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Econometric Study on Dynamics Relationships of International Stock Indices: Evidences from Regional Integrations

Dr.Namita Rajput
Sri Aurobindo College (Eve.)

Shoeba & Sufiya
Zakir Husian Delhi College

***Abstract*: At this instant, the whole world is moving towards a global village or single commune. In this context, this paper investigates dynamic inter-linkages of indices of seven Regional Integrations namely, *ASEAN, BRICS, EFTA, EU, LAFTA, NAFTA and SAARC* comprising of 53 countries including India and also its interlinkages with two Regional Integrations *BRICS* and *SAARC*, because of its membership in these Regional Integrations. Analysis of time series data relating to Index Prices has been taken for the period ranging from 1st April, 2011 to 31st March, 2016. Price discovery is confirmed for all Regional Integrations using Johnson's Co-integration test confirming long term relationship in all twenty-seven combinations. To understand the short term dynamics amongst these combinations of Regional Integrations VECM is employed. This test signifies the short-term adjustments made by various combinations of Regional Integrations to reach towards equilibrium and to understand the market dominance. The results of VECM are encouraging exhibiting establishment of strong market information mechanism. To add robustness to this result Variance Decomposition Analysis is employed. To understand the direction of causality Granger Causality/Block Exogeneity Test is used, the results of which are mixed showing bi-directional Granger lead relationships in 11 combinations of Regional Integration, showing greater regional influence amongst each other, and uni-directional Granger lead relationships in 10 combinations of Regional Integrations and in 6 combination of countries with India, depicting the regional influence reflecting nascent structure of markets. The results of interlinkages of India with BRICS and SAARC exhibit dominant role of India vis-à-vis Sri Lanka, China and Russia while with Pakistan, Brazil, and South Africa, India is in role reversal situation. The findings are relevant for policy makers, hedgers, traders and investors and it may provide diversification benefits for potential investors.**

Key Words: Interlinkages, Regional Integration, Price discovery, Granger Causality, VECM

I. INTRODUCTION

The National stock markets have over the time emerged as the major channel for financial integration of emerging market economies amidst globalization, deregulation and liberalization. There are various factors responsible for emergence and growth in financial and economic integrations, such as inter country mobility of private capital through FDIs and FIIs, rising dependence on another country's savings for funds required, enhancing their competitiveness in the world market, advances in computer technology and information processing etc. Regional integrations may lead to several advantages such as, development of markets and effective price discovery, which in turn results in advancements in terms of economic evolution, savings and investments. However, as every coin has two sides, likewise, certain risks are also associated with regional integrations. This is evident from the recession in the world economy owing to sub-prime crises in US in 2008, as national stock markets exhibited sharp decline in response to US economy crisis. The recent Brexit (Britain exit) from UN is also a prominence event that affect the world economies. In the wake of these events, economists realized the need to monitor interdependence among financial markets for both policy making and investments.

To diagnose and minimize the negative implications of financial interdependence among economies and regional integration, several researches were conducted to evaluate the interdependence across regional integration of national stock markets of several developed nations. In several literatures, bi-directional causality is tested among India and other countries, yet it is in scarce. Hence there is a need to examine these interdependence, as international interdependence of emerging markets has great implications for both in case of developed and developing economies. If the interdependence is sufficiently strong, then domestic market may get insulated from global shock while a weak interdependence facilitates gains from international divergences.

Information spread has been extensively analyzed across markets. Most of the studies focus on the long-term interdependence and causality among stock markets, which tries to find long-term or short term correlation among these markets (Eun and Shim, 1989; Nath and Verma, 2003; and Constantinou, Kazandjian, Kouretas and Tahmazian, 2005). However, some are of the view that, the information spread across markets might not be only through mean returns but also through volatility (Bekaert and Harvey (1997), Ng (2000), Baele (2002), Christiansen (2003), and Worthington and Higgs (2004)). The importance of US market in transmitting return and volatility with other developed and emerging markets, have been depicted major studies. It is claimed that if two markets are integrated then any external tremor in one market will not only affect the mean but also the variance of return in other markets.

There had been a growing interest among the investors in the developing capital markets as they are expected to provide higher

asset returns compared to the developed markets. However, the increasing integration between the emerging and the developed markets has led to information and sentiment spillover from one market to another. Also, the listing of stocks at dual or multiple stock exchanges all over the globe also adds to integration of markets (Bennett and Keller, 1988).

