect explains that the movement of the exchange rate of two currencies is proportional to the difference in their nominal interest rates.

Apart from the exchange rate determination, the knowledge on the relationship between stock prices and exchange rate provides the information for shareholders and policymakers to forecast and control their behaviors. The causality between stock prices and exchange rates has received widespread attention in the finance and economic literature and there is a growing literature on this topic, especially after the 1997 Asian financial crisis (Parsva & Tang, 2017). Therefore, certain theories such as the flow-oriented model and the stock-oriented model elaborate the relationship between exchange rate and stock prices.

Flow oriented model can be classified as a traditional school of thought of Dornbusch and Fischer (1980). The basic argument is that the local currency appreciation makes exports more expensive and imports cheaper and vice versa. In fact, the country's trade balance and current accounts are the major determinants of exchange rate of a country. The depreciation of local currency makes exports cheaper in the international market, strive the demand for local goods and consequently increases the foreign inflow to the country which will ultimately increases the net foreign inflow for local companies making more profitable and vice versa. In fact, the cheaper exports cause to increase the stock prices and expensive exports drives to lower the profitability and thereby lower the stock prices. Conversely, the appreciation of local currency makes. Similarly, the local currency devaluation provides favorable impact on imports by lowering the cost of inputs and vice versa. The lower (higher) input cost lower the overall cost (higher) of the company and improve (decrease) the profit level which will indirectly cause the stock prices to rise (lower). Yet increasing imports increase the trade deficit in Sri Lanka and make local companies unprofitable. Moreover, lower level of exports could not be able to gain the significant level of favorable effect on company performance and ultimately to the stock prices.

Stock-oriented approach introduced by Branson, Halttunen and Masson (1977) explains the causality runs from the stock market to exchange rate. The stock-oriented model emphasizes those capital accounts as the main factor that causes the exchange rate changes. Capital account is a part of balance of payment which consists of imports and exports of goods, services, capital, and as transfer payments such as foreign aid and remittances. The capital account keeps track of the net change in a nation's assets and liabilities. The theory asserts that change of stock index will impact on the behavior of domestic and overseas investors, which will cause to change money demand, and finally affect the exchange rate. Indeed, it explains negative association between stock market prices and exchange rate. Increases in stock prices stimulate foreign capital inflow, lead to create excess demand for local currency and ultimately appreciate the local currency vice versa. On the other hand, the increasing stock prices make investors wealthier and demand money and lead to appreciate local currency.

2.2 Empirical evidences for the relationship between sector stock returns and foreign exchange rates

As explained earlier CSE maintained its traditional sector classification system up to December 2019, we use the same classification for this study. Prior literature on the relationship between sector performance in the market and foreign exchange rates are presented here. Most of these empirical findings are based in the international context and there is a dearth of literature on sectors specifically in Sri Lankan context.

2.2.1 Bank, Finance and Insurance (BFI) Sector

This sector is consisted with three main sub sectors which are banks, insurance companies and diversified finance companies. All banks are registered as commercial banks under CBSL and provide all type of banking services such as commercial banking, investment banking and development banking services. Listed insurance companies provide life insurance schemes as well as general insurance services such as motor insurance. Even though diversified finance companies primarily engage in accepting deposits and lending, they provide many other financial services such as leasing, hire purchasing, factoring, real estate development etc.… When reviewing the banking literature, the weak relationship between exchange rate and bank performance (Moyo & Tursoy, 2020) was found in South Africa.Significant and positive long-run impact of exchange rate volatility on insurance sector performance (Offiong, et al., 2020) was reported in Nigeria. However, in contrary, Prada, Alonso and Fernández

(2019) found no indication of volatility transmission to the insurance indexes from the exchange rates fluctuations in South American country, Colombia.

2.2.2 Beverage, Food and Tobacco (BFT) Sector

This sector is comprised with companies who produce, pack, export and import agricultural, dairy and livestock products and companies who produce, import and distribute alcoholic and non-alcoholic beverages. Sri Lanka's only tobacco manufacturing company is also included in this sector. Suhendra and Istikomah (2019) found that Indonesian food industry (meat, fish and food oil, milk and dairy products, ground grains and nuts and fodders) is sensitive to the exchange rate fluctuations.

2.2.3 Construction and Engineering (CE) Sector

Sri Lankan companies in this sector involves mainly in civil and mechanical engineering projects together with piling projects. But it is not limited to just construction industry, since the sector includes one ship building company as well.Foreign exchange rates and the prices of construction materials such as tiles and cement had a very strong and positive relationship in Nigeria according to Ugochukwu, Eze, Akabogu and Abubakar (2017). Ahn, Holley, and Kang, (2009) revealed the transaction exposure as the primary concern related to foreign exchange rate risk in international construction projects. In addition, they found that Korean contractors are interested in buying foreign exchange risk insurances in contrast with American contractors.

2.2.4 Chemicals and Pharmaceuticals (CP) Sector

Companies, who import, manufacture and distribute chemicals and pharmaceuticals are belonging to this sector. Chemicals include a wide range of products such as agro chemicals, inorganic fertilizer, industrial chemicals and bituminous products. More specific products such as activated carbon are exported by one company in this sector. No significant impact of exchange rates on stock prices was observed for individual petrochemical companies in four Eastern European countries which are Czech Republic, Hungary, Poland and Slovakia according to Šimáková & Rusková (2019).Negative short term significant relationship between stock returns of pharmaceutical multinationals and exchange rate was found by Hussain & Khan(2014) in Pakistan.

2.2.5 Diversified Holdings (DIV) Sector

Conglomerates engaged in different range of businesses are falling to the sector of diversified holdings. These businesses include banking, insurance, plantation and real estate management, tourism, power and energy generation, retailing, business process outsourcing services, healthcare etc.… we see this as a weakness of traditional classification of CSE, because many different industries have been classified under one sector. As a result of it we couldn't find matching empirical evidence neither from international context nor Sri Lankan context.

2.2.6 Footwear and Textile (FT) Sector

Even though Sri Lanka's apparel sector is a main contributor to the country's foreign currency earnings, handful of apparel companies are listed in CSE. Sri Lanka's apparel sector is an import intensive exporting sector. With long standing trend of depreciating Sri Lankan Rupee (LKR) would lead to erosion of export competitiveness under import intensive nature of Sri Lankan apparel sector. Similar results were found by Abeysinghe and Yeok (1998).

2.2.7 Healthcare (HLT) Sector

As a country which prioritizes social welfare, Sri Lankan government maintains an island wide network of government hospitals. However, private hospitals became popular in main commercial cities such as Colombo and few of those private hospitals are listed in CSE. Prada, Alonso and Fernandez (2019) found that exchange rate volatility effects significantly to medicines in Colombia. This finding can be commonly applicable to Sri Lankan private healthcare sector as well since LKR is continuously depreciating since 1977, the year which open economy introduced to Sri Lanka.

2.2.8 Hotels and Travel (HT) Sector

This sector is mainly comprised of companies who own and operate city hotels and resorts. This sector is severely affected by Easter Sunday attack to main city hotels and churches in 2019. Ongoing Covid 19 pandemic worsened the situation of this sector due to the travel restrictions imposed by governments in all around the world. Ongan, Işik and Özdemir (2017) observed that tourists visiting the USA are more sensitive to changes in the real exchange rate. Bailey, Flanegin, Racic and Rudd (2019) found a significant relationship between foreign currency exchange rates and hotel occupancy. They examined the fluctuations of five exchange rates of major tourist markets to USA (British Pound, Euro, Canadian Dollar, Japanese Yen and Mexican Peso) and their impact to the occupancy rates of seven most popular tourist destinations in USA.

2.2.9 Investment Trusts (INV) Sector

Most of the companies listed under the investment trust sector manage investment portfolios including both stocks and bonds. Ali, Rehman, Yilmaz, Khan, and Afzal (2010) posited that stable foreign exchange system and efficient stock market will arbitrage fund flows in mutual fund industry back to the long run equilibrium.

2.2.10 Information Technology (IT) Sector

Only one company is registered with this sector and it is an e-commerce company. It provides a booking service for the consultation of doctors and related medical services. So, we have to emphasize that this sector is named as information technology sector, it is highly different and small from the technology sectors in regional and developed markets. Further we see it as a weakness of traditional classification system and CSE corrected it when adopting GICS classification by grouping it to healthcare services industry group. According to Missio and Gabriel (2016) both national innovation system and real exchange rate contributes to fill the technological gap of the nation and ultimately national innovation system. However, we should note that here the term 'technology' is not limited to the information technology.

2.2.11 Land and Property (LP) Sector

Commercial and residential property developers are belonging to this sector. Eppli, Shilling and Vandell (1998) revealed that less than 3% of the variance in unsmoothed real estate returns to be explained by macroeconomic variations including exchange rates. Jack, Okyere and Amoah (2019) found a cointegration between exchange rate volatility and real estate housing prices using autoregressive distributed lag (ARDL) model in Ghana.

2.2.12 Manufacturing (MFG) Sector

Biggest issue in this sector is the term "manufacturing" is too broad and it is not properly defined. This includes manufacturers who produce durable goods such as refrigerators, washing machines as well as producers of consumption materials such as petroleum-based lubricants and soaps. Further it includes manufacturers of construction materials such cement, tiles, PVC pipes, aluminum and steel products. Santosa (2019) identified exchange rate as an influencing factor to the financial performance of manufacturing sector in Indonesia. Further Mlambo (2020) found evidence to the negative relationship between exchange rate and manufacturing sector performance in SACU[3] states.

2.2.13 Motors (MOT) Sector

There are no motor vehicle manufacturers among Sri Lankan listed entities except very few firms. However, several motor vehicle importers and distributors are listed under this sector. Structure of a firm's operations and the competition faced within the industry are playing significant role in determining the relationship between automobile firm value and exchange rate exposure (Mall, Jafarey, Syed, & Hussain, 2011). Mall, Jafarey, Syed and Hussain (2011) found that Japanese firms are more exposed to the dollar compared to euro. Further it should be noted that most of the automobiles imported to Sri Lanka are from Japan.

