UNDERSTANDING OF THE LEVEL OF INTEGRATION BETWEEN INDIA AND SRI LANKAN ECONOMIES WITH THE APPLICATION OF (DCC)–MGARCH

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ABSTRACT

Prime focus of this article is to check if there are suitable diversification opportunities investing in India. Granger causality tests, vector auto-regression (VAR) and dynamic conditional correlation (DCC)–MGARCH are applied to investigate the level of integration between India and Sri Lankan economies. No causality is observed. Outcome of VAR suggest that Sri Lankan economy does not impact the return of the Indian stock market. Applying DCC–MGARCH, it is observed that there is no volatility spillover from Sri Lanka to India in short-run but there is long run spill over of volatility from Sri Lanka to India. The outcomes of the study may assist market managers in setting policies by considering the pattern of volatility transmission from Sri Lankan stock market to Indian stock market.

JEL Codes: C32, G10, G11

Keywords: Unit root test, VAR, Granger Causality DCC–MGARCH

INTRODUCTION

There is an increase in cross-border transaction because of liberalization. Since 1990s many investors are investing globally integrated markets. Because of linkage in the markets investors are getting higher returns and opportunities for hedging. In the present scenario the knowledge of volatility spill over is important for global investors to minimize risk. (Natarajan et al; 2014).

As per the previous studies, it was proven that developing countries were disproportionately influenced by global financial crises. The Great Depression of 1930, the Mexican crisis of 1994, the Asian currency crisis of 1997, and the global financial crisis of 2008, to mention a few, have shown how volatile stock markets of one country influenced the volatility of other markets.

Volatility spillovers using various tests from the group of ARCH have attracted the researchers to study developing and emerging markets. Global portfolio managers have been driven to diversify their portfolios by investing in

emerging markets such as India, China, South Korea, Malaysia, and Taiwan due to the high return potential of these markets.

The studies on volatility spillover suggest that there are leading and trailing correlations between various economies that are linked globally. Ebrahim (2000), Jaiswal-Dale and Jithendranathan (2009), Natarajan et al. (2014), and Alfreedi (2019) explored the spillover between various stock markets.

India has attracted more global portfolio managers for during last two decades because of fast growing economy in the world in spite of currency risk, political risk and interest rate risk. Along with India it would be worthwhile to investigate neighboring countries.

The research is broken down into five pieces. The second section contains a comprehensive assessment of the literature on interconnections and spillover. Section 3 discusses data and technique, whereas Section 4 discusses empirical outcomes. The last section includes an overview and concluding remark.

REVIEW OF LITERATURE

Extensive review of existing literature has been conducted to find out spill over in financial markets.

Savva et al. (2004) suggested that London and German markets are influences by US markets while studying dynamic correlation and spillover among US, Germany, London and France markets. Bartram et al. (2007) used time varying copula dependence model to find linkage between Euro and Non-Euro European economies and found that market dependence within Euro region grew only for a few countries like France, Germany, Italy, Netherlands and Spain.

Bekaert and Harvey (1997) found that in integrated markets, global variables drive volatility while in fragmented markets local factors also play part in volatility. In et al. (2001) during the Asian Financial Crisis of 1997–98, found that Hong Kong and Korea have reciprocal spillover.

Jang and Sul (2002), Leong and Felmingham (2003) studied the co-movement of Asian stock markets before, during, and after the Asian Financial Crisis and found that during the financial meltdown, Asian markets' it was intensified. Johnson and Soenen (2002), studied the equities markets of Australia, Malaysia, Hong Kong, New Zealand, China, and Singapore are highly integrated with Japan's stock market.

Premaratne and Miyakoshi (2002) studied the degree of return and volatility spillover from Japan and USA to Asian Stock Markets using bi-variate EGARCH and found that regional integration among Asian Countries was greater as compared with US market. Bala (2004) studied Asian, US and UK markets and found a high degree of volatility co-movement between Singapore and Hong Kong, Japan US and UK.

Rao and Naik (1990) studied the correlation between the US, Japanese, and Indian stock markets and found that Indian market had a poor link with overseas markets like US and Japan because of regulations and restrictions on trade and capital movement during 1970s.