The integration of Indian stock market with other markets has accelerated since 1991, with economic and financial sector reforms. In this phase, the policies related to the inflow of foreign funds with entry of foreign institutional investors (FII), investment norms for non-resident Indians (NRIs), persons of Indian origin (PIOs), overseas corporate bodies (OCBs), global depository receipt (GDR), American depository receipt (ADR) and foreign currency convertible bond (FCCB) have been liberalized.

In Indian context, there has been relatively few studies exploring linkages of Indian markets with international other markets. These are limited to studying linkages with few markets mainly the US and Japanese markets. The informational linkages between the US and Japanese markets with the Indian market has been studied by Rao and Naik (1990), Kumar and Mukhopadhyay (2002), Hansda and Ray (2002, 2003), Nair and Ramanathan (2002), Nath and Verma 2003, Kaur (2004), Mukherjee and Mishra (2006) and Kiran and Mukhopadhyay (2007). Most of the studies demonstrate the dominance of US and Japan market and information flows from these market to India.

The purpose of this study is to explore the price discovery through interlinkages among ASEAN, BRICS, EFTA, EU, LAFTA, NAFTA and SAARC and also analyzing interlinkages of India with Pakistan, Sri Lanka, Brazil, Russia, China and South Africa (India's co-members in BRICS and SAARC). In this study, lag effect of indices is estimated by VAR model, long-term integration, short-run adjustments of price discovery are explored using Johansen co-integration and Granger causality test (Block Erogeneity Test).

The rest of the paper is organized as follows. Section 2 presents the brief literature review of the price discovery and volatility across markets. The data and its descriptive statistics are provided in section 3. Methodology employed for the present study is explained in section 4. Section 5 describe the results and Section 6 exhibits the summary and empirical findings and discussions based on that, followed by references and Annexure containing all relevant tables and charts.

II. Review of Literature

Among studies on international markets, most of the studies have focused on the developed markets specially US, Japan & major European countries. In some interdependence between developed Asian and emerging markets with developed equity markets have been studied.

Grubel (1968), in the paper examined the gains of international diversification through co-movement and correlation between different markets and US perspective. Hamao et al (1990) used univariate GARCH model to study return and volatility spillover between New York, Tokyo and London stock markets. Same stock markets analyzed by Koutmos and Booth (1995) using EGARCH model to find return and volatility between the markets.

The multi-variate GARCH model is applied by Engle, Ito and Lin (1990), to investigate the intra day volatility spillover between US and Japanese foreign exchange market. The same model was further applied by various authors on different capital markets (Bekaert & Horway (1997), Ng(2000), Baele(2002), Christainsen(2003), & Worthington & Higgs (2004)).

The effects of introduction of EURO on European and US markets, have been examined by many authors. Yet the linkage between European and US market are not conclusive, most of studies claimed that these linkages increased after EURO. Bartram (2007), uses general time varying copula dependence model to study linkage among Euro and non-European countries. They concluded that, due to increased European integration, dependence within the Euro area increased only for some countries and not for the whole Europe and non-European countries.

Bekaert & Harvey (1997), claimed the influence of integrated global market factors on validity and local factors influence on segmented markets. Worthington and Higgs (2007), analyzed nine Asian Stock market and concludes the existence of volatility spillover and positive mean. Chuang et al (2007) uses VAR-BEKK framework to investigate volatility spillover among six East Asian markets. The study concludes the influential nature of Japanese market in transmitting volatility.

Hansda & Ray (2002), examine the interdependence between the Nasdaq/NYSE and BSE/ NSE. They analyzed technology shocks and conclude unidirectional causality between the sample. Nair & Ramanathan (2002), used Engle Granger residual based test of co-integration, between the US and Indian stock market indices. Causal results were found positive and flowed from Nasdaq to NSE.

Mukherjee & Mishra (2006), examined Indian stock market with 12 other developed Asian countries with reference to return and volatility. Results obtained through GARCH concludes that Indian open-to-close returns are more related to foreign market than close-to-open return.

III. Data and Descriptive Statistics

The sample used in the study consists of indices of seven regional integrations (ASEAN, BRICS, EFTA, EU, LAFTA, NAFTA, SAARC) comprising 53 countries, which are most liquid and actively traded in

respective countries. The period of study ranges from April 2011 to March 2016, however the data period varies across countries. The data comprises of daily closing stock prices of sample countries. The natural logarithm of daily prices is taken to minimize the heteroscedasticity in data. Then aggregate prices of respective regional integrations are calculated. These aggregate indices are applied to examine the aggregate behavior of regional integrations with regards to price discovery. The list of samples is given in the Table 1.