2.2.14 Oil Palms (OP) Sector

This sector includes companies who own and manage oil palm plantations in Indonesia and Malaysia. Differences of this sector from traditional plantation sector in Sri Lanka are twofold. One is products of traditional plantation sector are tea, rubber and coconuts while this sector is more specific to oil palm cultivation. Other difference is the location. Traditional plantation companies are limited to Sri Lankan plantations while oil palm companies are operating mostly in Malaysia.

2.2.15 Power and Energy (PE) Sector

Most of the companies in this sector operate mini hydro power plants together with other renewable energy plants and supply electricity to the national grid except one company who imports and distributes petroleum products. Beckmann, Czudaj and Arora (2017) found that exchange rates and oil prices are strongly time-varying and the presence of strong links between exchange rates and oil prices in the long run. However, the relationship between renewable energy and exchange rates yet to be explored.

2.2.16 Plantation (PLT) Sector

Plantation sector of Sri Lanka has origins from colonial period and primarily engages in the management of tea, rubber and coconut plantations. At the time of gaining the independence in 1948, Sri Lanka has a fixed exchange rate regime where Sri Lankan rupee was pledged against Indian rupee. As a solution for the balance of payment crisis faced by Sri Lanka in 1960s due to the low export prices and higher import prices, the dual exchange rate policy was introduced in 1968.Under this policy, one official rate applicable to essential imports and non-

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[3]The Southern African Customs Union (SACU) consists of Botswana, Lesotho, Namibia, South Africa, and Swaziland.

traditional exports, and another higher official rate applicable to all other exports and imports. Later on, in 1977 with the introduction of open economic policy, the managed floating exchange rate regime was introduced. To provide more flexibility for commercial banks, in 2001, the Central Bank liberalized the foreign exchange market by allowing the commercial banks to determine the exchange rate. However, CBSL is still in a controllable position influence exchange rates in Sri Lanka. Asian Development Bank (2016) reported that obstacles posed by above government policies were exacerbated by a fixed exchange rate that tended to favor importers over exporters like Plantation companies.

2.2.17 Services (SRV) Sector

This sector includes companies who provide ancillary services such as printing, produce broking and freight forwarding services. This sector also has the same weakness like manufacturing sector which is the lack of a proper definition to the sector. Baggs, Beaulieu and Fung (2008) revealed that real appreciations of the Canadian dollar reduce the probability of survival, sales and profitability of service firms while depreciations have the opposite effect.

2.2.18 Stores and Supplies (SS) Sector

This sector includes firms provide storing facilities as well as suppliers and distributors of hardware products. This sector also has the weakness of not having a clear definition. Therefore, it was not possible to find relevant international literature regards to this sector.

2.2.19 Telecommunications (TLC) Sector

Telecommunication Regulatory Commission of Sri Lanka (regulator of the telecommunication industry in Sri Lanka) has granted three fixed operator licenses and four mobile operator licenses. Out of these firms two largest operators are listed in the CSE. They offer complete portfolio of telecommunication services including mobile and fixed telephony, internet services and many other services. Hamara, Achsani and Buchari (2018) found that exchange rate has a positive influence to the stock market price of the telecommunication companies which are listed in Indonesia Stock Exchange.

2.2.20 Trading (TRD) Sector

There are companies who involved in importing and trading durable goods as well as commodities in this sector. Undervalued LKR is a significant threat to this sector. According to Klein and Shambaugh (2006); Qureshi and Tsangarides (2010) relationship between exchange rates and global trading is mainly driven by long term policy credibility rather than short term causality.

III.   DATA AND METHODOLOGY

3.1 Data

Secondary data has been used for the study from January, 2004 to December 2019. Daily data on sector total return indices have been obtained from CSE. Exchange rates of five currencies were obtained from CBSL annual reports.

3.2 Methodology

ARDL approach is applied to explore the short run and long run association of the sector stock returns and exchange rates. ARDL approach modified by the Pesaran, Shin and Smith (2001) and applied by the Khan (2019) included the bound test approach specifically to test long run relationships. The equation for cointegration is stated as below.

$$\Delta SEC_{s,t} = \beta_0 + \beta_1 \sum_{i-1}^{t} \Delta SEC_{s,t} + \beta_2 \sum_{i-1}^{t} \Delta ER_{j,t} + \gamma_1 SEC_{s,t-i} + \gamma_2 ER_{j,t-i} + \varepsilon_t \qquad \text{Eq1}$$

In the equation 1, β_0 is the constant term, $SEC_{s,t}$ is the return of the sector s at time t, $ER_{j,t}$ is the exchange rate of currency j at time t and ε_t is the error term at time t. Cointegration exists if the calculated F statistic value of the bound test is greater than upper bound value. No cointegration exists if the calculated F statistic in the bound test is lower than the lower bound value. If the calculated F statistic is between lower and upper bound values of the bound test, decision would be inconclusive.The following is the null hypothesis of the model.

$$\gamma_1 = \gamma_2 = 0 \qquad \text{Eq 2}$$

If the estimated results pointed out the long run association among the study variables, therefore long run elasticities were applied by utilizing the following ARDL model.

$$\Delta SEC_{s,t} = \beta_0 + \beta_1 \sum_{i-1}^{t} \Delta SEC_{s,t} + \beta_2 \sum_{i-1}^{t} \Delta ER_{j,t} + \varepsilon_t \qquad \text{Eq 3}$$

In the above equation, β1 and β2 indicates the long run relationship among the study variables by using Akaike Information Criterion (AIC) for selecting suitable lags for variables. For short run ARDL model, we apply the following error correctionmodel.

$$\Delta SEC_{s,t} = \beta_0 + \phi_1 \sum_{i-1}^{t} \Delta SEC_{s,t} + \phi_2 \sum_{i-1}^{t} \Delta ER_{j,t} + \delta_1 ECT_{t-1} + \varepsilon_t \qquad \text{Eq 4}$$

In the above equation, φ1 and φ2 indicates the short run relationship among the variables while Error Correction Term (ECTt-1) indicates the speed of adjustment towards stability. We check the serial correlation by Durbin-Watson test (DW) and stationarity by augmented Dickey Fuller test. Stability of coefficients are measured by the Cusum test. Wald test is used to indicate the existence of short run relationship or not between the sector stock returns and foreign exchange rates in Sri Lanka.

IV.   ANALYSIS

4.1 Descriptive Statistics

We provide descriptive statistics for sector stock returns and exchange rates separately. When we consider sector stock returns, means and medians are almost zero for all the sectors. However, it can be observed there is a significant range between maximum and minimum for all sectors. Further standard deviations are below than 10 percent except HLT and LP sectors. When we analyze the skewness of the sector stock returns, three sectors (BFI, DIV and TLC) are fairly symmetrical and four sectors (CE, CP, PLT and TRD) are moderately skewed. All other sectors can be categorized as highly skewed. When we analyze the kurtosis of sector stock returns, it can be observed that all the sectors are having heavier tails than normal distribution since kurtosis value exceeds three.

When considering the descriptive statistics of foreign exchange rates, range (difference between maximum and minimum) as a percentage of mean exceeds 50 percent for three currencies which are USD, JPY and EUR. Range as a percentage of mean is below than 50 percent for INR and GBP. Standard deviations are very high for USD, GBP and EUR. When considering the skewness of currencies, JPY, GBP and EUR are fairly symmetrical since their skewness value is between -0.50 and +0.50. Further USD and INR are also moderately skewed. When considering the kurtosis, all the currencies have lighter tails than normal distribution except INR.

Table 1: Descriptive Statistics of Currencies

	USD	INR	JPY	GBP	EUR
Mean	126.69	2.35	1.23	198.86	158.91
Median	117.23	2.33	1.27	199.11	159.68
Max	182.13	2.88	1.69	237.57	208.05
Min	97.45	2.06	0.86	162.49	117.44
Std. Dev.	22.79	0.17	0.24	17.82	21.21
Skewness	0.83	0.62	0.06	0.04	0.09
Kurtosis	2.75	3.11	2.01	2.01	2.59

Table 2: Descriptive Statistics of Sector Returns

	BFI	BFT	CE	CP	DIV	FT	HLT	HT	INV	IT	LP	MFG	MOT	OP	PE	PLT	SRV	SS	TLC	TRD
Mean	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Median	0.00	0.00	(0.00)	-	-	(0.00)	(0.00)	(0.00)	(0.00)	-	(0.00)	0.00	-	-	-	(0.00)	-	-	-	(0.00)
Max	0.19	0.37	0.21	0.18	0.11	0.44	29.33	0.21	0.42	0.75	9.48	0.29	0.50	0.99	0.73	0.14	0.40	3.46	0.17	0.24
Min	(0.16)	(0.28)	(0.17)	(0.17)	(0.13)	(0.19)	(0.97)	(0.12)	(0.27)	(0.29)	(0.90)	(0.22)	(0.16)	(0.33)	(0.13)	(0.13)	(0.27)	(0.27)	(0.15)	(0.20)
SD	0.01	0.01	0.02	0.02	0.01	0.02	0.47	0.01	0.02	0.04	0.15	0.01	0.02	0.03	0.02	0.02	0.02	0.06	0.02	0.02
Skewness	0.44	2.62	0.95	0.54	0.06	2.87	61.70	1.61	1.95	2.89	59.68	1.64	5.86	12.61	12.39	0.84	2.73	48.82	0.30	0.96
Kurtosis	49.39	194.40	15.16	18.20	21.06	49.15	3,817.44	35.76	44.63	44.85	3,656.07	106.54	129.19	361.43	430.50	12.91	54.60	2,793.37	13.55	18.17

4.2 Correlation Analysis

We have presented two separate tables for correlation analysis where one is for the sector stock returns and other is for exchange rates. Both the correlation tables don't show very high correlations indicating the absence of multicollinearity problem.

