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The Asymmetric Volatility Spillover Effect of The Indian Stock Market to Sri Lanka-CSSE, Bangladesh-DSE

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ABSTRACT

This article focuses on the effect of spillover from the Indian stock market to the Sri Lankan and Bangladeshi stock exchanges. The major goal of this research is to determine whether investing in these two markets offers suitable prospects for diversification. The degree of economic interconnectedness between the economies of India and Asia is examined using Granger causality tests and dynamic conditional correlation (DCC)-MGARCH. India, Sri Lanka, and Bangladesh are not found to be causally related. Using DCC-MGARCH, it was found that while there was no short-term volatility spillover from India to Sri Lanka or Bangladesh, there was long-term volatility spillover from India to the other nations examined in this study. By taking into account the pattern of volatility transmission from the Indian stock market to the stock markets in Bangladesh and Sri Lanka, the study's findings may help market managers formulate regulations.

Keywords: *Granger Causality; Unit Root Test; DCC–MGARCH*

JEL Codes: C32, G10, G11

Introduction

Cross-border trade has increased as a result of emancipation in developed and developing nations. Global financial markets became intertwined as a result of globalization. Since the 1990s, many investors have begun to invest in securities outside of their home countries. Investors are interested in market linkages because they can increase returns and serve as a kind of hedging. Therefore, understanding volatility spillover is crucial for investors to adopt minimum-risk strategies (Natarajan, Singh & Priya 2014).

Experience has demonstrated that financial market crises in developed countries have a disproportionately negative impact on developing and emerging nations. Examples of how stock market volatility in one country affects stock market volatility in other countries include the Great Depression of 1930, the Mexican Crisis of 1994, the Asian Currency Crisis of 1997, and the Global Financial Crisis of 2008, to name a few. The two methodologies for analyzing volatility spillovers are domestic volatility and cross-border volatility spillovers. The connection between current and earlier volatility shares in the same market is investigated in the former, whereas spillover between other markets is investigated in the latter.

The study and analysis of volatility spillovers using various tests from the category of autoregressive conditional heteroskedasticity (ARCH) has generated a lot of interest in developing and emerging countries whose capital markets have been impacted by shocks in industrialized countries. Worldwide portfolio managers have been forced to invest in these markets to diversify their holdings because of their high return potential. These markets include China, India, Malaysia, South Korea, Malaysia, and Taiwan, among others. Global portfolio managers have been driven to diversify their holdings by the high return potential of emerging markets like India, China, South Korea, Malaysia, and Taiwan.

Literature Review

To confirm volatility transmission in financial markets, a number of studies have been carried out.

Savva, Osborn and Gill, (2004) focusing on dynamic correlation, examined the spillovers between the markets of the United States, Germany, London, and France and found that only the London and Germany markets are affected by the United States. It was concluded that since the introduction of the euro, the correlation between European markets has increased.

Bartram, Taylor and Wang, (2007) examined market pairings between Euro-European and non-Euro-European countries using a broad time-varying copula dependency model. They examined the influence of the euro on stock market dependence in Europe and found that, as a result of greater European integration, market dependence within the euro region only increased for some countries, such as Italy, France, the Netherlands, Germany, and Spain.

Bekaert and Harvey (1997) considered the volatility of rising equity markets and found that global variables drive volatility in integrated markets, but local factors influence volatility in fragmented markets.

He looked at the distribution of volatility among nations in others (2001), which was conducted during the 1997–1998 Asian financial crisis. They discovered that there are mutual spillover effects between Korea and Hong Kong. Asian stock market movements were analyzed by Jang and Sul (2002) before, during, and after the Asian financial crisis. They discovered that during the financial crisis, Asian market activity increased. The movements of the Asian stock markets prior to, during, and following the Asian financial crisis were studied by Leong and Felmingham in 2003. They found that the financial crisis had increased the synchronization of Asian markets. The stock markets of Malaysia, Australia, Hong Kong, China, New Zealand, and Singapore—all of which have close ties to the Japanese stock market—were studied by Johnson and Soenen in 2002.