Nature and other descriptive statistics of the data are exhibited in Table 2 and Table 3, through averages and graphs respectively.

IV. METHODOLOGY

Given the nature of the problem and the quantum of data, we first study the data

Table 1: List of Sample Regional Integration

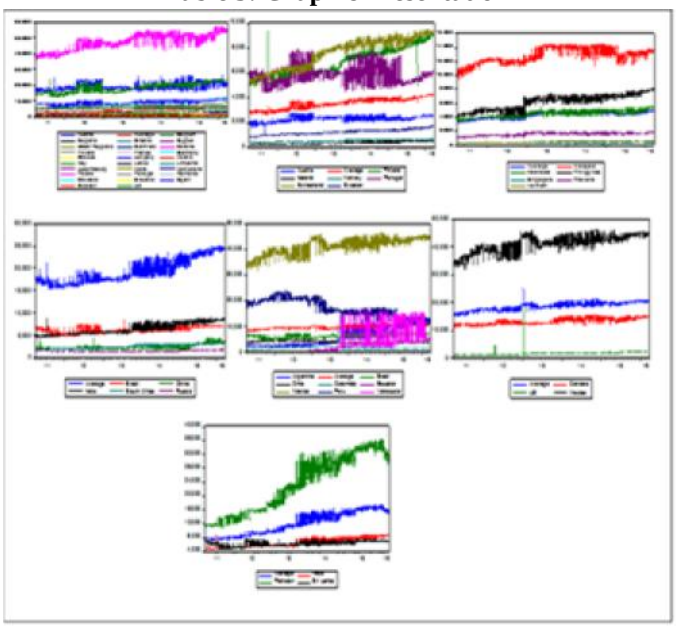
Regional Integration	Member Countries
ASEAN	Indonesia, Malaysia, Philippines, Singapore, Thailand, Vietnam.
BRICS	Brazil, China, India, Russia, South Africa.
EFTA	Austria, Finland, Iceland, Norway, Portugal, Sweden, Switzerland.
EU	Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherland, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, UK.
LAFTA	Argentina, Brazil, Chile, Colombia, Ecuador, Mexico, Peru, Venezuela.
NAFTA	Canada, Mexico, US.
SAARC	India, Pakistan, Sri Lanka.

The table shows the sample regional integration used in the study. The period of study is from April 2011-to March 2016 however the data period varies across regional integration. The sample consists of seven regional integrations comprising of 53 countries.

Table 2: Descriptive Statistics

	ASEAN	BRICS	EFTA	EU	LAFTA	NAFTA	SAARC
Mean	4313.584	19383.08	3557.564	5456.328	9882.275	18703.20	12020.26
Median	4450.388	18302.36	3669.111	5639.117	9642.310	18811.90	11648.92
Maximum	4989.044	25061.36	4379.491	6718.988	12274.22	25042.07	17398.26
Minimum	3130.953	15298.13	2645.294	4128.478	8104.174	14835.40	7185.697
Std. Dev.	461.1287	2744.328	429.9334	633.4205	957.3321	1440.214	3279.777
Skewness	-0.483888	0.552124	-0.339445	-0.255624	0.628211	-0.226913	0.072003
Kurtosis	2.012472	1.982308	1.941997	1.996851	2.373219	2.766195	1.466449
Jarque-Bera	102.2604	120.3573	82.83202	66.44779	103.3369	13.66102	124.3593
Probability	0.000000	0.000000	0.000000	0.000000	0.000000	0.001080	0.000000
Sum	5426469.	24383916	4475416.	6864060.	12557702	23528821	15121482
Sum Sq. Dev.	2.67E+08	9.47E+09	2.32E+08	5.04E+08	1.15E+09	2.61E+09	1.35E+10
Observations	1258	1258	1258	1258	1258	1258	1258

Table 3: Graphic Presentation



Properties from an econometric perspective and find whether co-integration exist, and then error correction models are applied to establish the equilibrium relationship between the markets. To test the causality block exogeneity test is performed and the findings are provided in detail in results section. The regression analysis would yield efficient and time invariant estimates provided the variables are stationary over time. However, many financial and macroeconomic time series behave like a random walk. We first test whether or not the indices of

different regional integrations are co-integrated. The concept of co-integration becomes relevant when the time series being analyzed are non-stationary.