Table 3: Correlation Analysis of Currencies

	USD	INR	JPY	GBP	EUR
USD	1.00	(0.02)	0.75	0.59	0.84
INR	(0.02)	1.00	0.07	0.25	0.22
JPY	0.75	0.07	1.00	0.25	0.79
GBP	0.59	0.25	0.25	1.00	0.66
EUR	0.84	0.22	0.79	0.66	1.00

Table 4: Correlation Analysis of Sector Returns

	BFI	BFT	CE	CP	DIV	FT	HLT	HT	INV	IT	LP	MFG	MOT	OP	PE	PLT	SRV	SS	TLC	TRD
BFI	1.00	0.56	0.51	0.55	0.67	0.39	0.02	0.59	0.44	0.25	0.07	0.76	0.36	0.16	0.34	0.52	0.45	0.08	0.50	0.44
BFT	0.56	1.00	0.35	0.38	0.44	0.26	0.03	0.40	0.30	0.14	0.04	0.57	0.26	0.12	0.21	0.36	0.34	0.07	0.34	0.26
CE	0.51	0.35	1.00	0.37	0.41	0.27	0.00	0.39	0.35	0.20	0.05	0.52	0.21	0.11	0.26	0.34	0.27	0.04	0.32	0.31
CP	0.55	0.38	0.37	1.00	0.44	0.29	0.01	0.40	0.32	0.22	0.06	0.55	0.27	0.12	0.25	0.39	0.29	0.10	0.30	0.32
DIV	0.67	0.44	0.41	0.44	1.00	0.31	0.02	0.55	0.45	0.22	0.06	0.59	0.28	0.21	0.32	0.42	0.36	0.11	0.44	0.39
FT	0.39	0.26	0.27	0.29	0.31	1.00	0.01	0.29	0.29	0.17	0.04	0.41	0.20	0.09	0.23	0.29	0.21	0.04	0.27	0.25
HLT	0.02	0.03	0.00	0.01	0.02	0.01	1.00	0.03	0.01	0.01	0.00	0.02	0.00	0.03	0.01	0.02	0.01	0.00	0.00	0.03
HT	0.59	0.40	0.39	0.40	0.55	0.29	0.03	1.00	0.37	0.24	0.07	0.56	0.29	0.13	0.30	0.44	0.31	0.09	0.43	0.37
INV	0.44	0.30	0.35	0.32	0.45	0.29	0.01	0.37	1.00	0.27	0.04	0.44	0.23	0.23	0.26	0.30	0.28	0.07	0.29	0.29
IT	0.25	0.14	0.20	0.22	0.22	0.17	0.01	0.24	0.27	1.00	0.03	0.26	0.12	0.05	0.19	0.22	0.12	0.02	0.15	0.21
LP	0.07	0.04	0.05	0.06	0.06	0.04	0.00	0.07	0.04	0.03	1.00	0.07	0.03	0.01	0.04	0.02	0.04	0.01	0.06	0.04
MFG	0.76	0.57	0.52	0.55	0.59	0.41	0.02	0.56	0.44	0.26	0.07	1.00	0.39	0.15	0.35	0.52	0.45	0.08	0.46	0.41
MOT	0.36	0.26	0.21	0.27	0.28	0.20	0.00	0.29	0.23	0.12	0.03	0.39	1.00	0.09	0.16	0.25	0.22	0.03	0.21	0.20
OP	0.16	0.12	0.11	0.12	0.21	0.09	0.03	0.13	0.23	0.05	0.01	0.15	0.09	1.00	0.09	0.14	0.08	0.01	0.11	0.08
PE	0.34	0.21	0.26	0.25	0.32	0.23	0.01	0.30	0.26	0.19	0.04	0.35	0.16	0.09	1.00	0.27	0.18	0.04	0.25	0.27
PLT	0.52	0.36	0.34	0.39	0.42	0.29	0.02	0.44	0.30	0.22	0.02	0.52	0.25	0.14	0.27	1.00	0.28	0.07	0.33	0.32
SRV	0.45	0.34	0.27	0.29	0.36	0.21	0.01	0.31	0.28	0.12	0.04	0.45	0.22	0.08	0.18	0.28	1.00	0.05	0.26	0.24
SS	0.08	0.07	0.04	0.10	0.11	0.04	0.00	0.09	0.07	0.02	0.01	0.08	0.03	0.01	0.04	0.07	0.05	1.00	0.04	0.06
TLC	0.50	0.34	0.32	0.30	0.44	0.27	0.00	0.43	0.29	0.15	0.06	0.46	0.21	0.11	0.25	0.33	0.26	0.04	1.00	0.30
TRD	0.44	0.26	0.31	0.32	0.39	0.25	0.03	0.37	0.29	0.21	0.04	0.41	0.20	0.08	0.27	0.32	0.24	0.06	0.30	1.00

4.3 ARDL regression results

ARDL regressions have been conducted for all 20 sectors in CSE traditional classification and independent variables are five different currencies which Sri Lanka uses for most of their foreign trading activities.

4.3.1 ARDL long run and short run tests of BFI sector

Number of optimum lags is four which is determined by minimum AIC for the BFI sector. When considering the ARDL regression between BFI sector stock returns and GBP, both the constant and GBP exchange rates are significant at 10 percent level. Further when considering the regression between BFI sector returns and JPY, constant is significant at 1 percent level. Except those findings, other variables don't show any statistical significance. However, when considering the all five regressions with BFI sector returns, F statistics are significant at 1 percent level which indicate exchange rates of all five currencies contributing to the significant results of the regressions. However, it should be noted that R squared values are very low in all these regressions. F statistic of ARDL bound test exceeds the upper bound value at 5 percent which indicates the existence of long run relationship between exchange rates considered and BFI sector returns. Further regressions are free from serial correlation since Durbin-Watson (DW) statistic is close to the value of 2 in all five regressions.

When considering the ARDL short run tests between BFI sector returns and all five exchange rates, R squared values and significance of the F statistic is at the healthy levels. According to the short run ARDL theory, error correction term (ECT) should be negative and significant. However, findings reveal a significant ECT with a positive sign.Further, DW statistics are close to the zero which indicate a positive serial correlation among residuals. Cusum tests also reveal the all five short run ARDL regressions are not stable. Further Wald test indicates that there are no short run relationships between considered exchange rates and BFI sector returns.

Table 5: ARDL Long Run and Short Run Tests of Banks, Finance & Insurance (BFI) sector

Dependent Variable: Daily returns of BFI Total Return Index					
	USD	INR	JPY	GBP	EUR
ARDL Long Run Test					
No. of lags	4	4	4	4	4
Constant	0.008 (1.490)	-0.002 (-1.090)	0.001*** (2.616)	0.020* (1.794)	0.008 (1.120)
Exchange rate	-0.002 (-1.385)	0.003 (1.336)	0.002 (0.055)	-0.068* (-1.952)	-0.016 (-0.471)
R squared	0.010	0.009	0.015	0.011	0.012
F statistic	7.436***	7.308***	6.315***	6.916***	5.018***
DW statistic	2.002	2.002	1.998	2.003	2.000
AIC	-6.084	-6.084	-6.087	-6.085	-6.084
F statistic of bound test	260.816	260.563	261.865	260.701	261.180
Upper bound value (5%)	4.160	4.160	4.160	4.160	4.160
Observations	3834	3834	3834	3834	3834
ARDL Short Run Test					
R squared	0.871	0.871	0.871	0.872	0.871
F statistic	2876.778***	2873.497***	2872.489***	2884.335***	2873.492***
ECT	0.953***	0.952***	0.951***	0.953***	0.952***
DW statistic	0.421	0.421	0.423	0.421	0.422
CUSUM test	Not stable	Not stable	Not stable	Not stable	Not stable
Wald test	81.19% > 5%	57.35% > 5%	10.76 > 5%	16.28% > 5%	33.25% > 5%
Observations	3833	3833	3833	3833	3833

*Note: *, ** and *** denote statistical significance at 10%, 5% and 1% respectively. DW statistic is Durbin-Watson Statistic and AIC means Akaike Information Criterion. ECT is correction term. This note will be applicable from Table 5 to Table 24.*

4.3.2 ARDL long run and short run tests of BFT sector

Number of optimum lags is four for BFT sector according to the minimum AIC. Constant is significant at 1 percent level for USD, JPY and GBP. Further constant is significant at 5 percent level for EUR. However, constant is not significant for INR. Further all five exchange rates are not significant to the BFT sector returns. However, F statistics are heavily significant at 1 percent level which is a good sign of the regression models. But R squared values remain at very low levels. F statistic of the ARDL bound test exceeds upper bound value indicating a long

run relationship between BFT sector stock returns and selected currencies. DW statistic is close to the value of 2 indicating no serial correlation problem.

When considering the ARDL short run tests, R squared values are at higher levels and F statistics are significant at 1 percent level. ECT is significant and positive. But according to the theory ECT should be negative with the statistical significance. Further we can observe many weaknesses in the ARDL short run regression models. DW statistic is close to the zero indicating positive serial correlation. Cusum tests also reveal that regressions are not stable. Finally, according to the Wald test, all five currencies don't have short run relationships with BFT sector returns.