Miyakoshi (2003) examined the degree of return and volatility carryover from Japan and the United States to seven Asian stock markets using a bivariate EGARCH model and

discovered that the United States had a massive impact on regional integration between Asian nations.

Premaratne and Balasubramanyan (2003) examined the impact of volatility on stock markets in Hong Kong, Singapore, the United States, Japan, and the United Kingdom.

In the synchronicity between the stock markets of Singapore, Hong Kong, Japan, the US, and the UK, they found significant volatility. When Rao and Naik (1990) looked at the correlation between the US, Japanese, and Indian stock markets, they discovered that the latter had weak ties to international markets. They came to the conclusion that the Indian market's stringent regulations and restrictions on trade and capital movements in the 1970s were to blame for the poor integration of the Indian market with the US and Japanese markets.

Hansda and Ray (2002) also examined price correlations between ten stocks listed on both the BSE/NSE and the Nasdaq/NYSE. They found two-way causality between dual-listed stock prices using VAR models. The authors concluded that markets efficiently receive and integrate price data.

Nandy and Chattopadhyay (2019) investigate the relationship between the National Stock Exchange of India and the domestic financial system, including the money market, FII, FOREX, the gold market, and other markets represented by the S&P500, such as the Japanese Nikkei and India. You'll notice that the Indian and international financial markets are very interdependent. There has also been evidence of an asymmetric transmission of volatility between domestic and foreign markets.

The price and volatility correlations between the prices of international securities traded in London and the underlying stocks listed on the Bombay Stock Exchange were studied by Madhavan and Ray (2019). Exchange rates, international and local indices, DCC from GARCH models for volatility links, and VAR for price analysis were used to evaluate the relationship. While DCC-GARCH demonstrated a high dynamic correlation, the prices of DDR and their underlying securities in Mumbai explained a high level of agreement in the VAR results.

Worthington and Higgs (2004) identified the presence of confirmatory mean and volatility transmission in nine Asian equity markets.

Vardar, Coşkun and Yelkenci (2018) fond that the volatility spillover affects ten countries' stock market indices and the spot price of five major commodities, which evolve depending on market conditions.

In summary, there is enough literature to evaluate the effect of instability spillovers across different financial institutions, including foreign and domestic markets. Portfolio directors, who are constantly on the lookout for diversification methods, are drawn to the literature. International investment managers are interested in India because it has one of the fastest-growing economies in the world. Therefore, it would be interesting to watch how India and Bangladesh in particular, as well as India and Sri Lanka, are affected. Since no sizable

studies have been done to evaluate these markets, as suggested by the literature, the authors were motivated to conduct this study.

Methodology

This study looked at how non-symmetric Indian stock market volatility affected Asian stock markets. The stock exchanges shown in this study are the Nifty 50, the CSSE in Sri Lanka, and the DSE in Bangladesh. The Nifty 50 represents the Indian stock market, whereas the S&P Sri Lanka 20 (SPLK20LP) and Bangladesh-DSE, respectively, stand in for the Sri Lankan and Bangladeshi stock markets. For these stocks, the daily-adjusted closing market indices were compiled from December 2, 2017, to January 30, 2022. The data's log difference was used to calculate the performance of the series. To investigate the effects of the transmission of volatility from the Sri Lankan stock market to the Indian stock market, Causation Granger, VAR, and DCC were used.

The cause of an event can be found using Granger's causality method. In order to determine the direction of causality (one-way, two-way, or none), they generally want to know whether a change in one series affects a change in another series. Investigating the causal connection between variables is a common practice known as Granger causality (Granger, 1969). Since it is used with stationary series, it will be applied to I(0) if two or more strings with level values are immobile. To determine whether lagged returns of Indian stock indices or lagged returns of stock indices from six other countries are driving stock returns, vector autoregression (VAR) is used. This would clarify how reliant Indian stock markets are on international stock markets.