V. RESULTS

The time series stationarity of sample price series has been tested using Augmented Dickey Fuller (ADF) 1981. The ADF test uses the existence of a unit root as the null hypothesis. To double check the robustness of the results, Phillips and Perron (1988) test of stationarity has also been performed for the series. The results of stationarity tests are given in Table 4. It confirms non-stationarity of data; hence we repeat stationarity tests on return series (estimated as first difference of log prices) which are also provided in Table 4. The table describes the sample price series that have been tested using Augmented Dickey Fuller, (ADF) 1981. The ADF test uses the existence of a unit root as the null hypothesis. To double check the robustness of the results, Phillips and Perron (1988) test of stationarity has also been performed for the price series and then both the tests are performed on return series. Panel A and Panel B report results of regional integration indices and countries respectively. The sample return series exhibit stationarity thus conforming that prices are integrated to the first order.

The price linkage between pairs of indices of regional integration and countries is examined using co-integration (Johansen, 1991) analysis that has several advantages. First, co-integration analysis reveals the extent to which two markets move together towards long run equilibrium. Secondly, it allows for divergence of respective markets from long-run equilibrium in the short run. The co-integrating vector identifies the existence of long run equilibrium, while error correction dynamics describes the price discovery process that helps the markets to achieve equilibrium (Schreiber and Schwartz, 1986). Co-integrating methodology fundamentally proceeds with non-stationary nature of level series and minimizes the discrepancy that arises from the deviation of long-run equilibrium. The observed deviations from long-run equilibrium are not only guided by the stochastic process and random shocks in the system but also by other forces like arbitrage process. As a result, the process of arbitrage possesses dominant power in the commodity future market to minimize the very likelihood of the short run disequilibrium.

Table 4: Stationarity Test for Regional Integration and Countries

	Stock Price- Series		Inference On Return Series Integration I (I)	
	ADF Test	Phillips-Perron Test	ADF Test	Phillips-Perron Test
Panel A: REGIONAL INTEGRATION	t-statistics	t-statistics	t-statistics	t-statistics
ASEAN	-1.71	-10.67	-18.76 **	-249.97 **
BRICS	0.27	-11.46	-14.82 **	-282.90 **
EFTA	-0.05	-7.61	-15.81 **	-444.62 **
EU	-0.66	-6.50	-15.75**	-351.04 **
LAFTA	-2.42	-22.68	-17.81 **	-212.44 **
NAFTA	-2.57	-15.28	-22.56 **	-217.01 **
SAARC	-0.69	-3.81	-14.76 **	-236.14 **
Panel B: COUNTRIES	t-statistics	t-statistics	t-statistics	t-statistics
BRAZIL	-1.71	-30.59	-17.50 **	-408.91 **
CHINA	-1.04	-21.02	-18.38 **	-280.86 **
INDIA	-0.43	-11.29	-15.61 **	-298.63 **
PAKISTAN	-1.12	-2.87	-20.07 **	-246.82 **
RUSSIA	-1.50	-2.51	-34.76 **	-34.76 **
SOUTH AFRICA	-0.56	-4.72	-17.84**	-245.13 **
SRI LANKA	-2.90	-29.35	-18.32 **	-230.79 **

The table describes the sample price series that have been tested using Augmented Dickey Fuller (ADF) 1981. The ADF test uses the existence of a unit root as the null hypothesis. To double check the robustness of the results, Phillips and Perron (1988) test of stationarity has also been performed for the price series and then both the test are performed on return series also as shown in Panel-A (regional integration stock price series) and Panel B (Countries individual stock price series). Unit root test is applied to data at level and at 1st difference I(1). All tests are performed using 5%level of significance (**)

Moreover, it is theoretically claimed that if pairs of indices are co-integrated, then it implies presence of causality at least in one direction. On the other hand, if some level series are integrated of the same order, it does not mean that both level series are co-integrated. Co-integration implies linear combinations of both level series cancelling the stochastic trend, thereby producing a stationary series.

Johansen's Co-integration test is more sensitive to the lag length employed. Besides, inappropriate lag length may give rise to problems of either over parameterization or under parametrization. The objective of the estimation is to ensure that there is no serial correlation in the residuals. Here, Akaike information criterion (AIC) is used to select the optimal lag length and all related calculations have been done embedding that lag length. The co-integration results are reported in Table 5. Panel A and Panel B report results of indices of regional integration and countries respectively.

Maximal Eigen value and trace test statistics are used to interpret whether null hypothesis of r =0 is rejected at 5% level and not rejected when r =1. Rejection of the null hypothesis implies there exists at least one co-integrating vector which confirms a long run equilibrium relationship between the two variables under consideration are combinations of regional integration and countries. The null hypothesis is rejected in case of all combinations, which reveals that one co-integration relationship exists between combinations of regional integrations and countries. Thus, these regional integrations and countries indices share common long-run information.