Table 6: ARDL Long Run and Short Run Tests of Beverage, Food and Tobacco (BFT) sector

Dependent Variable: Daily returns of BFT Total Return Index					
	USD	INR	JPY	GBP	EUR
ARDL Long Run Test					
No. of lags	4	4	4	4	4
Constant	0.021*** (3.260)	-0.003 (-0.940)	0.001*** (4.467)	0.039*** (2.870)	0.021** (2.388)
Exchange rate	0.125 (1.400)	0.019 (0.356)	0.064 (1.550)	-0.010 (-0.237)	0.030 (0.715)
R squared	0.040	0.040	0.043	0.041	0.041
F statistic	39.423***	17.714***	19.041***	18.014***	18.120***
DW statistic	2.001	2.000	1.997	1.998	1.996
AIC	-5.660	-5.657	-5.660	-5.658	-5.658
F statistic of bound test	828.390	342.820	341.391	346.490	344.306
Upper bound value (5%)	4.160	4.160	4.160	4.160	4.160
Observations	3836	3834	3834	3834	3834
ARDL Short Run Test					
R squared	0.942	0.941	0.942	0.942	0.942
F statistic	6911.888***	6831.071***	6836.186***	6899.973***	6870.064***
ECT	1.032***	1.031***	1.030***	1.032***	1.031***
DW statistic	0.363	0.361	0.361	0.363	0.362
CUSUM test	Not stable	Not stable	Not stable	Not stable	Not stable
Wald test	10.10% > 5%	96.66% > 5%	59.54% > 5%	63.81% > 5%	89.56% > 5%
Observations	3833	3833	3833	3833	3833

4.3.3 ARDL long run and short run tests of CE sector

Number of lags is selected as the four as per the minimum AIC value. Constant is significant at 5 percent level with the USD and it is significant at 1 percent level with INR and JPY. There are no significant constants for GBP and EUR. However, exchange rates of GBP and EUR are significant at 1 percent and 5 percent significant levels respectively. Exchange rates of other three currencies are not significant to CE sector returns. Even though R squared values are very low, F statistics of all five regressions are significant. F statistics of USD and INR are significant at 5 percent level. F statistics of JPY and GBP are significant at 1 percent level. F statistic of EUR regression is significant at 10 percent level. DW statistics remain very close to the value of 2 which indicates no serial correlation. F statistics of ARDL bound test heavily exceeds upper bound value indicating the existence of long run relationship between CE sector returns and selected exchange rates.

When considering the CE sector's short run ARDL tests, R squared values are very high and F statistics are significant at 1 percent level. However, DW statistic is closer to zero indicating positive serial correlation problem. Cusum tests also reveal short run regressions are not stable for all five currencies. ECT is significant and positive which is contrary to the theory. Theory states it should be negative and significant. According to the Wald test, regressions with USD and GBP as independent variables show a significant short run relationships while other currencies don't.

Table 7: ARDL Long Run and Short Run Tests of Construction and Engineering (CE) sector

Dependent Variable: Daily returns of CE Total Return Index					
	USD	INR	JPY	GBP	EUR
ARDL Long Run Test					
No. of lags	4	4	4	4	4
Constant	0.020** (2.111)	-0.009** (-2.235)	0.001*** (3.184)	-0.001 (-0.070)	0.005 (0.437)
Exchange rate	0.044 (0.341)	-0.087 (-1.143)	-0.020 (-0.340)	-0.217*** (-3.520)	-0.140** (-2.328)
R squared	0.005	0.005	0.006	0.007	0.004
F statistic	2.339**	2.034**	2.626***	3.008***	1.803*
DW statistic	2.000	1.999	1.999	2.000	2.000
AIC	-4.932	-4.932	-4.933	-4.918	-4.931
F statistic of bound test	339.100	338.653	338.877	336.416	336.467
Upper bound value (5%)	4.160	4.160	4.160	4.160	4.160
Observations	3834	3834	3834	3834	3834
ARDL Short Run Test					
R squared	0.911	0.911	0.911	0.911	0.911
F statistic	4359.283***	4354.877***	4341.860***	4345.843***	4325.277***
ECT	1.017***	1.017***	1.017***	1.016***	1.016***
DW statistic	0.393	0.393	0.394	0.392	0.393
CUSUM test	Not stable	Not stable	Not stable	Not stable	Not stable
Wald test	2% < 5%	77.15% > 5%	22.58% > 5%	0.01% < 5%	17.45% > 5%
Observations	3833	3833	3833	3833	3833

4.3.4 ARDL long run and short run tests of CP sector

Selected number of lags is four based on the minimum AIC. Constants are significant for JPY at 1 percent level and it is significant for USD at 10 percent. Coefficients of exchange rates of five selected currencies are not significant at all and R squared values are also too low. However, F statistics are significant at 1 percent for three currencies which are JPY, GBP and EUR. F statistics are significant for USD at 5 percent level and 10 percent level for INR. DW statistic is close to the value of 2 for all currencies indicating no serial correlation. F statistic of ARDL bound test easily exceeds upper bound value indicating long run relationship between CP sector returns and exchange rates studied in this paper.

When considering the short run ARDL tests for CP sector, R squared values are very high and F statistics are highly significant at 1 percent level. ECT is significant, but its sign is positive in contrast with the theory. Further DW statistics are very low indicating positive serial correlation and cusum tests show all the regressions are not stable. According to the Wald test, there is no short run relationship between CP sector returns and exchange rates.

Table 8: ARDL Long Run and Short Run Tests of Chemicals and Pharmaceuticals (CP) sector

Dependent Variable: Daily returns of CP Total Return Index					
	USD	INR	JPY	GBP	EUR
ARDL Long Run Test					
No. of lags	4	4	4	4	4
Constant	0.013* (1.905)	-0.003 (-1.153)	0.001*** (2.732)	0.024 (1.635)	0.013 (1.409)
Exchange rate	0.080 (0.828)	0.069 (1.183)	-0.018 (-0.407)	-0.035 (-0.742)	-0.023 (-0.498)
R squared	0.006	0.004	0.008	0.005	0.006
F statistic	2.563**	1.721*	3.491***	2.073***	2.415***
DW statistic	1.996	1.995	1.992	1.995	1.993
AIC	-5.496	-5.494	-5.498	-5.495	-5.495
F statistic of bound test	286.699	284.776	286.654	285.998	285.659

Upper bound value (5%)	4.160	4.160	4.160	4.160	4.160
Observations	3834	3834	3834	3834	3834
ARDL Short Run Test					
R squared	0.898	0.898	0.898	0.898	0.898
F statistic	3741.044***	3723.504***	3728.774***	3732.764***	3726.006***
ECT	0.985***	0.984***	0.984***	0.985***	0.984***
DW statistic	0.390	0.389	0.391	0.389	0.390
CUSUM test	Not stable	Not stable	Not stable	Not stable	Not stable
Wald test	22.94% > 5%	94.99% > 5%	36.90% > 5%	61.22% > 5%	72.84% > 5%
Observations	3833	3833	3833	3833	3833

4.3.5 ARDL long run and short run tests of DIV sector

Number of lags is determined as four based on minimum AIC. Constant is significant at 1 percent level for JPY and shows a 10 percent significance for GBP. Exchange rates show only 10 percent significance for USD and INR only and other exchange rates are not significant for DIV sector returns. R squared values are very low for all five regressions. However, F statistics are significant at 1 percent level for all five currencies. DW statistics are lied on the value of 2 which indicates no serial correlation at all. F statistic of ARDL bound test exceeds highly upper bound value indicating the existence of long run relationship between DIV sector returns and selected exchange rates.

When considering the short run ARDL tests, R squared values are very high and F statistics are highly significant at 1 percent level. DW statistics are very close to zero indicating positive serial correlation. ECT is significant, but it is positive unlike the negative sign as the theory suggests. Cusum tests show regressions are not stable for all five exchange rates. Wald test indicates there are no short run relationships between DIV sector returns and selected exchange rates.

Table 9: ARDL Long Run and Short Run Tests of Diversified Holdings (DIV) sector

Dependent Variable: Daily returns of DIV Total Return Index					
	USD	INR	JPY	GBP	EUR
ARDL Long Run Test					
No. of lags	4	4	4	4	4
Constant	0.009 (1.613)	-0.002 (-0.870)	0.001*** (1.997)	0.021* (1.910)	0.010 (1.345)
Exchange rate	0.135* (1.848)	0.083* (1.893)	0.030 (0.875)	-0.022 (-0.635)	0.030 (0.879)
R squared	0.030	0.029	0.032	0.029	0.029
F statistic	13.076***	12.851***	14.024***	12.785***	12.480***
DW statistic	2.000	2.000	2.000	2.000	2.000
AIC	-6.061	-6.061	-6.063	-6.060	-6.060
F statistic of bound test	253.129	252.250	252.469	252.742	252.244
Upper bound value (5%)	4.160	4.160	4.160	4.160	4.160
Observations	3834	3834	3834	3834	3834
ARDL Short Run Test					
R squared	0.839	0.839	0.839	0.839	0.839
F statistic	2215.304***	2213.716***	2206.862***	2220.101***	2210.986***
ECT	0.937***	0.937***	0.936***	0.938***	0.937***
DW statistic	0.454	0.455	0.455	0.453	0.453
CUSUM test	Not stable	Not stable	Not stable	Not stable	Not stable
Wald test	56.54% > 5%	6.95% > 5%	55.46% > 5%	46.74% > 5%	94.38% > 5%
Observations	3833	3833	3833	3833	3833

4.3.6 ARDL long run and short run tests of FT sector

Number of lags of the FT sector is determined as four according to the minimum AIC. Only the constant for JPY shows 5 percent level of significance while constants for other currencies show no significance. All five exchange rates also show no statistical significance for the FT sector. R squared values are also at very low levels. However, F statistics of four currencies out of five have 1 percent significance except INR. F statistic of the INR show 5 percent significance level. DW statistics are very close to the value of 2 indicating there is no serial correlation in all five regressions. F statistic of the ARDL bound test easily exceeds upper bound value. So, we can conclude that there is a long run relationship between FT sector returns and selected exchange rates.

R squared values of ARDL short run tests are very high with strongly significant F statistics at 1 percent level. ECT is significant but take a positive value instead of a negative value as theory suggests. DW statistics are very low indicating existence of positive serial correlation. Further Cusum tests show no stability in all regression models with FT sector returns. Finally, Wald test suggests there are no short run relationships between FT sector returns and selected exchange rates.