Hansda and Ray (2002) studied price correlations among ten stocks listed on BSE, NSE, and Nasdaq/ NYSE and found and established bi-directional causation between the prices of the dually listed equities using VAR models and found that markets are efficient in receiving and integrating pricing data.

Nandy and Chattopadhyay (2019) studied Indian stock exchange's interconnection with domestic financial system such as the money market, FIIs, FOREX, bullion market, and overseas stock markets such as the Nikkei of Japan and other markets reflected by the S&P500 and found high level of interconnection between Indian and international financial markets.

Madhavan and Ray (2019) studied the price and volatility relationships between global custodial receipt prices traded in London and shares listed on the BSE using VAR for price analysis and DCC of GARCH models for volatility links, as well as currency rates, international and local indexes. The prices of GDR and their underlying shares in BSE had high level of similarity in VAR findings, while DCC–GARCH showed a high dynamic correlation.

The fact that India is one of the world's fastest-growing economies draws the interest of international investment managers. As a result, the spillover effects between India and Sri Lanka in particular would be intriguing to observe. The authors were motivated to perform this study because, as the literature implies, no large studies have been done to assess these economies.

DATA AND METHODOLOGY

The asymmetric volatility spillover effect of the Sri Lankan stock market on the Indian stock market was investigated in this study. The Indian stock market is represented by the Nifty 50, whereas the Sri Lankan stock market is represented by the S&P Sri Lanka 20 (SPLK20LP). These stocks' daily adjusted closing stock indices were collected from January 4, 2011 to March 3, 2021. The return of the series has been calculated using the log difference of the data. Granger causality, VAR, and DCC were used to investigate volatility transmission effects from the Sri Lankan stock market to the Indian stock market.

The Granger Causality Method is a method for determining the cause of an event. Granger causality is a popular method for investigating the causal relationship between variables (Granger, 1969).

Vector auto-regression (VAR) is used to see if the lagged returns of Indian stock indices or the lagged returns of Sri Lankan stock indices determine stock returns. It would help us comprehend the extent to which Indian stock markets are reliant on foreign stock markets.

VAR and Variance Decomposition

The VAR model can be presented as follows:

$$Y_{t} = b_1 Y_{t-1} + b_2 Y_{t-2+} b_3 Y_{t-3} + \ldots + b_n Y_{t-n+} e_t$$

In this equation, Y_t is the asset return which is dependent on its own lag Y_{t-1},Y_{t-2} and Y_{t-3}. β_1, β_2 and β_3 are the coefficients of the lagged value of assets return. VAR model is applied on stationary series and it requires optimal lag. VAR model is used for variance decomposition. Lastly, we use the DCC model to investigate the transmission effect between the Indian and Sri Lankan economies. The DCC method was used to investigate the short- and long-term persistence of volatilities.

RESULTS AND DISCUSSION

The results are presented in Table 1 and are based on descriptive data of stock returns in our study countries. Both markets have negative skewness in their daily return series. Normality is rejected as evidenced by the Jarque–Bera test.

ADF test has been used to ensure the stationarity of each country's return series in this study. Tables 1 and 2 show that the P value for each series is less than 5%. As a result, each country's log return series is stable at I(0). Table 4 shows the Granger causality results for several series. The impact of the Indian stock market on the Sri Lankan stock market has been investigated in this study. The findings of the no causation test between the Indian and Sri Lankan stock markets are shown in Table 4.

Table 1: Descriptive Statistics

	Return NIFTY	**Return SPLK20LP**
Mean	0.0002	-0.0001
Median	0.0003	-0.0001
Maximum	0.0365	0.0487
Minimum	-0.0604	-0.0557
Std. Dev.	0.0048	0.0042
Skewness	-1.0688	-1.8306
Kurtosis	19.1366	44.5030
Jarque-Bera	27136.0800	172071.2000
Probability	0.0000	0.0000
Sum	0.4130	-0.1448
Observations	2458.0000	2379.0000

Author's estimation

Table 2: Granger Causality Test

Pairwise Granger Causality test			
Lags:2			
Null Hypothesis	Obs	F-Statistics	Prob.
Return NIFTY does not Granger Cause Return SPLKLP	2377	0.031	0.970
Return SPLK20LP does not Granger Cause Return NIFTY		0.155	0.857

Author's estimation

The lag selection criterion is shown in table 5. Table 6 summarizes the results of multivariate VAR. The connection of the Indian and Sri Lankan stock markets is depicted in Table 6. The results of the VAR clearly display that the Indian stock market is reliant on its lags. The Indian stock market and the Sri Lankan stock market have no association.