Our co-integration result confirms that in general there is a price discovery process in the concerned sample. Despite determining a co integrating vector for each regional integration/country, it is customary to produce the diagnostic checking criterions before estimating the ECM model. Diagnostic tests are performed for those sample indices for which long run relationship between regional integrations and countries is confirmed based on Johnson Co-integration test. Vector Auto Regression (VAR) estimated with various lags selected by AIC is used to check whether the model satisfies the stability, normality test as well as no serial correlation criterion among the variables in the VAR Adequacy model. Testing the VAR adequacy of the sample series, it was revealed that all the sample indices are satisfying the stability test. In normality test all the sample commodities are found to be non-normal. In verifying the VAR Residual Serial Correlation LM Tests it was found that in all sample series no serial correlation was present. Therefore, it leads to take the position that our model fulfils the adequacy criterion for majorly almost all commodities which exhibited a long run relationship between combinations of regional integration and countries.

The error correction model takes into account the lag terms in the technical equation that invites the short run adjustment towards the long run. This is the advantage of the error correction model in evaluating price discovery.

Table 5: Johansen's Co-Integration Test

Panel A: REGIONAL INTEGRATION	Lag Length	Max Eigen Value	Trace Statistic	Critical Value**
(1) ASEAN	6 lags*	0.01	15.49	15.49
BRICS		0.001	1.60	3.84
(2) ASEAN	8 lags*	0.02	26.67	15.49
EFTA		0.001	1.26	3.84
(3) ASEAN	8 lags*	0.01	20.06	15.49
EU		0.001	1.51	3.84
(4) ASEAN	8 lags*	0.01	19.45	15.49
LAFTA		0.002	3.05	3.84
(5) ASEAN	8 lags*	0.02	23.89	15.49
NAFTA		0.002	3.57	3.84
(6) ASEAN	6 lags*	0.01	18.23	15.49
SAARC		0.001	1.57	3.84
(7) BRICS	8 lags*	0.02	21.25	15.49
EFTA		0.001	0.56	3.84
(8) BRICS	8 lags*	0.02	22.51	15.49
EU		0.001	1.00	3.84
(9) BRICS	8 lags*	0.02	22.51	15.49
NAFTA		0.001	0.96	3.84
(10) BRICS	8 lags*	0.03	41.65	15.49
LAFTA		0.001	1.27	3.84
(11) BRICS	6 lags*	0.01	18.92	15.49
SAARC		0.001	2.26	3.84
(12) EFTA	8 lags*	0.02	27.64	15.49
EU		0.001	1.90	3.84
(13) EFTA	8 lags*	0.03	35.12	15.49
LAFTA		0.001	1.26	3.84
(14) EFTA	8 lags*	0.04	49.70	15.49
NAFTA		0.001	1.29	3.84
(15) EFTA	8 lags*	0.03	32.97	15.49
SAARC		0.001	0.57	3.84
(16) EU	8 lags*	0.03	36.52	15.49
LAFTA		0.001	1.84	3.84
(17) EU	8 lags*	0.03	39.88	15.49
EFTA		0.001	1.65	3.84
(18) EU	8 lags*	0.02	27.22	15.49
SAARC		0.001	0.83	3.84
(19) LAFTA	8 lags*	0.02	32.35	15.49
NAFTA		0.004	5.17	3.84
(20) LAFTA	7 lags*	0.03	37.94	15.49
SAARC		0.001	1.20	3.84
(21) NAFTA	8 lags*	0.02	26.70	15.49
SAARC		0.001	1.12	3.84
Panel B: COUNTRIES				
(1) INDIA	8 lags*	0.02	24.02	15.49
PAKISTAN		0.001	1.48	3.84
(2) INDIA	8 lags*	0.02	35.42	15.49
SRI LANKA		0.001	1.44	3.84
(3) INDIA	8 lags*	0.03	33.52	15.49
BRAZIL		0.001	1.40	3.84
(4) INDIA	6 lags*	0.01	18.88	15.49
CHINA		0.001	1.97	3.84
(5) INDIA	7 lags*	0.01	16.25	15.49
RUSSIA		0.001	1.19	3.84
(6) INDIA	8 lags*	0.03	38.84	15.49
SOUTH AFRICA		0.001	0.62	3.84

This table provides the Johansen's co-integration test, maximal Eigen value and Trace test statistics are used to interpret whether null hypothesis of r=0 is rejected at 5 % level and not rejected where r=1. Rejection of null hypothesis implies that there exists at least one co-integrating vector which confirms a long run equilibrium relationship between the two variables, spot and future prices in our case. The null hypothesis is rejected in case of all seven regional integrations and seven countries inclusive of India, which reveals that one co-integration relationship exists among regional integrations and concerned countries.

