Cointegration of Asian Developed and Frontier Stock Markets: An investigation of Diversification Opportunities

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ABSTRACT

This study examines the cointegration relationship of the Colombo Stock Exchange (CSE) with developed Asian markets (Hong Kong, Japan, Singapore). The main objective of the study is to identify potential diversification benefits that exist in Sri Lankan stock market. The stock market indices are Hang Seng Index (HSI), Nikkei 225(N225), Straits Times Index (STI) and All Share Price Index (ASPI). Daily closing prices of stock market indices were selected for the period of 2013- 2019. The main theoretical base for the stock market integration was the Law of One Price. The Autoregressive-Distributed Lag (ARDL) bound test used to analyze data, revealed an insignificant cointegration relationship between CSE and developed stock markets. The ASPI has statistically significant short-run relationships with the STI. HSI and N225 did not provide any evidence of a long-run relationship with the ASPI. A negative insignificant correlation between ASPI and HSI indicates a good combination to have a well-balanced portfolio gain both long and short-run diversification benefits. In conclusion, the non-existence of cointegration among the above stock markets provides opportunities for international diversification of portfolios and possibilities for risk hedging.

1. Introduction

According to Markowitz Modern Portfolio Theory, investors should diversify the risk by investing in variety of assets rather than investing in a single asset that has either no relationship or negative relationship. Further, international portfolio theory implies investors should go for geographic diversification that reduce the investment risk by maintaining domestic and foreign financial assets simultaneously in their portfolio. In this context, investors transcended domestic boundaries, invested in diverse equity markets, and reaped significant gains from international portfolio diversification. Reason behind impressive gains is that losses from negative portfolio performance in one country offset by the positive performance of a portfolio in another country. However, this offset

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could be expected in a situation where there are low correlations among international stock markets (Jebran, 2014).

On the other hand, liberalization of stock markets, bilateral trade, political relationships among countries, advanced information technologies, improved financial market sphere such as electronic trading platform and relaxation of foreign exchange control eventually led to close tights among stock markets around the world (Rey, 2015). The presence of such close links between different equity markets cause in diminished benefits of foreign portfolio investments. Therefore, investors started to look for low correlated stock markets, as those are more likely to offer portfolio diversification than highly correlated markets. In this context, frontier markets came into the picture view as hugely untapped, less correlated, high potential smaller markets for portfolio diversification. Investors identify frontier markets as "safe havens", as generally, those are less vulnerable to external shocks as well as a secure spot to sit out a surge in market turbulence such as a financial crisis. Colombo Stock Exchange (CSE) is one of the best-performing frontier markets in the Asian region, which is having high potential to attract investors. Over the years, the CSE has been unique as early researchers found weak or no relationship with other stock markets. Thus, this situation opens the intriguing questions, mainly whether diversification benefits can be gained by investing in CSE at present context. Therefore, this paper attempts to identify potential diversification benefits detecting through the existence of cointegration relationship between frontier market of CSE and Asian developed markets while examine the long run relationship and short run dynamics among selected markets.

This study differs from the existing studies in a few ways. First, current study adds to the existing body of research by exclusively focusing on stock market integration in the Asian region. The existing studies have focused frequently on the leading developed and emerging stock markets, inconsiderable attention has been paid on frontier markets (Dhanaraj et al. 2017). Therefore, the present study contributes to the thin body of work done on frontier markets. Further,this study uses daily data, which is considered to give a new perspective than frequent past studies conducted on weekly and monthly data. Finally, unlike most of the past studies that employed conventional methods of cointegration, the current study uses Autoregressive-Distributed Lag (ARDL) cointegration technique, which provides reliable estimates as compared to the other cointegration techniques and this bound test, is a recently developed new detailed technique. Empirical findings are vital for global portfolio managers and international investors who are seeking a lucrative frontier market in the future leading region of the world. Exploration of potential inter-market linkages shedding more light on the topic that paves the way for further studies. Understanding and exploring the nature of integration among regional developed stock markets will be helpful to policymakers in addressing financial stability issues building up the relationship with regional economic giants and ultimate economic sustainability of the country.

Subsequent sections of this paper are organized as follows. Section 2 presents a literature review on stock market integration. Section 3 illustrates data and the econometric methodology. Section 4 discusses the results followed by the discussion of results in Section 5. Finally, section 6 provides a conclusion of the study.