Table 3: Results of VAR

Vector Autoregression Estimates					
Standard errors in ( ) & t-statistics in []					
	Return NIFTY	**Return SPLK20LP**		**Return NIFTY**	**Return SPLK20LP**
Return NIFTY(-1)	0.0191	-0.0059	ReturnSPLK20LP(-1)	0.0057	0.1696
	-0.0205	-0.0180		-0.0235	-0.0206
	[0.93090]	[-0.32722]		[0.24333]	[8.23656]
Return NIFTY(-2)	0.0096	0.0012	ReturnSPLK20LP(-2)	-0.0035	0.0268
	-0.0204	-0.0179		-0.0238	-0.0209
	[0.46992]	[0.06735]		[-0.14793]	[1.28501]
Return NIFTY(-3)	0.0151	-0.0035	ReturnSPLK20LP(-3)	-0.0268	0.0318
	-0.0204	-0.0179		-0.0238	-0.0209
	[0.74154]	[-0.19361]		[-1.12494]	[1.52199]
Return NIFTY(-4)	-0.0252	-0.0003	ReturnSPLK20LP(-4)	0.0269	0.0368
	-0.0204	-0.0179		-0.0238	-0.0209
	[-1.23808]	[-0.01933]		[1.12923]	[1.76094]
Return NIFTY(-5)	0.0771	-0.0220	ReturnSPLK20LP(-5)	0.0011	0.0135
	-0.0204	-0.0179		-0.0239	-0.0209
	[3.78089]	[-1.23353]		[0.04748]	[0.64628]
Return NIFTY(-6)	-0.0879	0.0187	ReturnSPLK20LP(-6)	0.0288	0.0193
	-0.0205	-0.0179		-0.0239	-0.0209
	[-4.29662]	[1.04422]		[1.20551]	[0.92040]
Return NIFTY(-7)	0.0774	-0.0096	ReturnSPLK20LP(-7)	0.0237	-0.0192
	-0.0205	-0.0180		-0.0236	-0.0206
	[3.77283]	[-0.53237]		[1.00771]	[-0.93034]
C	0.000131		C	-4.37E-05	
	-9.80E-05			-8.60E-05	
	[1.33719]			[-0.50845]	
R-squared	0.0230		R-squared	0.0382	
Adj. R-squared	0.0172		Adj. R-squared	0.0325	
F-statistic	3.9573		F-statistic	6.6852	
Log likelihood	9322.7830		Log likelihood	9637.2360	
Akaike AIC	-7.8480		Akaike AIC	-8.1132	
Schwarz SC	-7.8115		Schwarz SC	-8.0767	

Table 4: Results of Variance Decomposition

Variance Decomposition of Return NIFTY				Variance Decomposition of Return SPLK20L9P			
Period	S.E.	Return NIFTY	Return SPLK20LP	Period	S.E.	Return NIFTY	Return SPLK20LP
1	0.005	100.000	0.000	1	0.004	0.002	99.998
2	0.005	99.997	0.003	2	0.004	0.005	99.995
3	0.005	99.997	0.003	3	0.004	0.005	99.995
4	0.005	99.941	0.059	4	0.004	0.007	99.993
5	0.005	99.904	0.096	5	0.004	0.007	99.993
6	0.005	99.903	0.097	6	0.004	0.069	99.931
7	0.005	99.837	0.163	7	0.004	0.093	99.907
8	0.005	99.773	0.227	8	0.004	0.100	99.900
9	0.005	99.771	0.229	9	0.004	0.101	99.899
10	0.005	99.767	0.233	10	0.004	0.101	99.899
11	0.005	99.767	0.233	11	0.004	0.102	99.898
12	0.005	99.765	0.235	12	0.004	0.103	99.897
13	0.005	99.765	0.235	13	0.004	0.104	99.896
14	0.005	99.765	0.235	14	0.004	0.104	99.896
15	0.005	99.765	0.235	15	0.004	0.104	99.896
16	0.005	99.765	0.235	16	0.004	0.104	99.896
17	0.005	99.765	0.235	17	0.004	0.104	99.896
18	0.005	99.765	0.235	18	0.004	0.104	99.896
19	0.005	99.765	0.235	19	0.004	0.104	99.896
20	0.005	99.765	0.235	20	0.004	0.104	99.896