VAR

In VAR models, a variety of tools or strategies are available to help determine the relationship between two variables. A reduced variant of VAR that does not differentiate between exogenous and endogenous variables is one of the approaches. The VAR method has been proven to be a credible and cogent strategy, according to the body of available literature. (Stock & Watson, 2001). The VAR model can be presented as follows:

$$Y_t = \beta_1 Y_{t-1} + \beta_2 Y_{t-2} + \beta_3 Y_{t-3} + \cdots + \beta_n Y_{t-n} + \varepsilon_t$$

In this equation, Y_t is the asset return and Y_{t-1},Y_{t-2} and Y_{t-3} are lag variables. β_1, β_2 and β_3 are the coefficients of the lagged value of assets return. A VAR model bases the variable's treatment as a dependent variable on the lagged value of the variable. The VAR model is used on stationary series and calls for the right amount of lag. Variance decomposition can be used to determine how variable a dependent variable is when lagged by its own variance. Knowing which of the variables is more potent can help explain the variability in dependent variables. It is also known as forecast error variance decomposition. Finally, they examine the transmission impact between the economies of India and Bangladesh, as well as between India and Sri Lanka, using the dynamic conditional correlation (DCC) model. The DCC approach was utilized to look into volatility's short- and long-term persistence.

Results

The findings, which are based on descriptive information about stock returns in the countries under study, are shown in Table 1. The Jarque-Bera test indicates a rejection of normality among the series. From Table 2, it is clearly visible that the correlation among the Stock Exchanges is highly positive.

In this study, the stationarity of the return series for each country is examined using the unit-root test of the Augmented Dickey Fuller Test (ADF). Table 3 demonstrates that the P value for each series is less than 5%. Because of this, the log return series for each nation is stable at I(0), supporting the Granger causality test's application. The Granger causality findings for various series are presented in Table 4. It is found that rNifty does not cause rCSE or rDSE. Therefore, the findings depicted in Table 4 show that the Indian stock market does not outperform Sri Lanka's CSE and Bangladesh's DSE.

Table 1: Descriptive Statistics

	Nifty	**CSE**	**DSE**
Min. :	7034	4383	3704
Median	10886	6442	5466
Mean	11342	6677	5459
Max	18802	14464	7468

Source Author's Estimation

Table 2: Correlation Matrix of ASIAN Stock Exchanges

	Nifty	**CSE**	**DSE**
Nifty	**1**		
CSE	0.6332	**1**	
DSE	0.6394	0.683	**1**

Source Author's Estimation

Table 3: Jarque-Bera & ADF test

	Nifty	**CSE**	**DSE**
Jarque-Bera (P value)	0.0000	0.0000	0.0000
ADF test	Dickey-Fuller = -11.119, Lag order = 11, *p*-value = 0.02	Dickey-Fuller = -12.744, Lag order = 11, *p*-value = 0.01	Dickey-Fuller = -9.4774, Lag order = 11, *p*-value = 0.01

Source Author's Estimation

Table 4: Granger Causality Test

Null Hypothesis	F Statistics	Probablity
rNifty does not Granger cause rCSE	0.6562	0.546
rCSE does not Granger cause rNifty	0.6671	0.5573
rNifty does not Granger cause rDSE	2.1368	0.1407
rNIKKEI does not Granger cause rDSE	0.1209	0.905

Source Author's Estimation

AIC must be used to estimate the appropriate lag duration in the VAR model. Because Lag 8 has the lowest AIC value, it is the best latency to use for VAR. In Table 5, the lag selection criterion is displayed. The multivariate VAR results are summarized in Table 6. because examining the relationship between the Indian stock market and other stock returns is the goal. Based on the lag selection criterion shown in Table 5, the interlinking of the Indian and Sri Lankan stock markets and the Indian and Bangladesh stock markets is shown in Table 6. The VAR's findings unequivocally show how dependent the Stock exchange is on its lags. It has been discovered that Dhaka, Sri Lanka is connected to the Indian stock market. Indian stock markets are impacted by the stock markets in Sri Lanka (at lags 3, 4), and Dhaka (at lags 2).