2. Literature Review

There are few definitions found in the literature on stock market "Cointegration". Sharpe (1972) argues that stock prices in different stock exchanges tend to move together if those markets are cointegrated. According to Harris et al. (1995), cointegrated markets are the markets, which are having high price correlations. Sharma and Wongbangpo (2002) have defined stock market integration as a situation wherein different equity markets tend to trend together. In this background, if international stock markets are strongly

correlated in the long run, the positive effects of diversification will be diminished or excluded (Brooks, 2008). If cointegration among markets is detected, it will imply that a common trend brings these stock markets together. Loss in one stock market will mean loss in another market as well, since they move together over time. Investing in a group of cointegrated markets at the same time will not hedge the risk of investment. On the other hand, if the cointegration among markets is not identified, it will imply that stock markets show that they follow their own different patterns (independent) and investors can fully achieve the benefits of international diversification. It is desirable to invest in stock markets that are not cointegrated to maximize the benefits of diversification (Kasa, 1992). Therefore, it is a fact that, examining cointegration among stocks is crucial to build best portfolio.

The literature on the stock market relationship has many dimensions in terms of empirical methodology, scope and selection of Stock markets. Early days, many researchers focused on analyzing the stock market co-integration giving special attention to world major equity markets (i.e. Eun and Shim, 1989, Grubel, 1968, Corhay et al., 1993, Yang et al., 2003). After conducting plenty of studies, researchers moved to explore market co-integration within the Asian region. The first group of researchers began by exploring the integration of key Asian markets. Hung and Cheung (1995) studied the cointegration of stock markets in Hong Kong, Malaysia, South Korea, Singapore and Taiwan using the weekly observations from January 1981 to December 1991 and there was no evidence that those markets were co-integrated. One example is the study developed by Lee and Jeong (2016) who investigated the integration of markets of the Association of Southeast Asian (Indonesia, Malaysia, the Philippines, Singapore and Thailand) countries with China and the US, which were considered respectively as regional and global benchmarks. In the same context, and employing a variety of methodologies, Yu et al. (2010) concluded that previously weak relationships were enhanced after 2007 Asian Financial Crisis. The strengthened trade between countries, the geographical proximity, and common cultural factors found as underlying reasons for such equity market integration.

Frontier markets in general have received less coverage in the literature; while recent past impressive returns have been given by those markets to investors. Then, the literature has lately documented frontier market cointegration as frontier markets have just started receiving attention from the academic world. Mensi et al., (2017) show that the frontier markets of the Asian region provide good diversification opportunities to international investors. Wang, Yang and Yang (2013) show that frontier markets are characterized importantly as neither completely segmented nor completely integrated with the global market. Similarly, Dania and Maysami (2017) found frontier equity markets to be fairly segmented from the major stock markets of the world.

Turning to the Sri Lankan context there are few studies that have attempted to examine the relationship between Sri Lanka and other regional stock markets. Most of them have considered Sri Lanka as one of the variables not necessarily analyzed ASPI as the dependent variable. Pioneering research by Elyasiani, Perera, and Puri (1998) investigated the co-movement between the Sri Lankan equity market and the stock markets of its major trading partners including Japan, Taiwan, Singapore, South Korea, Hong Kong, India and the United States during the period 1989 to 1994 using the daily closing index value. According to them, less interdependence found among selected markets. Kuruppuarachchi (2016) revealed that the Sri Lankan stock market is cointegrated with the Korean stock market but not with others. Contemporaneous correlations were significant between Sri Lanka and other Asian countries such as India, Singapore, Malaysia, Hong Kong, Korea, and Japan. Narayan and Rehman (2017) examined for diversification opportunities between a group of emerging (China, India, Indonesia, Korea,

Malaysia, Philippines, and Thailand) and frontier (Bangladesh, Pakistan, and Sri Lanka) Asian equity markets against two developed markets (US and Japan) over the period 2000 to 2013 using daily, weekly and monthly data. Results of panel cointegration and a Vector Error Correction Model (VECM) showed that stable long-run relationship between selected countries.

According to most of the previous findings, frontier markets provide better chances for diversification opportunities. However, current knowledge on frontier markets is not enough for better decisions especially about the Sri Lankan stock market. There are only a few studies that attempted to examine the relationship between Sri Lanka and other regional stock markets. Most of them have considered Sri Lanka as one of the variables, not Sri Lanka as the dependent variable, which is one gap, identified through the literature. Further, studies that applied new econometric techniques such as ARDL bound test approach were hard to find.