Table 10: ARDL Long Run and Short Run Tests of Footwear and Textiles (FT) sector

Dependent Variable: Daily returns of FT Total Return Index					
	USD	INR	JPY	GBP	EUR
ARDL Long Run Test					
No. of lags	4	4	4	4	4
Constant	0.011 (1.017)	-0.001 (-0.311)	0.001** (2.183)	0.014 (0.612)	0.021 (1.450)
Exchange rate	0.117 (0.789)	-0.012 (-0.131)	0.045 (0.648)	-0.071 (-0.993)	-0.022 (-0.313)
R squared	0.007	0.005	0.006	0.006	0.008
F statistic	2.794***	2.043**	2.778***	2.458***	3.433***
DW statistic	2.000	2.000	1.999	1.999	1.997
AIC	-4.648	-4.647	-4.648	-4.647	-4.650
F statistic of bound test	326.872	326.097	325.927	327.349	328.817
Upper bound value (5%)	4.160	4.160	4.160	4.160	4.160
Observations	3834	3834	3834	3834	3834
ARDL Short Run Test					
R squared	0.916	0.916	0.916	0.916	0.916
F statistic	4625.071***	4617.717***	4625.765***	4631.979***	4640.572***
ECT	1.014***	1.014***	1.014***	1.014***	1.014***
DW statistic	0.383	0.382	0.382	0.383	0.384
CUSUM test	Not stable	Not stable	Not stable	Not stable	Not stable
Wald test	81.29% > 5%	99.95% > 5%	94.15% > 5%	6.01% > 5%	14.28% > 5%
Observations	3833	3833	3833	3833	3833

4.3.7 ARDL long run and short run tests of HLT sector

Number of lags to be used in the regression was selected as four according to the minimum AIC. Constants and exchange rates are not statistically significant except the constant of the regression with JPY. Adding to the weaknesses of HLT sector regressions, R squared values are very low and no F statistics are significant for all five currencies. This is a notable exception with previous sectors which showed significant F statistics. However, regression models are free with serial correlation problem since DW statistics are takes the value of 2 exactly. F statistic of the ARDL bound test easily exceeds upper bound value and it conveys there are long run relationships between HLT sector returns and selected exchange rates.

However, there are very high R squared values and heavily significant F statistics at 1 percent level in ARDL short run tests of HLT sector. ECT is significant, but positive in contrast with the theory. DW statistics are close to zero indicating positive serial correlation. Cusum tests show stable regressions with currencies of USD, JPY and EUR. However, INR and GBP regressions are not stable according to the Cusum tests. Wald test suggests there are no short run relationships between HLT sector returns and selected currencies.

Table 11: ARDL Long Run and Short Run Tests of Healthcare (HLT) sector

Dependent Variable: Daily returns of HLT Total Return Index					
	USD	INR	JPY	GBP	EUR
ARDL Long Run Test					
No. of lags	4	4	4	4	4
Constant	0.255 (1.180)	0.067 (0.742)	0.021* (1.907)	0.067 (0.148)	0.390 (1.354)
Exchange rate	-0.076 (-0.026)	-0.129 (-0.073)	-0.066 (-0.048)	-0.124 (-0.087)	-0.101 (-0.072)
R squared	0.001	0.001	0.002	0.001	0.002
F statistic	0.607	0.507	0.745	0.462	0.656
DW statistic	2.000	2.000	2.000	2.000	2.000
AIC	1.349	1.350	1.349	1.350	1.349
F statistic of bound test	325.818	325.439	326.332	325.270	326.001
Upper bound value (5%)	4.160	4.160	4.160	4.160	4.160
Observations	3834	3834	3834	3834	3834
ARDL Short Run Test					
R squared	0.909	0.908	0.909	0.908	0.909
F statistic	4221.759***	4216.320***	4229.206***	4213.866***	4224.436***
ECT	1.007***	1.007***	1.007***	1.007***	1.007***
DW statistic	0.393	0.393	0.393	0.393	0.393
CUSUM test	Stable	Not stable	Stable	Not stable	Stable
Wald test	99.99% > 5%	100% > 5%	100% > 5%	100% > 5%	100% > 5%
Observations	3833	3833	3833	3833	3833

4.3.8 ARDL long run and short run tests of HT sector

Number of lags is determined as four according to the minimum AIC. Constants of USD and JPY regressions show 1 percent and 5 percent statistical significance respectively. Exchange rate of GBP shows a negative significant relationship with HT sector returns at 1 percent level. Although R squared values are very low, all regressions show significant F statistics indicating there is an overall contribution from respective exchange rates to HT sector returns. DW statistics are close to the value of 2 indicating there is no serial correlation problem in regressions. F statistics of ARDL bound tests easily exceed upper bound value indicating there is a long run relationship between HT sector returns and selected exchange rates.

When considering the ARDL short run tests, R squared values are very high and F statistics in all five regressions are significant at 1 percent level. ECT is significant, but positive. Theory suggests ECT should be significant as well as negative. DW statistic is close to the zero indicating positive serial correlation for all the regressions. Results of Cusum tests show regressions are not stable. Wald test suggests there is a short run relationship between HT sector returns and GBP. However, other currencies don't show short run relationships between them and HT sector returns.

Table 12: ARDL Long Run and Short Run Tests of Hotels & Travel (HT) sector

Dependent Variable: Daily returns of HT Total Return Index					
	USD	INR	JPY	GBP	EUR
ARDL Long Run Test					
No. of lags	4	4	4	4	4
Constant	0.011* (1.719)	0.031 (0.616)	0.001** (2.150)	0.021 (1.642)	0.009 (1.141)
Exchange rate	-0.003 (-0.034)	-0.002 (-0.919)	0.062 (1.583)	-0.132*** (-3.289)	0.013 (0.328)
R squared	0.014	0.014	0.017	0.017	0.014
F statistic	6.191***	5.961***	6.986***	7.480***	6.132***
DW statistic	1.997	1.997	1.997	1.997	1.996

AIC	-5.788	-5.788	-5.790	-5.791	-5.788
F statistic of bound test	313.803	312.7833	312.715	314.341	313.992
Upper bound value (5%)	4.160	4.160	4.160	4.160	4.160
Observations	3834	3834	3834	3834	3834
ARDL Short Run Test					
R squared	0.877	0.876	0.876	0.878	0.877
F statistic	3021.544***	3010.231***	3014.069***	3044.450***	3016.941***
ECT	0.974***	0.974***	0.876***	0.975***	0.974***
DW statistic	0.424	0.424	0.424	0.422	0.424
CUSUM test	Not stable	Not stable	Not stable	Not stable	Not stable
Wald test	42.36% > 5%	79.84% > 5%	24.89% > 5%	0% < 5%	19.29% > 5%
Observations	3833	3833	3833	3833	3833

4.3.9 ARDL long run and short run tests of INV sector

Minimum AIC indicates that optimal number of lags is four. Constants for regressions with USD and JPY shows a 10 percent and 5 percent statistical significance respectively. Regression with EUR exchange rate shows a 5 percent negative significance. R squared values are very low for all five regressions. F statistics show difference level of significance among five regressions. GBP and EUR regressions show 1 percent significant F statistics while USD and JPY depict 5 percent significant F statistics. INR just show a 10 percent significance level to INV sector returns. DW statistic is exactly the value of 2 which indicates no serial correlation. F statistic of ARDL bound test exceeds upper bound value easily. Hence it indicates a long run relationship between INV sector returns and selected exchange rates.

R squared values are very high for ARDL short run tests with INV sector returns. Further F statistics are heavily significant at 1 percent level for all currencies. ECT is significant, but positive in contrast with the theory. Theory suggests ECT should be significant and negative both. DW statistics are close to the zero indicating positive serial correlation. Cusum tests show regressions are not stable. Further Wald test reveals that there are no short run relationships between INV sector returns and selected exchange rates.

Table 13: ARDL Long Run and Short Run Tests of Investment Trust (INV) sector

Dependent Variable: Daily returns of INV Total Return Index					
	USD	INR	JPY	GBP	EUR
ARDL Long Run Test					
No. of lags	4	4	4	4	4
Constant	0.020* (1.778)	-0.003 (-0.554)	0.001** (2.190)	0.025 (1.091)	0.022 (1.505)
Exchange rate	-0.032 (-0.216)	0.070 (0.774)	-0.092 (-1.316)	-0.070 (-0.966)	-0.156** (-2.209)
R squared	0.005	0.004	0.005	0.006	0.007
F statistic	2.135**	1.796*	2.114**	2.416***	2.966***
DW statistic	2.000	2.000	2.000	2.000	2.000
AIC	-4.617	-4.616	-4.617	-4.618	-4.619
F statistic of bound test	296.933	295.729	296.674	296.062	297.224
Upper bound value (5%)	4.160	4.160	4.160	4.160	4.160
Observations	3834	3834	3834	3834	3834
ARDL Short Run Test					
R squared	0.881	0.881	0.881	0.881	0.881
F statistic	3156.318***	3143.15***	3151.451***	3148.109***	3152.700***
ECT	0.982***	0.981***	0.982***	0.981***	0.982***
DW statistic	0.414	0.414	0.414	0.415	0.415
CUSUM test	Not stable	Not stable	Not stable	Not stable	Not stable
Wald test	96.09% > 5%	99.90% > 5%	98.03% > 5%	75.63% > 5%	74.86% > 5%

Observations	3833	3833	3833	3833	3833

4.3.10 ARDL long run and short run tests of IT sector

Number of lags are determined as four according to the minimum AIC. Regression with JPY only shows a significant constant at 10 percent level. Further only exchange rates of USD and INR show statistical significance at 5 percent level. Even though R squared values are very low, all the F statistics are significant at 1 percent level. DW statistics are very close to the value of 2 indicating no serial correlation problem. F statistic of ARDL bound test easily exceeds upper bound value, hence indicating long run relationship between IT sector returns and selected exchange rates.

