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Evidences on Price Discovery in BRICS

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ABSTRACT

The present study tries to assess the price discovery process in BRICS economies. The price discovery is tested by assessing the long run and short run causality between the future and spot market indices of BRICS economies. The study employs daily closing prices of spot and future indices of BRICS economies. After testing the stationarity and order of integration of spot and future market series, the study employs Johansen co-integration test to assess the long run co-integrating relationship between the two markets. The long run causality is tested using error correction mechanism and Wald test is used to assess the short run causality. The results of the study suggest that the price discovery process is taking place in case of Russia and China in long run. The short run causality exists between future and spot market in case of Brazil and Russia.

Keywords: Price Discovery, Johansen Co-integration, Error Correction Mechanism, BRICS
JEL Classifications: C2, E3

1. INTRODUCTION

The two major roles of the futures market of the emerging economies towards the development of their financial markets is price discovery and risk reduction. This study examines the price discovery mechanism of the emerging economies with a special reference to the securities market of BRICS (Brazil, Russia, India, China and South Africa). The price discovery is the process of determining the prices of the spot market based on the prices of the futures market (Garbade and Silber, 1983; Kawaller et al., 1987; Chan, 1992; Hasbrouck, 2003; Bekiros and Diks, 2008; Sharma and Chotia, 2019).

The primary reason for dealing in the futures market is the ease of transacting in short selling and the lower transaction cost (Silvapulle and Moosa, 1999). Similarly, Black (1976) highlighted that dealing in futures market is more informed in terms of production, processing decisions and storage facilitation which induces speculators and hedgers to buy futures contract. While the transactions in the spot market are preferred by those investors who possess latest market information related to the stock which can be easily adjusted in the spot market prices (Theissen, 2012). But the issue of the debate is that which market transforms new information rapidly into prices i.e. the spot market or futures market.

Therefore, this research question of lead and lag relationship between the spot and futures markets has been an area of interest for academicians, policy makers and investors for a long time as this is interlinked with the arbitrage opportunities and informational market efficiency on the basis of which investors can gain abnormal returns.

2. LITERATURE REVIEW

Numerous theoretical, methodological and empirical studies have been added to the literature related to lead and lag relationship between spot and futures market in developed economies but the studies in the context of BRICS are very few, therefore, the focus

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of this study is to fill the aforesaid research gap by testing the price discovery mechanism in BRICS economies. The literature on the relationship between spot and futures market can be majorly divided into three parts i.e., unidirectional relationship between futures and spot market, causal relationship between futures and spot market, and no relationship between the same.

Some of the studies which suggested that futures indices lead spot indices are Cornell and French (1983), Modest and Sundaresan (1983) and Figlewski (1984) and Frino and West (1999), Kawaller et al. (1987) empirically investigates intraday price mechanism between Standard and Poor's (S&P) 500 Futures and S&P 500 index for the year 1984 to 1985 using minute to minute data by employing three- stage least regression analysis. The lead - lag relationship was estimated based upon the comparison between the estimates of expiration day with estimates of 1 day before expiration. The result of this study suggests that S&P 500 Futures lead the S&P 500 Index by 45 min. Stoll and Whaley (1990) also concluded that Major Market (MM) index futures lead S&P 500 index by 5 to 10 min using vector autoregressive (VAR) model. Tang et al. (1992) investigated the interrelationship between Hang Sang index and Hang Sang index futures using Granger causality (1969) and Hsiao's test (1981); and concluded futures index lead cash index before market crash but post-crash statistics indicate bidirectional causality.

Atchison et al. (1987), Gordon et al. (1987), Finnerty and Park (1987) tested for causality between suggested that there exists a causal relationship between futures market and S&P 500 cash and the results of the study highlighted that there exists a strong causality between the same. Kutner and Sweeney (1991) presented the similar results using minute to minute intraday returns of S&P 500 cash index and futures index between the period of 4 months from August to December 1987 and applied the causality technique suggested by Granger (1969). Wahab and Lashgari (1993) tested the bidirectional causality between S&P 500 index and index futures for daily data between the periods 1988 to 1992 using co-integration and concluded strong causality between the two. Chan (1992) suggested a much stronger interdependence between the spot and futures market. Turkington and Walsh (1999) suggested causality between All-Ordinaries index (AOI) and index futures in Australia by applying co-integration on cost-of-carry model using high frequency data.