3. Data and Research Methodology

This study includes stock market indices of three Asian developed markets (Hong Kong, Japan and Singapore) and Sri Lanka as the frontier market. Selected stock exchanges respectively from each country are Hong Kong Stock Exchange, Tokyo Stock Exchange, Singapore Exchange and Colombo Stock Exchange. The stock market indices covered in this study are Hang Seng Index (HSI), Nikkei 225(N225), Straits Times Index (STI) and the All Share Price Index (ASPI). The MSCI (2015) Market Classification Framework is used to categorize markets as developed, and frontier. The sample period of this study spanned from January 2013 to August 2019 for all countries, which is large enough to accommodate the dynamic relationships between the selected stock markets. Daily closing stock price indices expressed in local currency units of respective countries. Daily data, better accounts for the stock market dynamics and provides greater insight on cross-market interactions. Elyasiani et al. (1998) argued that daily return data are preferred to the lower frequency data such as weekly and monthly returns because longer horizon returns can obscure temporary responses to innovations which may last only for a few days. Angelovska (2017) also mentioned the use of high frequency data able to capture short-run market interactions that may be absent in lower frequency data. The current study has not transformed indices into a common currency, instead uses the nominal indices in domestic currency in order to avoid problems associated with transformation due to fluctuations in cross-country exchange rates and to avoid the restrictive assumption the relative purchasing power parity holds.

All the indices are converted into natural logs before any test is conducted. Log returns for each market are calculated by taking the natural log of the price on time t divided by the price on time t-1, and the result is then multiplied by 100 to convert the returns into percentages.

The daily returns of the indices are computed as follows.

$$R_t = \ln (P_t / P_{t-1}) * 100 \quad (1)$$

Where,

R_t = The stock index return

P_t = Daily closing value of the index for the day t

P_{t-1} = Daily closing value of the index for the day t-1

Econometric Analysis- Stationary Test

Stationarity of the time series is a prerequisite for most econometric methods. Stationarity is a statistical characteristic of a series such as its mean and variance over time. Augmented Dickey-Fuller (ADF) test and Phillips–Perron (PP) tests were employed to check the stationarity of the variables. The null hypothesis of the existence of a unit root (non-stationary) was tested against the alternative hypothesis of stationary variables. Automatic selection of lag

length for the ADF test was using Akaike Information Criterion (AIC). Since variables are in the combined order of I (0) and I (1) and none of the series are at I (2), ARDL bound test was selected as the most appropriate cointegration technique.

ARDL Bounds Test of Cointegration

The Autoregressive Distributed Lag (ARDL) model based on bounds test approach is applied to examine the co-integration relationship between selected markets. Cointegration is considered as a measure of long-term asset price comovement (Batareddy et al., 2012). Two non-stationary series are said to be cointegrated when their linear combination is stationary. If the stock market indices are cointegrated, then it implies that even if the index series are non-stationary, they will never drift far apart from each other. The following ARDL models was used in the present study.

$$\Delta lnSL_t = \beta_0 + \sum_{t=1}^{n} \alpha_1 \Delta lnSL_{t-1} + \sum_{t=1}^{n} \alpha_2 \Delta lnHK_{t-1} + \sum_{t=1}^{n} \alpha_3 \Delta lnJPN_{t-1} + \sum_{t=1}^{n} \alpha_4 \Delta lnSIN_{t-1} + \lambda_1 lnSL_{t-1} + \lambda_2 lnHK_{t-1} + \lambda_3 lnSIN_{t-1} + \lambda_4 lnSL_{t-1} + \epsilon_t \quad (2)$$

In above equation dependent variable ΔlnY is the Sri Lanka denotes as natural log of Sri Lanka $(\Delta lnSL_t)$. All independent variables ΔlnX in this study includes natural log of Hong Kong $(\Delta lnHK_t)$, natural log of Japan $(\Delta lnJPN_t)$, natural log of Singapore $(\Delta lnSIN_t)$. natural log of Japan $(\Delta lnJPN_t)$, λ are long run coefficients while ά are short run coefficient.

In order to find cointegration between variables, hypotheses are formulated as stated below.