Table 5: Lag Selection Test

VARselect(data.frame(Nifty, Srilanka,Dhaka)				
AIC(n)	**HQ(n)**	**SC(n)**	**FPE(n)**	
8	1	1	8	
	AIC	**HQ**	**SC**	**FPE**
Lag 1	6.11E+01	6.12E+01	6.13E+01	3.34E+26
Lag 2	6.11E+01	6.12E+01	6.13E+01	3.17E+26
Lag 3	6.11E+01	6.12E+01	6.16E+01	3.18E+26
Lag 4	6.11E+01	6.12E+01	6.17E+01	3.14E+26
Lag 5	6.11E+01	6.12E+01	6.19E+01	3.16E+26
Lag 6	6.11E+01	6.12E+01	6.21E+01	3.11E+26
Lag 7	6.11E+01	6.12E+01	6.22E+01	2.97E+26
Lag 8	6.11E+01	6.12E+01	6.09E+01	2.99E+26
lag9	6.11E+01	6.15E+01	6.26E+01	2.98E+26
lag10	6.11E+01	6.16E+01	6.28E+01	2.99E+26

Source Author's Estimation

Table 6: Outcomes from VAR Estimation

Estimation results for equation rNifty:				
	Estimate	**Std. Error**	***t* value**	**Pr(>|t|)**
rNifty.l1	-0.105	0.0269	-3.89	0.0001***
rSrilanka.l1	0.022	0.0325	0.68	0.494
rDhaka.l1	-0.015	0.0352	-0.42	0.675
rNifty.l2	-0.012	0.0271	-0.43	0.665
rSrilanka.l2	-0.017	0.0333	-0.50	0.615
rDhaka.l2	0.086	0.0353	2.44	0.014*
rNifty.l3	0.046	0.0268	1.71	0.087
rSrilanka.l3	-0.087	0.0333	-2.60	0.009**
rDhaka.l3	-0.036	0.0353	-1.02	0.306
rNifty.l4	0.055	0.0266	2.08	0.0381*
rSrilanka.l4	0.080	0.0334	2.39	0.0171*
rDhaka.l4	0.004	0.0355	0.10	0.919
rNifty.l5	-0.110	0.0262	-4.20	2.82e-05***
rSrilanka.l5	0.008	0.0334	0.24	0.807
rDhaka.l5	0.010	0.0355	0.28	0.777
rNifty.l6	-0.040	0.0259	-1.55	0.1216
rSrilanka.l6	0.028	0.0335	0.83	0.4043

Source Author's Estimation

Table 7: Spillover Effect from Nifty To Others Asian Stock Markets

Variables	**Estimate**	**Std. Error**	**t value**	**Pr(>|t|)**
[rNifty].mu	0.001128	0.000267	4.2247191	0.00012
[rNifty].omega	0.000006	0.000004	1.5	0.100235
[rNifty].alpha1	0.12969	0.02008	6.4586653	0
[rNifty].beta1	22.57341	0.034331	657.52265	0
[rSrilanka].mu	-0.00017	0.000139	-1.2230216	0.275493
[rSrilanka].omega	0.000002	0.000002	1	0.260393
[rSrilanka].alpha1	0.240737	0.043562	5.5263073	0
[rSrilanka].beta1	0.766258	0.037389	20.49421	0
[rDhaka].mu	0.000353	0.000294	1.2006803	0.122449
[rDhaka].omega	0.000002	0.000002	1	0.275341
[rDhaka].alpha1	0.27793	0.055098	5.0442847	0
[rDhaka].beta1	0.758481	0.053579	14.156311	0
[Joint]dcca1	0.0009872	0.000799	1.2355444	0.223975
[Joint]dccb1	0.980257	0.004358	224.93277	0

Source Author's estimation

Findings

They make use of the DCC-MGARCH model to check the spillover of volatility from the stock market of India to the stock market of Sri Lanka and from the Indian stock market to the Bangladesh stock market. It is found to be positive and negligible *dcca1*, whereas they have found positive and substantial dccb1, indicating that there is no amalgamation and disproportional effect from the economy of India to the other two economies in the short period, but there is amalgamation in the long period. Therefore, in the long run, there is a dynamic conditional correlation or transmission of volatility from the Indian market to the Sri Lankan and Bangladeshi markets.