3. DATA AND METHODOLOGY

The present section of the study discusses the sample and data used for the study. The section also presents the descriptive statistics and demonstrates the statistical tests used to assess the causality between the future and spot market indices of BRICS economies.

3.1. Sample and Data

The present study considers the time series data (daily closing price) of spot and future market index of BRICS countries. The data period for sample countries is described in following Table 1.

To maintain the consistency in the data, the study tries to collect the same from same data source. After reviewing various such data sources, the daily closing price of spot and futures market is collected from Investing.com (web based financial database). The descriptive statistics of sample indices of spot and futures markets are given in following Table 2.

3.2. Unit Root Test

The time series variables suffer with the problem of unit root due to the presence of trend, seasonality, cyclicality and structural breaks. If the same is not taken care of, the predictors based on such time series analysis are going to result in spurious output. Thus, to overcome the same, the unit root test of both the spot market index and futures market index of all five BRICS countries is conducted using Augmented Dickey-Fuller test (ADF) proposed by (Dickey and Fuller, 1981). The ADF test use the null hypothesis that the time series variable is having unit root. If the t-value of ADF test is significant, the null hypothesis can be rejected, and it can be concluded that the time series variable is not having problem of unit root and follows the stationarity process. The ADF is applied initially at level and if the time series is found non-stationary at level, the same is tested at first difference. The following equation of ADF test is sued.

$$\Delta Y_t = \mu + \gamma Y_{t-1} + \sum_{j=1}^{p} \alpha_j \Delta Y_{t-j} + \beta t + \omega_t \quad (1)$$

Where Y_t is the closing price of time series variable (spot and futures market price of BRICS countries), Y_{t-1} is the first lag values of Y_t, μ is presented as the drift term, time trend is presented by t and the largest lag length used are shown by p.

3.3. Co-integration of Variables

After assessing the stationarity of closing prices of spot and futures market of BRICS countries, Johansen co-integration (1988) test is used to assess the long run integrating relationship among the variables. The intuitive logic to run the Johansen co-integration analysis derived from the order of integration which both the spot and future market series were following in the data. From the results reported in Table 3, it was evident that both the series (spot and futures) are non-stationary at level and stationary at first difference. This shows that both follows the first order of integration.

The maximum likelihood approach is adopted for the test and output is reported in two parts (first showing eigen-values and second indicating trace statistics). The Johansen co-integration approach test the null hypothesis that there is no co-integrating relationship between the spot and future prices of BRICS economies. The test assumes the following reduced form of VAR framework (the test is a multivariate version of the univariate Dickey-Fuller test). The functional form of order n is given below in equation (2).

$$y_t = B_1 y_{t-1} + \ldots + B_n y_{t-n} + Cx_t + u_t \quad (2)$$

where y_t is a k-vector of I(1) variables, x_t is a n-vector of deterministic trends, and u_t is a vector of shocks. We can rewrite this VAR as:

$$\Delta y_t = \Pi y_{t-1} + \sum_{i=1}^{n-1} \Gamma_i \Delta y_{t-i} + Cx_t + u_t \quad (3)$$

Table 1: Sample description

Country	Proxy for spot market	Proxy for futures market	Data period
Brazil	BOVESPA index	BOVESPA futures	March 7, 2017-March 29, 2019
Russia	RTSI index	RTS futures	December 19, 2013-July 19, 2019
India	NIFTY index	NIFTY futures	April 13, 2016-March 29, 2019
China	HANGSENG index	HANGSENG futures	April 1, 2011-March 29, 2019
South Africa	FTSE/JSE40 index	FTSE/JSE40 futures	April 1, 2011-March 29, 2019