When considering the ARDL short run tests, R squared values are very high and F statistics are heavily significant at 1 percent level. ECT is significant, but takes a positive value. However, as theory suggests ECT should be a negative value. DW statistic is close to the zero indicating positive serial correlation. Further Cusum tests show all five regressions are not stable. Results of the Wald test indicates there are no short run associations between IT sector returns and selected exchange rates.

Table 14: ARDL Long Run and Short Run Tests of Information Technology (IT) sector

Dependent Variable: Daily returns of IT Total Return Index					
	USD	INR	JPY	GBP	EUR
ARDL Long Run Test					
No. of lags	4	4	4	4	4
Constant	0.027 (1.498)	-0.006 (-0.768)	0.002* (1.827)	0.040 (1.065)	0.035 (1.446)
Exchange rate	0.567** (2.276)	0.372** (2.498)	0.168 (1.445)	0.134 (1.116)	0.189 (1.613)
R squared	0.018	0.015	0.016	0.015	0.015
F statistic	7.655***	6.446***	7.093***	6.265***	6.473***
DW statistic	1.997	1.999	1.997	1.999	1.999
AIC	-3.606	-3.603	-3.605	-3.603	-3.603
F statistic of bound test	367.877	367.635	367.071	367.614	367.499
Upper bound value (5%)	4.160	4.160	4.160	4.160	4.160
Observations	3834	3834	3834	3834	3834
ARDL Short Run Test					
R squared	0.928	0.928	0.928	0.928	0.928
F statistic	5490.582***	5488.077***	5489.133***	5482.941***	5489.106***
ECT	1.025***	1.025***	1.025***	1.025***	1.025***
DW statistic	0.384	0.384	0.385	0.384	0.384
CUSUM test	Not stable	Not stable	Not stable	Not stable	Stable
Wald test	51.84% > 5%	17.16% > 5%	58.66% > 5%	60.58% > 5%	81.47% > 5%
Observations	3833	3833	3833	3833	3833

4.3.11 ARDL long run and short run tests of LP sector

Number of optimal lags are determined as four according to the minimum AIC. Constants and exchange rates show no significance at all for all five currencies. R squared values are also very low. However, F statistics of all five regressions are significant at 1 percent level. Further DW statistic is also exactly the value of 2 indicating there is no serial correlation problem. F statistic of ARDL bound test easily exceeds upper bound value indicating there is a long run relationship between LP sector returns and selected exchange rates.

When considering the short run ARDL tests, R squared values are very high. F statistics are also highly significant at 1 percent level. Even though it resultssignificant ECTs for all five currencies, their sign is positive which contradicts with theory. Further to the weaknesses of short run ARDL regressions of LP returns, there are very weak DW statistics and unstable regressions according to the Cusum tests conducted. Finally, Wald test reveals there are no short run relationships between LP sector returns and selected exchange rates.

Table 15: ARDL Long Run and Short Run Tests of Land and Property (LP) sector

Dependent Variable: Daily returns of LP Total Return Index					
	USD	INR	JPY	GBP	EUR
ARDL Long Run Test					
No. of lags	4	4	4	4	4
Constant	-0.011 (-0.156)	0.045 (1.518)	0.005 (1.382)	-0.048 (-0.329)	0.068 (0.724)
Exchange rate	-0.007 (-0.008)	-0.010 (-0.018)	0.059 (0.131)	-0.119 (-0.256)	-0.078 (-0.171)
R squared	0.008	0.009	0.009	0.009	0.009
F statistic	3.616***	3.825***	3.667***	3.621***	3.659***
DW statistic	2.000	2.000	2.000	2.000	2.000
AIC	-0.895	-0.895	-0.895	-0.895	-0.895
F statistic of bound test	335.033	335.828	335.161	335.065	335.208
Upper bound value (5%)	4.160	4.160	4.160	4.160	4.160
Observations	3834	3834	3834	3834	3834
ARDL Short Run Test					
R squared	0.922	0.922	0.922	0.922	0.922
F statistic	5013.453***	5027.338***	5016.394***	5014.310***	5016.546***
ECT	1.017***	1.018***	1.017***	1.017***	1.017***
DW statistic	0.381	0.382	0.381	0.381	0.381
CUSUM test	Stable	Stable	Stable	Stable	Stable
Wald test	99.59% > 5%	100% > 5%	99.93% > 5%	97.64% > 5%	99.95% > 5%
Observations	3833	3833	3833	3833	3833

4.3.12 ARDL long run and short run tests of MFG sector

Optimal number of lags is four for all five regressions with MFG sector returns according to the minimum AIC. Constants of USD and JPY regressions show 10 percent significance and 1 percent significance respectively. USD exchange rate only show 10 percent significance while others don't have any sort of statistical significance. R squared values are also at very low levels. F statistics are highly significant at 1 percent level for all currencies except INR which has no any significant probability to its F statistic. DW statistics remain close to the value of 2 which indicates no serial correlation problem. F statistic of ARDL bound test easily exceeds upper bound value indicating the existence of a long run relationship between MFG sector returns and selected exchange rates.

R squared values are very high and F statistics are highly significant at 1 percent level in ARDL short run regressions. ECT is significant, but positive in contrast with the theory. DW statistics are close to the zero indicating positive serial correlation problem. Cusum tests also reveal that there is no stability in regressions. Wald test indicates that there is a short run relationship between MFG sector returns and GBP exchange rate. Other exchange rates don't have short run relationships with MFG sector returns according to the Wald test.

Table 16: ARDL Long Run and Short Run Tests of Manufacturing (MFG) sector

Dependent Variable: Daily returns of MFG Total Return Index					
	USD	INR	JPY	GBP	EUR
ARDL Long Run Test					
No. of lags	4	4	4	4	4
Constant	0.012* (1.936)	-0.001 (-0.523)	0.001*** (3.202)	0.012 (0.913)	0.011 (1.302)
Exchange rate	0.141* (1.691)	0.053 (1.053)	0.050 (1.298)	-0.049 (-1.219)	-0.005 (-0.118)
R squared	0.007	0.004	0.012	0.006	0.009
F statistic	3.073***	1.571	5.106***	2.624***	3.659***
DW statistic	2.001	2.000	1.997	1.999	1.996
AIC	-5.796	-5.792	-5.800	-5.795	-5.797
F statistic of	288.951	286.400	288.597	288.958	289.341

bound test					
Upper bound value (5%)	4.160	4.160	4.160	4.160	4.160
Observations	3834	3834	3834	3834	3834
ARDL Short Run Test					
R squared	0.902	0.902	0.902	0.902	0.902
F statistic	3922.866***	3897.926***	3914.470***	3910.919***	3912.907***
ECT	0.991***	0.990***	0.989***	0.990***	0.989***
DW statistic	0.385	0.384	0.386	0.385	0.386
CUSUM test	Not stable	Not stable	Not stable	Not stable	Not stable
Wald test	26.84% > 5%	96.92% > 5%	10.29% > 5%	4.79% < 5%	10.16% > 5%
Observations	3833	3833	3833	3833	3833

4.3.13 ARDL long run and short run tests of MOT sector

Number of lags is determined as four according to the minimum AIC. All constants are significant except INR at 1 percent significant level. No exchange rates are statistically significant and R squared values are very low. F statistics show different significant levels except INR which has no statistical significance. F statistics of USD and JPY regressions are significant at 1 percent and 5 percent levels respectively. F statistics of GBP and EUR regressions are significant at 10 percent level. DW statistics are close to the value of 2 which indicate zero serial correlation. F statistic of ARDL bound test exceeds upper bound value which indicates long run relationships between the MOT sector returns and selected exchange rates.

When considering the short run ARDL regressions, R squared values are very high and all the F statistics of five regressions are significant at 1 percent level. ECT is significant, but positive which contradicts with the theory. DW statistics are close to the zero which indicates positive serial correlation problem. Cusum tests reveal all five regressions are not stable. According to the Wald test, there are no short run relationships between MOT sector returns and selected exchange rates.

Table 17: ARDL Long Run and Short Run Tests of Motors (MOT) sector

Dependent Variable: Daily returns of MOT Total Return Index					
	USD	INR	JPY	GBP	EUR
ARDL Long Run Test					
No. of lags	4	4	4	4	4
Constant	0.032*** (3.560)	-0.001 (-0.237)	0.002*** (4.157)	0.054*** (2.876)	0.035*** (2.946)
Exchange rate	0.018 (0.147)	-0.101 (-1.383)	-0.019 (-0.338)	-0.061 (-1.035)	-0.057 (-1.000)
R squared	0.009	0.002	0.006	0.004	0.005
F statistic	3.748***	1.019	2.364**	1.855*	1.947*
DW statistic	1.999	2.000	1.999	1.999	1.999
AIC	-5.038	-5.032	-5.035	-5.033	-5.034
F statistic of bound test	306.769	298.413	303.994	303.254	303.783
Upper bound value (5%)	4.160	4.160	4.160	4.160	4.160
Observations	3834	3834	3834	3834	3834
ARDL Short Run Test					
R squared	0.894	0.892	0.893	0.893	0.893
F statistic	3565.324***	3493.618***	3535.155***	3536.454***	3539.226***
ECT	0.989***	0.985***	0.987***	0.987***	0.988***
DW statistic	0.404	0.403	0.403	0.403	0.403
CUSUM test	Not stable	Not stable	Not stable	Not stable	Not stable
Wald test	15.79% > 5%	83.65% > 5%	26.59% > 5%	69.92% > 5%	47.96% > 5%
Observations	3833	3833	3833	3833	3833

4.3.14 ARDL long run and short run tests of OP sector

Number of lags is determined as four according to the minimum AIC. Constants of USD and JPY regressions show 5 percent statistical significance while constants of GBP and EUR regressions show 10 percent statistical significance. All exchange rates show no statistical significance in all five regressions. R squared values are close to 10.70 percent in all the regressions which is a higher value compared to other sectors. DW statistics are slightly higher than value of 2 which indicate no serial correlation problem. F statistics of ARDL bound test exceed upper bound value. This shows evidence for the long run relationships between the OP sector returns and selected exchange rates.