$\lambda_1 = \lambda_2 = \lambda_3 = \lambda_4 = 0$ (Null hypothesis of no cointegration)

$\lambda_1 \neq \lambda_2 \neq \lambda_3 \neq \lambda_4 \neq 0$ (Alternative hypothesis of existence of cointegration)

Null hypothesis of no cointegration will be examined against the alternative hypothesis of cointegration via the F bound test. The decision rule is based on comparing the calculated F-statistics value with the critical values. The co-integration decision rules are:

(1) If the calculated F-statistics value is greater than the upper bounds value, I (1), the null hypotheses, no cointegration, would be rejected. This means that all the variables included in the models have a long-run relationship with each other.

(2) If the calculated F-statistics value falls below the lower bounds value, the null are accepted. Thus, the variables included in the models do not share long-run relationships among themselves.

(3) If the calculated F-statistics value falls in the range I(0) ≤ F-statistics value ≤ I(1), the decisions are inconclusive to either accept or reject the null hypothesis.

Error Correction Model

According to Pesaran et al. (2001), the ARDL approach involves two steps for estimating the long-run relationship. The first step is to examine the existence of a long– run relationship among all variables in the equations under estimation. The second step is to estimate the long-run and the short-run coefficients of the same equation. The second step is run only if a long-run relationship is found in the first step. Error Correction Model (ECM) has been used to describe the short run dynamics between these two variables. The core idea of the Error Correction Model (ECM) is that "a proportion of the disequilibrium from one period is corrected in the next period" (Granger, 1987).

The bounds test part of the ARDL approach only provides information on whether the variables are co-integrated or not. If the variables are cointegrated, the long-run coefficients of each variable can be estimated through an error correction model as below:

Sri Lanka Vs. Developed

$$\Delta lnSL_t = \gamma_0 + \sum_{t=1}^{n} \delta_1 \Delta lnSL_{t-1} + \sum_{t=1}^{n} \emptyset_1 \Delta lnHK_{t-1} + \sum_{t=1}^{n} \emptyset_2 \Delta lnJPN_{t-1} + \sum_{t=1}^{n} \emptyset_3 \Delta lnSIN_{t-1} + \mu ECT_{t-1} + U_t \quad (3)$$

Here, the ECT term denotes the error correction term and the μ parameter is the speed of adjustment. A negatively estimated, significant μ parameter implies a correction mechanism on the deviations from the equilibrium. Pascual (2003) argues that, "The error correction term (ECT) reflects deviations from the long run cointegration relationship; therefore the coefficient of the ECT represents the speed adjustment to deviations from the long-run equilibrium. Higher values of those coefficients can be interpreted as a higher degree of stock market integration".

4. Results

Findings of the ADF and PP test are shown in Table 1. Results suggest that the null hypothesis of unit root test performed for index series is rejected for N225 series. Test statics is 0.935429 (P=0.0416) which exceed MacKinnon's critical value of – 2.863008 at 5% significance level. It implies that the N225 is stationary at levels, I(0). The remaining series of HIS, STI, ASPI were integrated at first difference I (1) at 5% significance level.

After the preliminary analysis, the next phase of the analysis was involved in determining cointegration between CSE and selected Asian developed equity markets Hong Kong, Japan and Singapore. The ARDL model requires a prior knowledge or estimation of the orders of the extended ARDL. Therefore, the first part of the analysis gives a snapshot of the settings used during ARDL model selection. This appropriate modification of the orders of the ARDL model is sufficient to simultaneously correct for residual serial correlation and the problem of endogenous regressiveness.

Table 2 presents results of Autoregressive Distributed Lag estimate in which dependent variable is lnSL (Natural Logarithms of closing price of ASPI) with 1468 observations used for estimation from January 2013 to August 2019. Automatic lag selection using Akaike Information Criterion (AIC) was used with a maximum of 4 lags to dependent variables and determine appropriate lag length to independent variables. Out of 128 models evaluated, the procedure has selected an ARDL (2, 0, 1, 2) model where two lags have been given to the dependent variable lnSL. Further, two lags have been attributed to lnSIN; one lag has been attributed to lnJPN while no lag has been given to lnHK in the selected model.