Author's estimation

In reality, the variance decomposition index in Table 7 shows that, aside from India, Sri Lanka has no significant lagged impact on the Indian stock market. It demonstrates that there is very little interconnectedness between the Indian and Sri Lankan stock markets. The DCC–GARCH model was used to assess the volatility and co-volatility dynamics between the Sri Lankan and Indian stock exchanges. In Table 5, the terms 'mu' and 'omega' refer to the overall mean and the intercept term, respectively. Apart from that, the ARCH effect, which is denoted by alpha1, is the influence of prior disturbances or error term generated using mean equation, whereas the effect of previous variance is expressed by GARCH (beta1). All ARCH and GARCH terms of various stock indices are substantial, implying that volatility is persistent. As a result, each stock exchange experiences volatility in both short and extended time periods. Because the coefficients of alpha and beta are positive, it has a positive effect on present conditional variance. In Indian stock markets, however,

volatility decay is the slowest (sum of ARCH and GARCH coefficients is 0.99). Furthermore, we use the DCC– MGARCH model to look at the volatility spillover between the Indian and Sri Lankan economies. It is seen that dcca1 is positive and negligible, but dccb1 is positive and substantial, implying that there is no integration and asymmetry influence between the Indian and Sri Lankan economies in the short term. There is integration in the long run. Consequently, portfolio managers investing in India in the short term benefit from this economy's diversification.

Table 5: Results of Dynamic Conditional Correlation

Variables	Estimate	Std. Error	t value	Pr(>|t|)
rSPSrilanka].mu	0.00	0.00	0.54	0.59
[rSPSrilanka].omega	0.00	0.00	0.60	0.55
[rSPSrilanka].alpha1	0.14	0.05	3.07	0.00
[rSPSrilanka].beta1	0.85	0.06	14.69	0.00
[rNiftyIndia].mu	0.00	0.00	3.57	0.00
[rNiftyIndia].omega	0.00	0.00	1.77	0.08
[rNiftyIndia].alpha1	0.09	0.02	4.19	0.00
[rNiftyIndia].beta1	0.89	0.02	44.25	0.00
[Joint]dcca1	0.00	0.00	1.00	0.32
[Joint]dccb1	0.99	0.01	140.44	0.00