R squared values of short run ARDL regressions are very high compared to R squared values of long run regressions. Further F statistics are highly significant at 1 percent level. ECT is significant but positive which contradicts with theory. DW statistics are close to zero which indicates the presence of serial correlation problem. Cusum tests show all five regressions are not stable. Wald test reveals there are no short run relationships between OP sector returns and selected exchange rates.

Table 18: ARDL Long Run and Short Run Tests of Oil Palms (OP) sector

Dependent Variable: Daily returns of OP Total Return Index					
	USD	INR	JPY	GBP	EUR
ARDL Long Run Test					
No. of lags	4	4	4	4	4
Constant	0.028** (2.134)	-0.001 (-0.181)	0.001** (1.991)	0.046* (1.669)	0.029* (1.661)
Exchange rate	0.040 (0.218)	0.012 (0.107)	0.024 (0.286)	-0.090 (-1.028)	-0.072 (-0.843)
R squared	0.107	0.106	0.106	0.107	0.107
F statistic	50.818***	50.296***	50.550***	50.791***	51.019***
DW statistic	2.012	2.012	2.012	2.012	2.012
AIC	-4.233	-4.232	-4.233	-4.233	-4.234
F statistic of bound test	325.012	322.880	323.584	324.145	324.378
Upper bound value (5%)	4.160	4.160	4.160	4.160	4.160
Observations	3834	3834	3834	3834	3834
ARDL Short Run Test					
R squared	0.779	0.778	0.778	0.778	0.779
F statistic	1495.969***	1486.162***	1489.414***	1492.605***	1492.604***
ECT	0.937***	0.935***	0.936***	0.936***	0.936***
DW statistic	0.549	0.550	0.550	0.549	0.550
CUSUM test	Not stable	Not stable	Not stable	Not stable	Not stable
Wald test	86.98% > 5%	93.49% > 5%	93.79% > 5%	81.84% > 5%	72.29% > 5%
Observations	3833	3833	3833	3833	3833

4.3.15 ARDL long run and short run tests of PE sector

Optimal number of lags is four according to the minimum AIC. No constant is significant in all five regressions. Only GBP exchange rate shows a negative significance at 5 percent level. Other exchange rates are not statistically significant. Further R squared values are very low. However, F statistics are significant at 1 percent level in all the regressions. DW statistic is almost 2 which indicates no serial correlation problem in long run ARDL regressions. F statistic of ARDL bound test easily exceeds upper bound value which indicates a long run relationship between PE sector returns and selected exchange rates.

R squared values of short run ARDL tests are very high and F statistics are highly significant at 1 percent level. ECTs are also significant at 1 percent level. However, signs of the ECTs are positive in contrast with the theory. DW statistics are close to zero which indicates the existence of positive serial correlation problem. Cusum tests show all five regressions are not stable. Finally, Wald test reveal that there are no short run relationships between PE sector returns and selected exchange rates.

Table 19: ARDL Long Run and Short Run Tests of Power and Energy (PE) sector

Dependent Variable: Daily returns of PE Total Return Index					
	USD	INR	JPY	GBP	EUR
ARDL Long Run Test					
No. of lags	4	4	4	4	4
Constant	0.008 (0.893)	-0.000 (-0.044)	0.000 (0.646)	-0.006 (-0.288)	-0.001 (-0.118)
Exchange rate	0.056 (0.441)	-0.024 (-0.317)	-0.016 (-0.274)	-0.132** (-2.155)	-0.047 (-0.783)
R squared	0.006	0.006	0.006	0.007	0.007
F statistic	2.791***	2.460***	2.744***	3.170***	2.899***
DW statistic	2.000	2.000	2.000	2.001	2.000
AIC	-4.937	-4.936	-4.937	-4.938	-4.937
F statistic of bound test	311.928	310.751	311.864	311.868	311.354
Upper bound value (5%)	4.160	4.160	4.160	4.160	4.160
Observations	3834	3834	3834	3834	3834
ARDL Short Run Test					
R squared	0.901	0.901	0.901	0.901	0.901
F statistic	3879.495***	3874.314***	3875.619***	3878.568***	3874.348***
ECT	1.001***	1.001***	1.001***	1.001***	1.001***
DW statistic	0.393	0.392	0.393	0.392	0.393
CUSUM test	Not stable	Not stable	Not stable	Not stable	Not stable
Wald test	65.54% > 5%	70.82% > 5%	51.88% > 5%	21.31% > 5%	70.10% > 5%
Observations	3833	3833	3833	3833	3833

4.3.16 ARDL long run and short run tests of PLT sector

Optimal number of lags is four according to the minimum AIC. Constants of INR and JPY regressions show 5 percent significant level. GBP exchange rate shows 10 percent negative significant level with PLT sector returns. Even though long run R squared values are very low, F statistics are significant at 1 percent level for all currencies. DW statistics are close to the value of 2 indicating no serial correlation problem. F statistic of ARDL bound test exceeds upper bound value easily indicating long run relationship between PLT sector returns and selected exchange rates.

When considering the ARDL short run regression results, R squared values are very high. Further, F statistics show very high statistical significance at 1 percent level. However, DW statistics are close to zero indicating positive serial correlation. Further ECT is significant, but sign is positive contrary to the theory. Cusum tests show stable regressions for three currencies which are USD, JPY and EUR. However, Wald tests show there are no short run relationships between PLT sector returns and selected exchange rates.

Table 20: ARDL Long Run and Short Run Tests of Plantations (PLT) sector

Dependent Variable: Daily returns of PLT Total Return Index					
	USD	INR	JPY	GBP	EUR
ARDL Long Run Test					
No. of lags	4	4	4	4	4
Constant	0.009 (1.223)	-0.007** (-2.288)	0.001** (2.379)	0.000 (0.022)	0.011 (1.038)
Exchange rate	0.050 (0.471)	-0.012 (-0.186)	0.033 (0.685)	-0.086* (-1.678)	-0.040 (-0.805)
R squared	0.008	0.009	0.010	0.009	0.009
F statistic	3.559***	3.878***	4.081***	3.741***	3.699***
DW statistic	1.999	1.999	1.999	1.999	1.998
AIC	-5.311	-5.312	-5.312	-5.311	-5.311
F statistic of bound test	277.187	278.408	276.583	276.551	276.984
Upper bound	4.160	4.160	4.160	4.160	4.160

value (5%)					
Observations	3834	3834	3834	3834	3834
ARDL Short Run Test					
R squared	0.872	0.873	0.872	0.872	0.872
F statistic	2895.465***	2923.021***	2904.492***	2893.420***	2893.862***
ECT	0.971***	0.973***	0.971***	0.970***	0.971***
DW statistic	0.419	0.418	0.418	0.419	0.419
CUSUM test	Stable	Not stable	Stable	Not stable	Stable
Wald test	98.64% > 5%	47.39% > 5%	8.63% > 5%	24.28% > 5%	90.01% > 5%
Observations	3833	3833	3833	3833	3833

4.3.17 ARDL long run and short run tests of SRV sector

Optimum number of lags is determined as four according to the minimum AIC. Constants of regressions for USD and JPY show 10 percent and 5 percent statistical significance respectively. GBP exchange rate show 10 percent significance to the SRV sector returns. Although R squared values remain at low levels, F statistics for all the currencies are significant at 1 percent level. DW statistics remain close to the value of 2 indicating no serial correlation problem. F statistic of ARDL bound test easily exceeds the upper bound value. This indicates there is a long run relationship between SRV sector returns and selected exchange rates.

When considering the short run ARDL regressions, R squared values are very high and F statistics are highly significant at 1 percent level for all currencies. ECT is significant at 1 percent level, but with a positive sign. Sign of the ECT should be negative according to the theory. DW statistics are close to the zero indicating positive serial correlation. Cusum tests show stable regressions for three currencies which are USD, JPY and GBP. Wald test concludes that there is no short run relationship between SRV sector returns and selected exchange rates.

Table 21: ARDL Long Run and Short Run Tests of Services (SRV) sector

Dependent Variable: Daily returns of SRV Total Return Index					
	USD	INR	JPY	GBP	EUR
ARDL Long Run Test					
No. of lags	4	4	4	4	4
Constant	0.020*	-0.007	-0.001**	0.030	0.015
	(1.905)	(-1.519)	(2.228)	(1.345)	(1.095)
Exchange rate	-0.219	0.080	-0.001	-0.121*	-0.028
	(-1.507)	(0.925)	(-0.009)	(-1.726)	(-0.404)
R squared	0.015	0.015	0.015	0.016	0.015
F statistic	6.400***	6.364***	6.449***	6.699***	6.413***
DW statistic	2.000	2.000	1.998	1.999	1.997
AIC	-4.681	-4.681	-4.681	-4.681	-4.681
F statistic of bound test	374.802	373.577	373.533	375.591	373.587
Upper bound value (5%)	4.160	4.160	4.160	4.160	4.160
Observations	3834	3834	3834	3834	3834
ARDL Short Run Test					
R squared	0.930	0.930	0.930	0.930	0.930
F statistic	5647.759***	5641.460***	5624.057***	5644.094***	5626.196***
ECT	1.031***	1.031***	1.030***	1.031***	1.030***
DW statistic	0.389	0.388	0.388	0.389	0.389
CUSUM test	Stable	Not stable	Stable	Stable	Not stable
Wald test	61.90% > 5%	83.27% > 5%	83.13% > 5%	14.16% > 5%	96.31% > 5%
Observations	3833	3833	3833	3833	3833

4.3.18 ARDL long run and short run tests of SS sector

Optimum number of lags is four according to the minimum AIC. Constants show different levels of statistical significance. JPY and EUR regressions show significant constants at 5 percent level. But USD and GBP regressions result 10 percent statistical significance. All exchange rates show no statistical significance. To weaken the long run ARDL models further, R squared values are very low and F statistics show no statistical significance

for all the currencies. However, DW statistics are 2 for all the regressions which indicate no serial correlation problem. F statistic of ARDL bound test exceeds upper bound value indicating there is long run relationship between SS sector returns and selected exchange rates.