Table 2: Descriptive statistics

Index	BOVESPA spot	BOVESPA futures	RTSI spot	RTSI futures	NIFTY spot	NIFTY futures	HANGSENG spot	HANGSENG spot	FTSE spot	FTSE futures
Mean	78128.2	78518.0	1063.6	1046.2	9794.3	9810.6	23704.2	23670.6	41872.9	42040.3
Median	76946.0	77348.0	1096.5	1083.4	10086.6	10108.6	23109.7	23075.0	44661.8	44903.5
Max.	99993.9	100321	1453.1	1422.0	11738.5	11752.5	33154.1	33154.0	55065.4	55441.0
Min.	60761.7	61445.	628.4	560.4	7706.6	7732.8	16250.3	16274.5	25180.6	25193.0
Std. Dev.	10053.3	10037.0	167.31	165.055	1074.5	1074.7	3240.0	3243.3	7593.3	7659.9
Skew.	0.173	0.183	–0.237	–0.341	–0.30	–0.30	0.61	0.61	–0.60	–0.60
Kurt.	2.200	2.206	2.456	2.403	1.83	1.83	2.81	2.80	2.12	2.11
J-B	16.079	16.158	28.955	45.709	52.80	52.46	126.35	124.25	186.80	186.22
Prob.	0.0003	0.0003	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000

Table 3: Unit root test statistics

Exchange rate	Variables	t-Statistics at level	P-value	t-statistics at first difference	P-value
Brazil	Spot	–0.869	0.797	–23.061**	0.000
	Futures	–0.931	0.777	–23.394**	0.000
Russia	Spot	–2.221	0.198	–35.466**	0.000
	Futures	–2.126	0.234	–37.373**	0.000
India	Spot	–1.004	0.753	–25.299**	0.000
	Futures	–0.998	0.755	–26.319**	0.000
China	Spot	–1.441	0.562	–43.433**	0.000
	Futures	–1.530	0.518	–45.101**	0.000
South Africa	Spot	–1.577	0.493	–45.864**	0.000
	Futures	–1.552	0.506	–45.614**	0.000

**Shows significance at 1% level of significance

where $\Pi = \sum_{i=1}^{n} B_i - 1, \Gamma_i = -\sum_{j=t+1}^{n} B_j$

3.4. Long Run Causality Analysis

The study employs error correction mechanism (ECM) to assess the long run causality between the futures and spot market indices of BRICS economies. To assess the long run causality, the following equations (4 to 13) are used to determine the error correction term. If the error correction term is negative and significant then it can be concluded that there is significant causality between the futures and spot market. The error correction model equations of five BRICS economies are given below.

Brazil

$$\Delta(BOVESPA_S)_t = \alpha_1 + \beta_1 \sum_{i=1}^{i=n} \Delta(BOVESPA_S)_{t-i} + \gamma_1 \sum_{i=1}^{i=m} \Delta(BOVESPA_F)_{t-i} + \lambda_1 e_{t-1} + v_{1t} \quad (4)$$

$$\Delta(BOVESPA_F)_t = \alpha_1 + \beta_1 \sum_{i=1}^{i=n} \Delta(BOVESPA_F)_{t-i} + \gamma_1 \sum_{i=1}^{i=m} \Delta(BOVESPA_S)_{t-i} + \lambda_1 e_{t-1} + v_{1t} \quad (5)$$

Russia

$$\Delta(RTSI_S)_t = \alpha_1 + \beta_1 \sum_{i=1}^{i=n} \Delta(RTSI_S)_{t-i} + \gamma_1 \sum_{i=1}^{i=m} \Delta(RTSI_F)_{t-i} + \lambda_1 e_{t-1} + v_{1t} \quad (6)$$

$$\Delta(RTSI_F)_t = \alpha_1 + \beta_1 \sum_{i=1}^{i=n} \Delta(RTSI_F)_{t-i} + \gamma_1 \sum_{i=1}^{i=m} \Delta(RTSI_S)_{t-i} + \lambda_1 e_{t-1} + v_{1t} \quad (7)$$