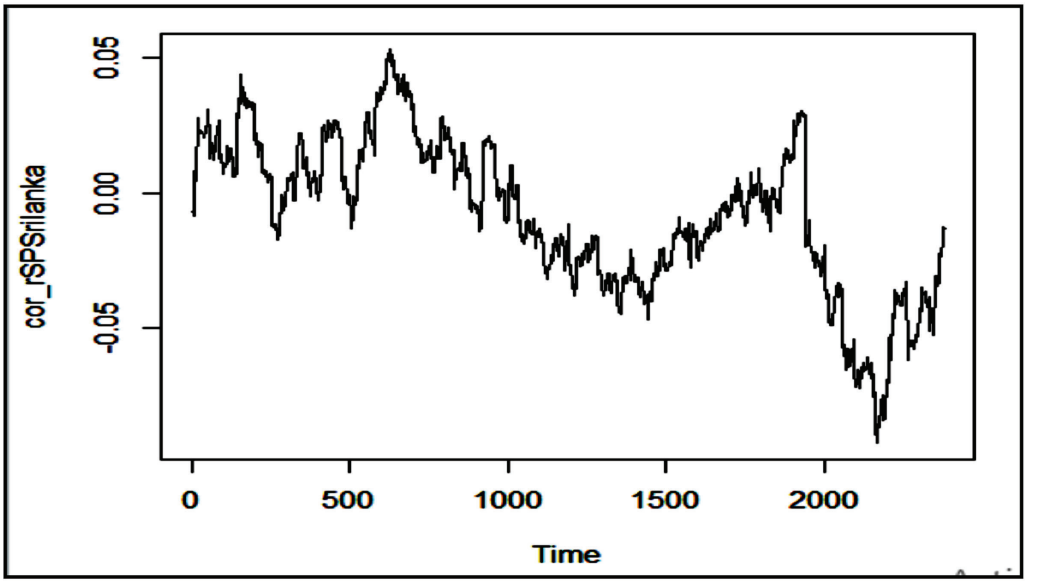
Author's estimation

Table 6: Five Periods Ahead Forecasting

		ReturnNIFTY	ReturnSPLK20LP
Day 1	ReturnNIFTY	1	-0.01557
	ReturnSPLK20LP	-0.01557	1
Day 2	ReturnNIFTY	1	-0.01554
	ReturnSPLK20LP	-0.01554	1
Day 3	ReturnNIFTY	1	-0.01551
	ReturnSPLK20LP	-0.01551	1
Day 4	ReturnNIFTY	1	-0.01548
	ReturnSPLK20LP	-0.01548	1
Day 5	ReturnNIFTY	1	-0.01546
	ReturnSPLK20LP	-0.01546	1

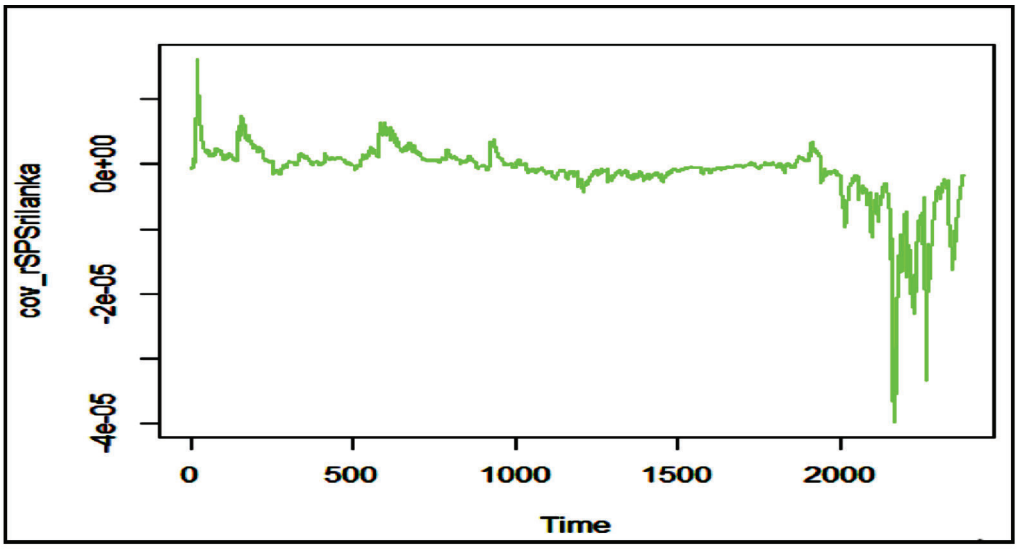
Author's estimation

Figure 1: Plot of DCC of 2379 observations:



Author's estimation

Figure 2: Plot of Covariance



Author's estimation

Five periods ahead forecasting is given in table 6. In figure 1 and in figure 2 time plot of DCC of 2379 and plot of covariance are presented respectively.

SUMMARY & CONCLUSION

Portfolio managers are always looking for stock markets of other countries that are not integrated with each other in order to achieve the global diversification benefit among diverse markets. In this study, we inspect the spillover effect between the Indian and Sri Lankan economies to investigate if fund managers investing in India can diversify their portfolios into other similar nations. Indian markets are more associated with their own lags, according to our findings. There is no causal relation as indicated by Granger causality. Furthermore, our findings are strengthened by a variance-decomposition matrix, which vividly reveals that, aside from its own lagged values, the Sri Lankan economy has no impact on India. These markets are poorly connected, according to our findings. Finally, we use the DCC–MGARCH model to test the spread of volatility from Sri Lanka to the Indian market. Dcca1 is positive and negligible, and dccb1 is positive and considerable; implying that there is no incorporation and asymmetric effect from the Indian economy to the Sri Lankan economy in the short- term, but there is integration in the long -run.

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