Discussion

Han, Kordzakhia and Truck (2020) examine the volatility spillovers among five regional electricity markets in the NEM and conclude that the volatility of electricity markets is significantly higher than that of other comparable financial or commodity markets, and the pattern of spillover effects may be influenced by the market structures and specific events.

Wen *et al.,* (2021) in their article, they found that there was a highly dependent relationship between the Chinese stock market and Chinese commodity markets, and the level of total volatility spillover varied in different periods.

Ahmed and Huo (2021) suggested that there was a significant unidirectional return spillover effect from the oil market to the Chinese stock market, while there was no return spillover between gold and these two markets.

Reboredo, Ugolini and Hernandez (2021) investigated connectedness spillovers among six stock indices and three blocks of markets. They believed that the risk effect of stock markets needed to be hedged with other asset classes or financial derivatives.

There are global leading and trailing correlations between various economies, according to research on volatility spillover. Ebrahim (2000), Jaiswal-Dale and Jithendranathan (2009), Natarajan, Singh and Priya (2014) and Alfreedi (2019) all conducted studies on the spillover between various stock markets (2019). Over the past 20 years, India has attracted the attention of international portfolio managers as one of the fastest-growing economies.

However, given the various risks in the Indian market, including currency risk, political risk, and interest rate risk, as well as the current recession, it would be beneficial to look at other rapidly developing economies. Which offer investors a variety of opportunities. Some commentators are predicting the rise of Asia and the advent of a Pacific Century as a result of Asia's incredible economic success since the 1980s. The four developing Asian countries have made great strides in high-tech industrialization. There study focuses on the three tiger states of Japan, South Korea, and Taiwan, followed by the Chinese "dragon" and the Indian "elephant". As a result, it will be fascinating to study India's ripple effect on these economies. They could offer portfolio management options to portfolio managers investing in India due to their geographic advantage, similarity to India and growth prospects. As far as the authors are aware, there is no previous evidence of the interconnections between

India and these economies. Therefore, this study fills the gap by focusing on the interconnections between the Indian stock market and the equity markets of the other six countries to reduce the volatility spillover. This research adds to existing knowledge by determining whether portfolio managers investing in emerging markets can benefit from global portfolio diversification.

The results of the present study point to evidence of long-term volatility spillover from India to these markets, even if there is no evidence of short-term volatility spillover from the Indian stock market to the Sri Lankan and Bangladeshi stock exchanges. These results have significance for market managers developing laws and offer information to investors looking for chances for diversification in these two markets.

Conclusion

According to modern portfolio theory, portfolio managers must increase or diversify their holdings in low- or negatively correlated asset classes in order to maximize returns and lower risk. Due to highly coordinated swings and strong spillovers from volatility across several equity markets, fund management's outlook for diversification is constrained. To profit from the benefits of global diversification across multiple markets, portfolio managers are constantly looking for equities markets from other nations that are not integrated with one another. The degree of market integration can be assessed via the transmission of volatility. In the present research, They analyze whether fund managers investing in Asian economies may diversify their portfolios into other comparable nations by examining the spillover effects of volatility between the Indian and Asian economies. There evidence indicates that the Indian markets are more frequently affected by their own delays. Granger causality provides additional evidence that there is no correlation between the Indian and Sri Lankan markets. Finally, they evaluate if volatility from the Indian market is transferred to the other two stock markets (Sri Lanka and Bangladesh) using the DCC-MGARCH model. The value of Dcca1 is negligible and positive, while dccb1 is significant and also positive. This implies that there is no integration and an asymmetric effect of the Indian economy on the economies concerned in the short term, but there is integration in the long term. As a result, portfolio managers who invest long-term in the economies of Sri Lanka and Bangladesh benefit from the diversification of these economies. This research also suggests that global portfolio managers with investments in Asian countries should consider Asian economies as a possible diversification option.

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