The presence of error correction dynamics in a particular system confirms the price discovery process that enables the market to converge towards equilibrium. In addition, the model shows not only the degree of disequilibrium from one period that is corrected in the next, but also the relative magnitude of adjustment that occurs in both markets in achieving equilibrium. Moreover, co-integration analysis indicates how two markets reveal pricing information identified through the price difference between the respective markets. The implication of co-integration is that the prices in two separate markets respond

disproportionately to the pricing information in the short run, but they converge to equilibrium in the long run under the condition that both markets are innovative and efficient. In other words, the root cause of disproportionate response to the market information is that a particular market is not dynamic in terms of accessing the new flow of information and adopting better technology. Therefore, there is a consensus that price changes in one market generates price changes in the other market with a view to bring a long run equilibrium relation.

The Vector Error Correction Model (VECM) results shows short run dynamics in the price series and price movements in the two markets. The lag length of the series is selected in Vector Error Correction Model (VECM) on the basis of Akaike's Information Criteria. The residual diagnostics tests; indicate existence of Heteroscedasticity, in most of the sample commodities and indices which exhibit cointegration. Thus, t-statistics are adjusted, as well as the Wald test statistics which are employed to test for Granger causality, by the White (1980) heteroscedasticity correction.

According to empirical results shown in the VECM model, error correction coefficients are significant in both equations with correct signs, suggesting a bidirectional error correction in relevant commodities and indices. Error Correction Terms (ECTS) also known as mean- reverting price process, provide insights into the adjustment process of pairs of regional integration and countries' indices towards long run equilibrium. For the entire period, coefficients of the ECTs are statistically significant between one to two lags, in both equations as suggested by Akaike Information Criterion (AIC). This implies that once the price relationship of both market deviates away from the long-run co-integrated equilibrium, both markets will make adjustments to reestablish the equilibrium condition during the next period except with little drifts in one or two lags of the sample.

In addition, the empirical results of VEC Granger Causality/Bloc Exogeneity Wald test between spot and futures markets were examined to check the direction of causality. The results of VEC Granger causality test are provided in Table 6. The results display a mix of bidirectional and uni-directional linkages among various combinations of regional integration and countries. These empirical results are consi--stent with the co--integrating relationships above.

Table 6: The Empirical Results of Variance decomposition analysis and Granger Lead Analysis