According to the ARDL cointegration method, there are two stages to follow where the first stage requires testing the presence of a long-run relationship between the variables under consideration by computing the F statistics and checking for the significance. If the first stage exhibits existence of cointegration between the variables, the second stage requires conducting a two-step procedure of estimation of the long run and short run parameters using the related ARDL and Error CorrectionModels (ECMs). The presence of a common long-term trend for the stock markets can be empirically proven by the significant joint F-statistics produced by the estimated equation. The F-test simply tests the hypothesis of no co-integration among the variables against the existence of cointegration among the variables. The results of the ARDL bounds test for cointegration alongside with critical values are reported in Table 2. The number of regressors in the model are three, hence K = 3. Findings from the Table 2 indicate that F-statistics, FlnSL = 3.3169 falls in the range I (0), lower bounds critical value = 2.7 and I (1), upper bounds value = 3.67 (2.7< 3.32< 3. 67) at 5% significance level.

Table 1

Unit Root Estimation

	Variable	Levels				1st Difference				
		ADF Statistics	Prob.	PP statistics	Prob.	ADF statistics	Prob.	PP statistics	Prob.	Decision
Asia – Developed										
Hong-Kong	HSI	-1.7870	0.3872	-1.8323	0.3650	-40.1819**	0.0000	-40.1819**	0.0000	I(1)
Japan	Nikkei 225	-2.9352**	0.0416	-2.9272**	0.0425	-45.0448**	0.0001	-45.0672**	0.0000	I(0)
Singapore	STI	-2.4050	0.1405	-2.4048	0.1405	-40.0703**	0.0000	-40.0703**	0.0000	I(1)
Asia – Frontier										
Sri Lankan	ASPI	-1.7220	0.4198	-1.9734	0.2988	-24.6393**	0.0000	-35.0854**	0.0000	I(1)

Notes: The critical value for both the ADF and PP t-statistics are -3.43, -2.86, and -2.56 at 1%, 5% and 10% levels of significance respectively. For both tests, a constant term was included. For the ADF test the optimal lag length is determined by using the AIC. The t-statistics and p-values are obtained from Mackinnon (1991), according to the asymptotic distribution. ** denote rejection of the null hypothesis of a unit root at the 5% significance level.

Table 2

ARDL bound F- test results for Co-integration

Null Hypothesis: No long-run relationships			
Test Statistics	Value	K	Decision
F Statistic	3.3169*	3	Reject the null (Exist long run relationship)
		Bound Critical Values	
Significance Level		I(0)	I(1)
1%		3.65	4.66
5%		2.79	3.67
10%		2.37	3.20

Table 2 presents the results for ARDL bound F-test results for Cointegration. * Denotes that the F-statistic falls above the 90% upper bound

The decision is inconclusive to either accept or reject the null hypothesis of no cointegration. However, the null hypothesis of no cointegration is rejected at 10% significance level as that the calculated F-statistic FlnSL = 3.316908 exceeds the relevant upper bound critical value of 3.20 (3.3 >3.2). Therefore, there is a marginal long-run relationship between the variables when ASPI is the dependent variable.

The second stage of ARDL test was proceeded and results are as follows. Since the F-bound test has provided the evidence of a marginal long-run relationship between the variables in the model; analysis proceeded to estimate the long-run cointegration equation and the coefficients of the model specified. The long run equation is as follows.

lnSL = -1.4872*lnHK + 0.295604*lnJPN + 3.481454*lnSIN -5.291005

were estimated. The ARDL model was estimated by setting the maximum lag length to 2 and using Akaike Information Criteria in selecting the optimum lag order for the model. The specification finally selected is ARDL (2, 0, 2, 1), the derived long run coefficients are presented in Table 3. Long run relationships between the Colombo stock market and Asian developed markets are consistent with both negative and positive coefficients. Since the variables in the model are in the natural log form, the coefficients of the above long run cointegration equations can be interpreted as long-term elasticities.

According to the equation, the natural log price index of Hong Kong is negatively related with the natural log price index of Sri Lanka implying that the Sri Lankan stock market has a negative long-run relationship with the Hong Kong stock market. This long run relationship is

Table 3

Estimated Long-Run Coefficients Using the ARDL Approach

ARDL (2, 0, 1, 1) Selected based on Akaike Information Criteria				
Dependent Variable: lnSL				
Regressor	Coefficient	Standard Error	t-Statistic	Prob.
lnHK	-1.4871	0.7764	-1.9154	0.0714
lnJPN	0.2956	0.3162	0.9346	0.3501
lnSIN	3.4814*	1.4559	2.3911	0.0169
C	-5.2910	6.6448	-0.7962	0.4260

Table 3 presents the coefficients obtained from the ARDL approach

After determining the existence of long run equilibrium between Sri Lanka (lnSL) and Asia developed stock markets, the long run coefficients statistically insignificant at 5% level as P value is higher than 0.05 (P, 0.0714 > 0.05) and absolute t value was less than 2 (t, 1.92 >2). Result shows that

around -1.5 coefficient value for the Hong Kong stock market (HGX) means that an increase in stock prices in Hong Kong stock market leads to decrease in stock prices of Sri Lankan stock market (CSE) by 1.5 times.