India

$$\Delta(NIFTY_S)_t = \alpha_1 + \beta_1 \sum_{i=1}^{i=n} \Delta(NIFTY_S)_{t-i} + \gamma_1 \sum_{i=1}^{i=m} \Delta(NIFTY_F)_{t-i} + \lambda_1 e_{t-1} + v_{1t} \quad (8)$$

$$\Delta(NIFTY_F)_t = \alpha_1 + \beta_1 \sum_{i=1}^{i=n} \Delta(NIFTY_F)_{t-i} + \gamma_1 \sum_{i=1}^{i=m} \Delta(NIFTY_S)_{t-i} + \lambda_1 e_{t-1} + v_{1t} \quad (9)$$

China

$$\Delta(HANGSENG_S)_t = \alpha_1 + \beta_1 \sum_{i=1}^{i=n} \Delta(HANGSENG_S)_{t-i}$$
$$+\gamma_1 \sum_{i=1}^{i=m} \Delta(HANGSENG_F)_{t-i} + \lambda_1 e_{t-1} + v_{1t} \quad (10)$$

$$\Delta(HANGSENG_F)_t = \alpha_1 + \beta_1 \sum_{i=1}^{i=n} \Delta(HANGSENG_F)_{t-i}$$
$$+\gamma_1 \sum_{i=1}^{i=m} \Delta(HANGSENG_S)_{t-i} + \lambda_1 e_{t-1} + v_{1t} \quad (11)$$

South Africa

$$\Delta(FTSE40_S)_t = \alpha_1 + \beta_1 \sum_{i=1}^{i=n} \Delta(FTSE40_S)_{t-i}$$
$$+\gamma_1 \sum_{i=1}^{i=m} \Delta(FTSE40_F)_{t-i} + \lambda_1 e_{t-1} + v_{1t} \quad (12)$$

$$\Delta(FTSE40_F)_t = \alpha_1 + \beta_1 \sum_{i=1}^{i=n} \Delta(FTSE40_F)_{t-i}$$
$$+\gamma_1 \sum_{i=1}^{i=m} \Delta(FTSE40_S)_{t-i} + \lambda_1 e_{t-1} + v_{1t} \quad (13)$$

In the above equations, Δ shows the first difference operation of spot and future index series, e_{t-1} shows the lagged error values of the error correction term (ECT). The equation 4, 6, 8, 10, 12 test the long run causality from the futures markets to the spot market. If the error correction term of these equations turn out to be negative and significant, it can be concluded that there is long run causality from futures market to sport market in BRICS economies and the price discovery is taking place in long run. On the contrary, if the coefficients of equation 5, 7, 9, 11, 13 are negative and significant (as these tries to assess the causality from spot market to futures market), the existence of causality from spot market to futures market in BRICS can be derived and in such scenario, the conclusion will lead to no price discovery situation in BRICS economies.

3.5. Short Run Causality Analysis

Further to test the short run causality between the futures and spot market of BRICS economies, the study employs Wald Test proposed by Wald (1943). The test employs unrestricted regression to assess the estimates and test the null hypothesis as the coefficients of error equation (H_0: $\delta = 0$). In the present study, If the test results are significant, the null hypothesis will be rejected. This implies that there is short run causality from futures market to spot market in BRICS economies.

4. RESULTS AND DISCUSSION

The present section of the study discusses the results of unit root test, Johansen co-integrating analysis, Error Correction Mechanism and Walt test.

4.1. Unit Root Test

The unit root results presented in following Table 3 shows that at level, the values of ADF test statistics of spot market indices for Brazil, Russia, India, China and South Africa are -0.869, –2.221, –1.004, –1.441 and –1.577 with P-values of 0.797, 0.198, 0.753, 0.562 and 0.493 respectively. The P-values in case of all five BRICS economies are higher than 5% level of significance values. This indicates that the ADF test statistics is insignificant, and results fail to reject the null hypothesis of unit root in the spot market indices series of BRICS economies.