Panel A: REGIONAL INTEGRATION						
	ASEAN	**BRICS**	**ASEAN**	**EFTA**	**ASEAN**	**EU**
Variance decomposition analysis	7.56% DV: ASEAN	92.43% DV: BRICS	99.68% DV: ASEAN	0.32% DV: EFTA	92.87% DV:	7.13% DV: EU
VAR Granger Causality/Block Exogeneity Wald Tests	P(0.14)	P(0.02)	P(0.03)	P(0.00)	P(0.00)	P(0.04)
	ASEAN	**LAFTA**	**ASEAN**	**NAFTA**	**ASEAN**	**SAARC**
Variance decomposition analysis	6.93% DV: ASEAN	93.07% DV: LAFTA	97.95% DV: ASEAN	2.05% DV: NAFTA	8.97% DV: ASEAN	91.03% DV: SAARC
VAR Granger Causality/Block Exogeneity Wald Tests	P(0.00)	P(0.00)	P(0.07)	P(0.00)	P(0.05)	P(0.01)
	BRICS	**EFTA**	**BRICS**	**EU**	**BRICS**	**LAFTA**
Variance decomposition analysis	11.52% DV: BRICS	88.48% DV: EFTA	25.59% DV: BRICS	74.41% DV: EU	45.32% DV: BRICS	88.48% DV: LAFTA
VAR Granger Causality/Block Exogeneity Wald Tests	P(0.01)	P(0.04)	P(0.03)	P(0.39)	P(0.08)	P(0.00)
	BRICS	**NAFTA**	**BRICS**	**SAARC**	**EFTA**	**EU**
Variance decomposition analysis	21.35% DV: BRICS	78.65% DV: NAFTA	48.2% DV: BRICS	51.8% DV: SAARC	78.18% DV: EFTA	21.82% DV: EU
VAR Granger Causality/Block Exogeneity Wald Tests	P(0.22)	P(0.00)	P(0.02)	P(0.80)	P(0.04)	P(0.10)
	EFTA	**LAFTA**	**EFTA**	**NAFTA**	**EFTA**	**SAARC**
Variance decomposition analysis	87% DV: EFTA	13% DV: LAFTA	11.02% DV: EFTA	88.98% DV: NAFTA	84.47% DV: EFTA	15.53% DV: SAARC
VAR Granger Causality/Block Exogeneity Wald Tests	P(0.00)	P(0.00)	P(0.00)	P(0.00)	P(0.01)	P(0.00)
	EU	**LAFTA**	**EU**	**NAFTA**	**EU**	**SAARC**
Variance decomposition analysis	14.91% DV: EU	85.09% DV: LAFTA	87.3% DV: EU	12.7% DV: NAFTA	86.04% DV: EU	13.96% DV: SAARC
VAR Granger Causality/Block Exogeneity Wald Tests	P(0.01)	P(0.00)	P(0.00)	P(0.00)	P(0.06)	P(0.00)
	LAFTA	**NAFTA**	**LAFTA**	**SAARC**	**NAFTA**	**SAARC**
Variance decomposition analysis	88.71% DV: LAFTA	11.29% DV: NAFTA	16.75% DV: LAFTA	83.25% DV: SAARC	78.5% DV: NAFTA	21.5% DV: SAARC
VAR Granger Causality/Block Exogeneity Wald Tests	P(0.00)	P(0.00)	P(0.00)	P(0.40)	P(0.00)	P(0.75)
Panel A: COUNTRIES						
	INDIA	**PAKISTAN**	**INDIA**	**SRI LANKA**	**INDIA**	**BRAZIL**
Variance decomposition analysis	86.15% DV: INDIA	13.85% DV: PAKISTAN	41.43% DV: INDIA	58.57% DV: SRI LANKA	79.43% DV: INDIA	20.57% DV: BRAZIL
VAR Granger Causality/Block Exogeneity Wald Tests	P(0.00)	P(0.97)	P(0.11)	P(0.01)	P(0.16)	P(0.03)
	INDIA	**CHINA**	**INDIA**	**RUSSIA**	**INDIA**	**SOUTH AFRICA**
Variance decomposition analysis	12.46% DV: INDIA	87.54% DV: CHINA	2.07% DV: INDIA	97.93% DV: RUSSIA	83.74% DV: INDIA	16.26% DV: SOUTH AFRICA
VAR Granger Causality/Block Exogeneity Wald Tests	P(0.26)	P(0.01)	P(0.01)	P(0.51)	P(0.00)	P(0.63)

The results of Table 5 are reconfirmed in this table by Variance Decomposition Analysis. There are bi-directional Granger lead relationships in 11 combinations of regional integration and single Granger lead relationships in 10 combinations of regional integrations and in 6 combination of countries with India.

To reconfirm the empirical results of which market whether price discovery exist across regional integrations and validate the dominant role of various regional integrations Variance Decomposition Analysis is done. The Variance Decomposition Analysis measures the percentage of the forecast error of a variable that is explained by another variable. It indicates the relative impact that one variable has upon another variable within the VECM system. A summary of lead-lag relationship and dual and singular causal aspects are depicted in Table 7.

Table 7: Lead-Lag Relationship of VECM

COMBINATIONS	DOMINANT ROLE	DIRECTION
ASEAN & BRICS	ASEAN	Uni-directional
ASEAN & EFTA	EFTA	Bi-directional
ASEAN & EU	ASEAN	Bi-directional
ASEAN & LAFTA	ASEAN	Bi-directional
ASEAN & NAFTA	NAFTA	Uni-directional
ASEAN & SAARC	ASEAN	Uni-directional
BRICS & EFTA	EFTA	Bi-directional
BRICS & EU	EU	Uni-directional
BRICS & LAFTA	BRICS	Uni-directional
BRICS & NAFTA	NAFTA	Uni-directional
BRICS & SAARC	SAARC	Uni-directional
EFTA & EU	EU	Uni-directional
EFTA & LAFTA	EFTA	Bi-directional
EFTA & NAFTA	NAFTA	Bi-directional
EFTA & SAARC	EFTA	Bi-directional
EU & LAFTA	EU	Bi-directional
EU & NAFTA	EU	Bi-directional
EU & SAARC	EU	Uni-directional
LAFTA & NAFTA	NAFTA	Bi-directional
LAFTA & SAARC	SAARC	Bi-directional
NAFTA & SAARC	SAARC	Uni-directional
INDIA & PAKISTAN	PAKISTAN	Uni-directional
INDIA & SRI LANKA	INDIA	Uni-directional
INDIA & BRAZIL	INDIA	Uni-directional
INDIA & CHINA	INDIA	Uni-directional
INDIA & RUSSIA	RUSSIA	Uni-directional
INDIA & SOUTH AFRICA	SOUTH AFRICA	Uni-directional