The natural log price index of Singapore (lnSIN) is positively related to the natural log price index of Sri Lanka (lnSL) which indicates a positive long run relationship between the stock market of Sri Lanka and Singapore. It is statistically significant at 5% significance level as P value is less than 0.05 (P, 0.016 < 0.05) and absolute t value is greater than 2 (t, 2.391180 >2). Singapore exerts a significant and positive impact (Coefficient value around 3. 48) towards the Colombo stock market suggests that an increase in stock prices of Singapore market causes to increase stock prices in Sri Lanka in the long run. Coefficient value for the Singapore stock market (HGX) is 3.48, which is a huge value. Increases of price levels in the Singapore stock market cause an increase in the price level in the Sri Lankan stock market by 3.5 times.

Colombo stock market while Hong Kong and Japan don't have a significant impact on the Sri Lankan stock market in the long run.

Re - Parameterization of ARDL model into Error Correction Model

After detecting the long run equilibrium relationship among the variables, the short-run dynamics are yet to be explored. Therefore, the analysis proceeded to determine the short-run elasticities when Sri Lanka (lnSL) is the dependent variable. That is to find out the response of the short run return in Sri Lankan stock market when changes and innovations occur in Asia developed stock markets and the adjustments that it takes to correct for any deviations from the long-run equilibrium relationship. Estimated short run coefficients and ECT are presented in Table 4.

For the sample period, the equation shows that in the short run return of the Sri Lankan stock market depends on lagged values of the return itself. Own market changes in the two adjacent lagged periods (previous day and day before previous day) positively and significantly influence the present-day price level of Colombo Stock Exchange.

Table 4

Error Correction Representation for the Selected ARDL-Model

Dependent Variable: dlnSL				
Variable	Coefficient	Std. Error	t-Statistics	Prob.
dlnSL(-1)	0.1903	0.0234	8.1283	0.0000***
dlnJPN	0.0193	0.0097	1.9796	0.0479**
dlnSIN	0.0620	0.0181	3.4268	0.0006**
CointEq(-1)*	-0.0037	0.0009	-4.0771	0.0000***

Table 4 presents the error correction representation for the selected ARDL Model.
*** and ** denote statistical significance at 1% and 5% levels, respectively

Further, results exhibit that the natural log price index of Japan (lnJPN) is positively related to the natural log price index of ASPI. The referring P value is greater than 0.05 (P, 0.3501 >0.05) and absolute t value is less than 2 (t, 0.934632 < 2) which is statistically insignificant at 5% significance level. Results indicate that an increase in stock prices in Japan has an insignificant impact on stock prices in CSE in the long run. Eventually, it can be determined that the Singapore stock market exerts a significant positive impact on the

The short run results reveal that both Tokyo stock exchange and Singapore Exchange show positive significant relationship between Sri Lankan stock market. Through cointegration, it is found that the Japanese stock market does not significantly affect the Colombo stock market. However, in the short run Japanese stock market has a positive and significant impact on the Sri Lankan stock market. A 1% change in the Japanese stock market results in a 2%

increment in CSE stock return 1% return change in SGX will lead to 6% return increment in CSE, which is considerably a high value.

Although, in the long run Hong Kong was significant, in short run Hong Kong was not significant means it's exogenous. However, unlike Hong Kong, Singapore exerts positive and statistically significant impact in both long run and short run. In addition, Japan does not extend long-term impact towards Sri Lanka in the long run but exerts significant impact in the short run. Further, ECM indicates that own market changes in the previous day and day before previous day positively and significantly influence in present day equity return of Colombo Stock Exchange.