Similarly, in case of futures indices of BRICS economies, the ADF test statics for Brazil, Russia, India, China and South Africa are –0.931, –2.126, –0.998, –1.530 and –1.552 with respective P-values of 0.777, 0.234, 0.755, 0.518 and 0.506. This clearly shows that the ADF test is insignificant and fail to reject the null hypothesis of futures indices of BRICS economies are having unit root. This confirms that at level both the spot and futures market series of BRICS economies are having problem of unit root and series are non-stationary.

Further, to test the existence of unit root at first difference, the ADF test for both spot and futures market series is computed by taking the first difference of the series. The results reported in Table 3 shows that the values of ADF test statistics of spot market indices at first difference for five BRICS economies *i.e.* Brazil, Russia, India, China and South Africa are –23.061 (P = 0.000), -35.466 (P = 0.000), –25.299 (P = 0.000), –43.433 (P = 0.000) and –45.864 (P = 0.000) respectively. These results indicate that the ADF test statistics is significant and sufficient to reject the null hypothesis of spot market indices are having problem of unit root. Similarly, in case of future market indices of BRICS economies, the values of ADF test statistics are –23.394 (P = 0.000), –37.373 (P = 0.000), –26.319 (P =0.000),–45.101 (P = 0.000) and –45.614 (P = 0.000) respectively for Brazil, Russia, India, China and South Africa. The results are significant and provide sufficient evidences to reject the null hypothesis of existence of unit root in the futures market series of BRICS economies. This confirms that there is no problem of unit root in case of all five BRICS economies at first difference and both the spot and future market series can be treated as stationary at first difference.

4.2. Johansen Co-integration Test

As discussed in the previous section 4.1 of the study, both the spot market and future market series of all five BRICS economies are non-stationary at level and significant at first difference. This shows that both the series (spot and future market) demonstrated the order of integration one *i.e.* I (1). This fulfil the condition of applying the Johansen co-integration test to assess the long run co-integrating relationship between the spot and future market indices of BRICS economies. The results of Johansen co-integration test (reported in the form of Trace statistics and Max-eigen statistics) are reported in following Tables 4and 5.

From the results reported in Table 4, the values of Trace statistics for testing the null hypothesis of no-integration between the spot and future market series of Brazil, Russia, India, China and South

Table 4: Trace statistics (Johansen co-integration test)

Variables	Number of lags	Hypothesized No. of CE(s)	Eigenvalue	Trace statistic	0.05 Critical value	Prob.**
Brazil	2	None*	0.077846	41.80795**	15.49471	0.0000
		At most 1	0.001743	0.881004	3.841466	0.3479
Russia	4	None*	0.006369	12.34101	15.49471	0.1413
		At most 1	0.002892	3.849638*	3.841466	0.0498
India	3	None*	0.141426	112.3806**	15.49471	0.0001
		At most 1	0.001463	1.068656	3.841466	0.3012
China	4	None*	0.057469	118.3369**	15.49471	0.0001
		At most 1	0.001220	2.391233	3.841466	0.1220
South Africa	3	None*	0.025638	53.92197**	15.49471	0.0000
		At most 1	0.001097	2.185568	3.841466	0.1393

*Presents significance at 5% level of significance. **Shows significance at 1% level of significance

Table 5: Max-Eigen statistics (Johansen co-integration test)

Variables	Number of lags	Hypothesized No. of CE(s)	Eigenvalue	Max-eigen Statistic	0.05 Critical Value	Prob.**
Brazil	2	None	0.077846	40.92694**	14.26460	0.0000
		At most 1	0.001743	0.881004	3.841466	0.3479
Russia	4	None	0.006369	8.491373	14.26460	0.3309
		At most 1	0.002892	3.849638*	3.841466	0.0498
India	3	None	0.141426	111.3120**	14.26460	0.0001
		At most 1	0.001463	1.068656	3.841466	0.3012
China	4	None	0.057469	115.9457**	14.26460	0.0001
		At most 1	0.001220	2.391233	3.841466	0.1220
South Africa	3	None	0.025638	51.73640**	14.26460	0.0000
		At most 1	0.001097	2.185568	3.841466	0.1393