Out of 21 combinations of regional integrations, bi-directional interlinkages are found in 11 such combinations while 10 have only uni-directional relation. However, India exhibits uni-direction relationship having dominant role with Sri Lanka, Brazil and China. Although, it is a follower of Pakistan, Russia and South Africa.

VI. Summary and Empirical Findings

We cover time series stock indices seven Regional Integration namely ASEAN, BRICS, EFTA, EU, LAFTA, NAFTA & SAARC, comprising 53 countries including India, being the member of BRICS and SAARC. The study period is from 1st April, 201 to 31st March, 2016. We find that sample indices are non-stationary, and in fact integrated of order one. A long run equilibrium relationship is confirmed for all combinations of Regional Integration and India vis-à-vis BRICS and SAARC using Johansson Co-integration procedure. These co-integration results are supported by VAR adequacy test. Short term dynamics of the markets are examined using VECM. The results show that once the price relationship of spot and future markets deviates away from the long run co-integrated equilibrium, both markets make adjustments to re-establish the equilibrium. Except LAFTA all Regional Integration are playing dominant role in at least one such combinations. Although, LAFTA do confirms co-integration with other Regional Integration and do satisfies all results of VECM, yet doesn't play dominant role. India plays dominant role with Sri Lanka, Brazil and China, while reverse its role with Pakistan Russia and South Africa. The results of VEC Granger causality test show both uni-directional and bi-directional Granger lead relationships between combination of Regional Integration. Out of the twenty-one combinations of regional integration 11 shows bi-directional causal relationship while in remaining 10 it is unidirectional. India shows only uni-directional causality with BRICS and SAARC. The Variance Decomposition results reconfirm the dominant role of futures in price discovery for these Regional Integration.

The empirical analysis provides various applied finance perspective on co-integration among stock markets of various Regional Integration. Empirical evidence supports the international integration of India's stock market in terms of stock prices of BRICS and SAARC. There is evidence of the differential impact of regional and global stock market on the Indian market in the long run as well as in the short run. From a policy perspective, co-integrated stock markets would contribute to financial stability, since they cannot deviate too far from the long-run equilibrium path. From the standpoint of their portfolio diversification objective, investors cannot benefit from arbitrage activities in the long run. However, in the short run, markets would continue to be influenced by the portfolio diversification objective of foreign investors. The lack of evidence of integration of stock markets in terms of local currency gives rise to a concern that India's stock market integration may not be complete, a finding attributable to the inadequate role of domestic investors.

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Author's Profile

Dr. Namita Rajput
namitarajput27@gmail.com
9312180054, K-94, First Floor, Kirti Nagar, New Delhi-110015, Presently, she is Principal in Sri Aurobindo College (Evening), University of Delhi. She is a highly-qualified academician with twenty-two years of rich expertise in teaching, lecturing, research & development with specialization in Finance, International Business, Marketing. She has participated in various seminars and has presented paper and business reviews. She has authored several books and has also published her research papers in national and international journals.

Shoeba (Corresponding Author)
shab2008@gmail.com
9958969433, H. No. 3019, Shah Ganj Chowk, Ajmeri Gate, Delhi-110006
She is currently working as Assistant Professor at Zakir Husain Delhi College (M), University of Delhi. She has completed her graduation and post-graduation from University of Delhi. She has teaching experience of more than 6 years in University of Delhi. She has specialization in teaching Income Tax and

Finance. She has presented research papers in various national and international conferences and has authored many research papers in the field of finance.

Sufiya
sufiyatamsil.tamsil@gmail.com
9810990638, H. No. 3019, Shah Ganj Chowk, Ajmeri Gate, Delhi-110006, She is an Assistant professor at Zakir Husain Delhi College (M), University of Delhi. Her areas of specialization include Computer fundamentals and Marketing. She has more than 5 years of teaching experience in University of Delhi. She has authored and presented many research articles in various seminars and conferences at national and international level.