The existence of an error-correction term among a number of cointegrated variables implies that changes in the dependent variable are a function of both the level of disequilibrium in the cointegration relationship (represented by the ECM) and the changes in other explanatory variables. This indicates that any deviation from the long run equilibrium will feedback into the changes in the dependent variable in order to force the movement towards the long-run equilibrium (Masih and Masih, 2002).

The Error Correction Term indicates adjustment speed to restore the balance towards the long-run equilibrium, having one period of shock in the model. Coefficient of ECM shows how quickly or slowly the relationship goes back to its equilibrium path. According to Pahlavani et al. (2005) a stable model error correction term necessarily should satisfy two important properties that it should be negative in sign and statistically significant. Many researchers have highlighted that the error correction term confirms the presence of a long-term relationship if the term is statistically significant (Banerjee et al.,1998). With the result on Table 4 shows the Error Correction coefficient estimated -0.0037 is highly significant (P = 0.0000) and has the correct negative sign but implies a slower speed of adjustment to the equilibrium. This negative sign indicates a convergent correction mechanism for deviations from the long-term equilibrium in the model. Coefficient of the ECT (-1) suggesting that deviation from the equilibrium level of stock market index in the current period will be corrected nearly by 0.004% in the next period to restore the equilibrium in the next day to restore the equilibrium. This result implies that the adjustment takes place very slowly. Further, the speed of adjustment suggests that integration between Sri Lanka and developed counterparts is weaker.

5. Discussion of Findings

Prior to testing the individual significance, the F-bound test used to have insight on the joint significance of the variable (here daily closing price index of selected developed stock market) on the Colombo stock exchange. Results of ARDL F-bound test supported a marginal cointegration relationship among CSE and developed Asian stock markets. The relationship was not significant at five percent significance level but was significant at ten percent significance level. However, results do not depict a strong long-run relationship between variables instead showed a marginal relationship between Colombo stock market and the selected developed Asian stock markets. Consequently, results infer that there is no cointegration relationship among series in the model. In spite of the exhibited marginal relationship between the variables at the first stage, the continued analysis of estimated long run and short run parameters revealed more information about the relationship between CSE and three other developed markets.

Error Correction Model (ECM) where the ASPI was the dependent variable showed that speed of adjustment is very low. Marginal cointegration and very slow speed of adjustment indicates a very weak relationship of the Colombo stock market with developed Asian stock markets. This finding is consistent with Elyasiani et al. (1998) which justifies the weak (mostly insignificant) correlations from the Colombo stock market. The reason for this deviation may be the Sri Lankan stock market is not sizable enough or

not obvious that investors to realize international diversification opportunities. According to Bekaert and Urias (1996) high transaction costs and other trading frictions associated with illiquid and thinly traded stocks, discourage foreign investors to keep looking on investment in frontier markets such as Sri Lanka. This hopefully explains the insignificant cointegration relationship of Sri Lankan stock market with developed markets. Mensi et al. (2017) mention that frontier markets offer diversification benefits due to their low cointegration with the global markets because these markets are relatively small and illiquid. However, stock markets under consideration individually may offer varying levels of risk reduction to the portfolio.

Turning to discuss long run relationship of selected developed markets with the Colombo stock market firstly, the Hong Kong stock market showed no evidence of a long run relationship with the CSE. It means that the Sri Lankan stock market is not influenced by the Hong Kong stock market. It is not surprising that the Hong Kong stock market does not have a relationship with the Sri Lankan stock market due to many reasons. The Hong Kong stock market is nearly 240 times larger than the Sri Lankan stock market. Mobarek et al. (2016) reported that size differential of stock markets are significant in explaining the cointegration between stock markets. When size difference increases cointegration between two markets also tend to decrease. Fundamental factors including economic growth, market liquidity and trade intensity are driving forces for market linkages (Bracker and Koch, 1999; Flavin et al., 2002; Dumas et al., 2003; Dellas and Hess, 2005; Waiti, 2005; and Liu et al. 2006). Accordingly, enormous differences in above fundamental factors may be the underlying reason for not having a long run relationship between Sri Lanka and Hong Kong stock markets. In addition, insignificant relationships between two markets showed a negative statistical relationship indicating that stock prices of two markets move in opposite directions from one another. According to Modern Portfolio Theory (MPT) investing in stock markets which are negatively related possibly brings long term benefits to investors as if a market downturn in one country may recover by an upswing in the other market. Therefore, having Colombo stock market and Hong Kong market are good combinations to have a well-balanced portfolio to reduce risk and gain diversification benefits.