*Presents significance at 5% level of significance. **Shows significance at 1% level of significance

Africa are 41.807, 12.341, 112.380, 118.336 and 53.921 with P-values of 0.000, 0.141, 0.0001, 0.0001 and 0.000 respectively. The test is significant in case of four economies *i.e.* Brazil, India, China, and South Africa and confirms the presence of long run co-integrating relationship between the spot and future market indices of these economies. On the contrary, in case of Russia, the results fail to reject the null hypothesis of no co-integrating relationship between the spot and future market indices. These findings are supported by the results reported in following Table 5 of Max-eigen statistics. The results of Max-eigen statistics also confirms the long run co-integrating relationship in case of Brazil, India, China, and South Africa.

4.3. Error Correction Mechanism

The estimates of error correction term used to assess the long run causality between the future and spot market indices of BRICS economies are reported in following Table 6. As discussed in section 3.4 of the study, if the error correction term is negative and significant then it can be concluded that there is significant causality between the futures and spot market. From the results reported in Table 6, it is evident that error correction term for Brazil is having value of –0.2373 with P = 0.216. The error correction term negative but insignificant. Thus, it can be concluded that there is no long run causality from future market towards spot market in case of Brazil. It can further be concluded that the price discovery is not taking place in Brazil economy in long run. Further, in case of Russia, the value of error correction term is –0.0456 with P = 0.011. The error correction term is negative and significant and directs the existence of long run causality from future market to spot market in Russia. This further confirms that the price discovery is taking place in Russian economy in long run.

For India, the error correction term is neither negative nor significant as the value is 0.228 with P = 0.275. This signifies that there is no long run causality between future and spot market indices of Indian economy. The similar results are found in case of South Africa where the error correction term is negative (–0.0261) but insignificant (with P = 0.620). This further confirms that there is no long run causality between future and spot market indices of South African economy. This further confirms that in case of India and South Africa, the price discovery is not taking place in long run.

On the contrary, in case of China, the error correction term is having value of –0.291 with P = 0.005. Since the error correction term is negative and significant, the results confirm that there is long run causality in the China from future market to spot market. The price discovery is taking place in case of China in long run.

In light of the analysis of the error correction term presented above, it can be concluded that in case of Russia and China, there is long run causality between future and spot market with the direction of causality from future to spot market. This confirms the price discovery process in case of Russia and China in long run. On contrary, in case of other three BRICS economies *i.e.* Brazil, India and South Africa, there is no long run causality between future and spot market and no evidences of price discovery process followed.

4.4. Wald Test

Further to test the short run causality between the future and spot market of BRICS economies, Wald Test is computed. The test employs unrestricted regression to assess the estimates and test the null hypothesis as the coefficients of error equation (H_0: $\delta = 0$). From the results reported in following Table 7, the values