Short run ARDL regressions show very high R squared values and highly significant F statistics at 1 percent level. DW statistics are close to the zero indicating positive serial correlation problem. ECT is significant at 1 percent level, but sign is positive which contradicts with the theory. Cusum tests reveal no stability in all five regressions. Finally, Wald test concludes that there are no short run relationships between SS sector returns and selected exchange rates.

Table 22: ARDL Long Run and Short Run Tests of Stores and Supplies (SS) sector

Dependent Variable: Daily returns of SS Total Return Index					
	USD	INR	JPY	GBP	EUR
ARDL Long Run Test					
No. of lags	4	4	4	4	4
Constant	0.049*	0.009	0.003**	0.101*	0.081**
	(1.758)	(0.758)	(2.312)	(1.760)	(2.194)
Exchange rate	-0.144	-0.039	-0.031	-0.062	-0.110
	(-0.381)	(-0.171)	(-0.177)	(-0.342)	(-0.621)
R squared	0.001	0.002	0.001	0.001	0.002
F statistic	0.427	0.072	0.382	0.430	0.721
DW statistic	2.000	2.000	1.999	2.000	1.999
AIC	-2.772	-2.771	-2.772	-2.772	-2.772
F statistic of bound test	322.410	321.274	322.369	321.476	323.062
Upper bound value (5%)	4.160	4.160	4.160	4.160	4.160
Observations	3834	3834	3834	3834	3834
ARDL Short Run Test					
R squared	0.902	0.901	0.902	0.902	0.902
F statistic	3894.519***	3879.250***	3891.140***	3898.325***	3902.328***
ECT	1.000***	1.000***	1.000***	1.000***	1.001***
DW statistic	0.400	0.400	0.400	0.403	0.400
CUSUM test	Not stable	Not stable	Not stable	Not stable	Not stable
Wald test	84.69% > 5%	92.23% > 5%	99.60% > 5%	12.63% > 5%	95.96% > 5%
Observations	3833	3833	3833	3833	3833

4.3.19 ARDL long run and short run tests of TLC sector

Number of optimum lags is determined as four according to the minimum AIC. Constants and exchange rates both show no any statistical significance for all regressions. R squared values are too low and only JPY regression shows a F statistic with 10 percent significance. However, DW statistic is almost 2 which indicates no serial correlation problem. F statistic of ARDL bound test easily exceeds upper bound value indicating there is long run relationship between TLC sector returns and selected exchange rates.

When considering the short run ARDL tests, R squared values are very high and F statistics are significant at 1 percent level. ECT is also significant at 1 percent level with the positive sign instead of the negative sign as suggested by the theory. DW statistics are close to the zero indicating positive serial correlation problem. Cusum tests also reveal all five regressions are not stable. Wald test shows there are two positive relationships between TLC sector returns and two currencies which are INR and EUR.

Table 23: ARDL Long Run and Short Run Tests of Telecommunications (TLC) sector

Dependent Variable: Daily returns of TLC Total Return Index					
	USD	INR	JPY	GBP	EUR
ARDL Long Run Test					
No. of lags	4	4	4	4	4
Constant	0.004	0.001	0.000	0.008	0.011
	(0.506)	(0.293)	(1.002)	(0.513)	(1.134)
Exchange rate	0.112	0.053	0.026	0.008	0.064

	(1.115)	(0.887)	(0.566)	(0.165)	(1.355)
R squared	0.003	0.003	0.004	0.003	0.003
F statistic	1.122	1.362	1.854*	1.190	1.325
DW statistic	2.000	1.999	2.001	2.000	2.000
AIC	-5.431	-5.431	-5.432	-5.431	-5.431
F statistic of bound test	332.782	333.951	333.096	333.509	333.024
Upper bound value (5%)	4.160	4.160	4.160	4.160	4.160
Observations	3834	3834	3834	3834	3834
ARDL Short Run Test					
R squared	0.912	0.912	0.912	0.912	0.912
F statistic	4401.840***	4414.925***	4399.287***	4396.406***	4413.531***
ECT	1.014***	1.015***	1.014***	1.014***	1.014***
DW statistic	0.392	0.394	0.391	0.392	0.393
CUSUM test	Not stable	Not stable	Not stable	Not stable	Not stable
Wald test	15.58% > 5%	0.09% < 5%	26.18% > 5%	67.31% > 5%	1.86% < 5%
Observations	3833	3833	3833	3833	3833

4.3.20 ARDL long run and short run tests of TRD sector

Number of optimal lags are determined as four according to the minimum AIC. Constants of JPY and GBP regressions show 5 percent level statistical significance. Constant of INR regression shows 10 percent level of negative significance. No exchange rate is statistically significant to the TRD sector returns. R squared values are at low levels and F statistics show different level of statistical significance. F statistics of INR, JPY and GBP regressions show a 5 percent level of significance. Further F statistics of USD and EUR regressions show 1 percent and 10 percent significance level respectively. DW statistic is exactly the value of 2 which indicates no problem of serial correlation. F statistic of ARDL bound test exceeds upper bound value indicating there is a long run relationship between TRD sector returns and exchange rates.

ARDL short run tests show very high R squared values and they have very high F statistics with 1 percent significant value. ECT is significant but depicts a positive sign instead of the negative sign as suggested by the theory. DW statistics are very close to zero indicating positive serial correlation problem. Cusum tests reveal all five regressions are not stable. Finally, Wald test concludes that there is no short run relationship between TRD sector returns and selected exchange rates.

Table 24: ARDL Long Run and Short Run Tests of Trading (TRD) sector

Dependent Variable: Daily returns of TRD Total Return Index					
	USD	INR	JPY	GBP	EUR
ARDL Long Run Test					
No. of lags	4	4	4	4	4
Constant	0.015	-0.006*	0.001**	0.042**	0.012
	(1.621)	(-1.658)	(2.213)	(2.185)	(0.947)
Exchange rate	0.162	0.040	0.074	-0.088	0.016
	(1.284)	(0.531)	(1.264)	(-1.455)	(0.266)
R squared	0.006	0.005	0.004	0.005	0.004
F statistic	2.436***	2.277**	1.887**	2.207**	1.756*
DW statistic	2.000	2.000	2.000	2.000	2.000
AIC	-4.970	-4.970	-4.969	-4.970	-4.968
F statistic of bound test	329.230	328.930	327.451	330.147	328.149
Upper bound value (5%)	4.160	4.160	4.160	4.160	4.160
Observations	3834	3834	3834	3834	3834
ARDL Short Run Test					
R squared	0.892	0.893	0.892	0.893	0.892

F statistic	3522.854***	3528.776***	3514.958***	3532.565***	3514.234***
ECT	0.999***	0.999***	0.998***	1.000***	0.998***
DW statistic	0.411	0.412	0.411	0.411	0.412
CUSUM test	Not stable	Not stable	Not stable	Not stable	Not stable
Wald test	47.23% > 5%	55.29% > 5%	10.36% > 5%	76.16% > 5%	37.05% > 5%
Observations	3833	3833	3833	3833	3833

V.   CONCLUSION

We found significant long run relationships between all the sector returns and selected exchange rates. This finding supports to the previous literature of Wickremasinghe (2012) where he examined overall price index (ASPI) of CSE instead of sector returns. In international context, our results are inline with the Tian and Ma (2010); Katechos (2011); Aslam and Ramzan (2013) where they found long run relationship between exchange rates and stock returns. However, we couldn't find short run relationships between sector returns and selected exchange rates. But Wickremasinghe (2012) did with the ASPI instead of sector returns. Our results with short run ARDL tests are similar to the international studies of Amihud (1994); Bartov and Bohnar (1994) where they couldn't find short run relationships between stock returns and exchange rates.

More specifically, when we are discussing the short run relationship between sector returns and exchange rates, our results show significant, but positive ECTs. This contradicts with the theory which suggests sign of the ECT should be negative. This may be due to the structural changes in the Sri Lankan economy and society which happened during the study period from January,2004 to December,2019. Most structural change of them is the end of the armed conflict in Sri Lanka between the Sri Lankan Government and armed organization called Liberation Tigers of Tamil Eelam (LTTE) on 18th May, 2009. Further Sri Lankan Government and CBSL liberalized its balance of payment (BOP) policy several times during our study period. Some of them are mentioned here. CBSL relaxed the restrictions on authorized dealers entering in to forward contracts with their customers to hedge foreign exchange risk on 11th March, 2010. Further CBSL permitted foreign companies to open business in Sri Lanka and granted the permission to Sri Lankan companies to borrow from foreign sources on 22nd November, 2010. Further CBSL permitted Sri Lankan citizens and companies to invest in shares of foreign companies and sovereign bonds issued by foreign governments on 1st of January, 2011. CBSL permitted authorized dealers to issue and extend the validity period and amend clauses of a letter of credit without referring to the Controller of Exchange on 28th May, 2014 which directly impacts imports. This decision was very important considering the imports dominated economy in Sri Lanka.

Therefore, we would like to give some suggestions to future researchers who are interested in this area. Most important one out of them is conducting the research on relationships between sector returns and exchange rates by incorporating the time series tests such as chow test to represent the effect of structural breaks. Further this research has been carried out based on the traditional sector classification of CSE. However, now CSE has implemented GICS classification to group sectors and industries. Future researchers have the excellent opportunity to conduct the similar research based on GICS classification.

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