In the case of Japan stock market, the Tokyo Stock Exchange did not show a significant long run relationship with the Sri Lankan stock market (CSE). This result is consistent with the findings of Bashiri and Zadeh (2014) who reported that the extent of cointegration between Japan and other Asian markets is low. Turning to discuss the relationship between two states, Sri Lanka and Japan have developed strong bilateral ties which early years bilateral relationship were characterized by cultural ties based on Buddhism and other shared values. Later, it evolved into important economic ties marked by large flows of Japanese aid to Sri Lanka, as well as ties formed through trade and investments. Despite strong bilateral relationships over years, results depict that weak relationship between Japan and Sri Lankan stock markets. According to Attanayake and Kapur (2019) Japanese investors who are highly risk averse that may be due to perception build up during the Sri Lanka's civil war as it disrupted country security and stability. However, it seems to be continued the same perception about Sri Lanka, as investors still do not show much interest about Sri Lanka when compared to some other Asian countries such as India and Bangladesh (Attanayake and Kapur, 2019). This is explained further by Hussain and Saeed (2016) as "South Asia is less economically integrated due to political tension, mistrust and shortage of infrastructure, connectivity between the countries. Political instability and policy uncertainty create significant challenges for sustained economic growth since the associated uncertainties negatively affect investment decisions and business confidence. Aisen and Veiga (2011) argue that political instability negatively affects country's performance. Political stability, presence of good

governance, effectiveness of the government, rule of law, and eradication of corruption contribute positively to the sustained growth of an economy. Frequent changes in governments, the absence of an independent civil service and the lack of national policies have led to inconsistent policies and affected Sri Lanka's image as an unpredictable destination for investment and other long term economic activities.

Continuing the discussion of individual developed stock markets, long run analysis revealed the existence of positive, strong relationship between Sri Lanka and Singapore stock markets. The mean price changes occurring in Singapore stock market greatly affect prices of Colombo stock market indicating that the CSE is not independent. As expected, bilateral trade, socio-economic and diplomatic relations between the two states have led to integration between two stock markets. The Sri Lanka-Singapore Free Trade Agreement has moved towards a deepening economic relationship between Sri Lanka and Singapore. For Singapore, Sri Lanka represents an untapped potential market as they explore new opportunities for investment in financial services, insurance, and infrastructure development. Warm diplomatic relationship between the two countries have been continuing for more than 50 years. The increased integration between Sri Lanka and Singapore stock markets could be attributed to the increasing trend of bilateral trade between these two countries over years. This study found evidence that the Singapore stock market is integrated with the Sri Lankan stock market. This finding is consistent with the view that the stronger the bilateral trade ties among the countries, the higher the degree of cointegration (Kearney and Lucey, 2004). Thus, contrary to Karim and Gee (2006), current study find evidence that there is a connection between trade linkages and stock market integration. Findings of the present study are in par with Sriyalatha et al. (2012) who examined the interdependence of Sri Lanka including developed Asian markets Japan and Singapore. Kavinda (2018) also found that long run relationship between Sri Lankan and Singapore stock markets. According to CSE data the highest number of foreign investor participation in CSE is from Singapore. As the foreign investors operate in more than one country at the same time, the operation of foreign investors contributes to its integration between two stock markets.

6. Conclusion

This study investigated the long-run equilibrium relationship between Asian frontier market (Colombo Stock Exchange) and Asian developed markets (Hong Kong, Japan, Singapore). In conclusion, long run relationships were not identified between Sri Lanka and Hong Kong markets, Sri Lanka and Japanese stock markets. Results imply that CSE is independent from Hong Kong and Japan stock markets. It is desirable to invest in these stock markets as they are not cointegrated which ultimately allow investors to gain international portfolio diversification benefits. Investing in this group of non-cointegrated markets (Sri Lanka and Asian developed markets of Japan, Hong Kong and Singapore) allow investors to hedge the risk of investment. Eventually it can be concluded that non-existence of cointegration among above stock markets provide opportunities for international diversification of portfolios and possibilities for risk hedging. The findings of this study have important portfolio management implications for international investors to include fairly segmented Colombo stock market in order to enhance its risk-adjusted returns. To conclude, Colombo Stock Exchange follows a different integration path with developed stock markets nevertheless portfolio diversification benefits are promising with developed markets.

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