Table 6: Error correction mechanism

Error correction:	Brazil		Russia		India		China		South Africa	
	Spot	Future	Spot	Future	Spot	Future	Spot	Future	Spot	Future
CointEq1	–0.247341	–0.072230	–0.04654*	–0.033160	0.228814	0.708303	–0.2914**	0.003921	–0.026124	0.05141
	[–1.23701]	[–0.34845]	[–2.53614]	[–1.83087]	[1.09250]	[3.30816]	[–2.77514]	[0.03555]	[–0.49534]	[0.9536]
S(–1)	–0.16783	–0.083470	0.2142**	0.812210	–0.211301	0.016770	–0.182694	0.280182	–0.201578	0.12676
	[–0.50790]	[–0.24366]	[2.84732]	[10.9379]	[–0.99899]	[0.07756]	[–1.53111]	[2.23587]	[–1.73495]	[1.0673]
S(–2)	0.724638	0.737515	0.062166	0.405590	–0.133610	0.023794	–0.227837	0.022374	0.026851	0.10489
	[2.28359]	[2.24187]	[0.71493]	[4.72690]	[–0.69868]	[0.12171]	[–1.90629]	[0.17825]	[0.22250]	[0.8503]
S(–3)			0.008243	0.184213	–0.228244	–0.156973	–0.077242	0.082840	–0.046131	–0.04157
			[0.09521]	[2.15617]	[–1.45137]	[–0.97641]	[–0.69440]	[0.70912]	[–0.41048]	[–0.3618]
S(–4)			0.119942	0.180034			–0.100593	–0.049167		
			[1.57032]	[2.38860]			[–1.12894]	[–0.52541]		
F(–1)	0.134561	0.036320	–0.19811*	–0.781999	0.275791	0.031679	0.189186	–0.272030	0.175048	–0.142693
	[0.41828]	[0.10890]	[–2.59519]	[–10.3810]	[1.32631]	[0.14903]	[1.60794]	[–2.20150]	[1.53771]	[–1.2262]
F(–2)	–0.780292*	–0.780615	–0.071792	–0.419710	0.150404	0.002001	0.223353	–0.023171	–0.080851	–0.15310
	[–2.51819]	[–2.43003]	[–0.82420]	[–4.88291]	[0.80212]	[0.01044]	[1.89319]	[–0.18701]	[–0.68502]	[–1.2690]
F(–3)			–0.035740	–0.176091	0.221322	0.159312	0.089917	–0.066729	0.060586	0.05845
			[–0.41501]	[–2.07209]	[1.44419]	[1.01689]	[0.81737]	[–0.57758]	[0.55090]	[0.5199]
F(–4)			–0.14616*	–0.219794			0.075777	0.022137		
			[–1.99802]	[–3.04465]			[0.86078]	[0.23944]		
C	64.74473	63.86304	–0.019112	0.042025	4.722637	4.785670	2.417737	2.364491	11.03376	11.0036
	[1.38864]	[1.32123]	[–0.03864]	[0.08610]	[1.76884]	[1.75336]	[0.40595]	[0.37802]	[1.14306]	[1.1151]

The t-statistics is given in [ ], *Presents significance at 5% level of significance. **Shows significance at 1% level of significance

Table 7: Walt test statistics

Variables	Chi-square statistics	Df	Prob.
Brazil	7.680	2	0.0215*
Russia	12.095	4	0.0167*
India	3.005	3	0.3908
China	4.3641	4	0.3590
South Africa	5.029	3	0.1696

*Presents significance at 5% level of significance

of Wald test statistics for BRICS economies are 7.680, 12.095, 3.005, 4.364 and 5.029 with respective p-values of 0.0215, 0.0167, 0.3908, 0.3590 and 0.1696 for Brazil, Russia, India, China and South Africa respectively. The results show that the Wald test is significant in case of Brazil and Russia and insignificant in case of India, China, and South Africa. This confirms that there is short causality exists between future and spot market of Brazil and Russia while there are not significant evidences of same in case of India, China, and South Africa.

5. CONCLUSION

In light of the results and discussion presented in section 4 of the study, the findings of the study suggest that there is long run co-integrating relationship between the future and spot market indices of Brazil, India, China and South Africa. The results of analysis of the error correction term reveal that in case of Russia and China, there is long run causality between future and spot market with the direction of causality from future to spot market. On contrary, in case of other three BRICS economies *i.e.* Brazil, India and South Africa, there is no long run causality between future and spot market. In case of short run causality, the results of Wald test reveal that there is short causality exists between future and spot market of Brazil and Russia while there are not significant evidences of same in case of India, China and South Africa.

It can be concluded that the price discovery process is taking place in case of Russia and China in long run while the same is not available in case of other three BRICS economies i.e. Brazil, India and South Africa in long run. Out of the three economies, only Brazil is demonstrating the short run causality between future and spot market indices. The rest two economies India and South Africa are neither having long run nor short run causality between the future and spot market indices.

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