Testing the Relationship between Stock Prices of Cross Listed Firms: A Case of Standard Chartered PLC

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ABSTRACT

The present study has empirically investigated long term relationship between Indian Depository Receipt (IDR) and the respective underlying share price of the only IDR issue of Standard Chartered PLC in India. The study has used the daily closing prices of the bank in India {STAN (NSE)} and prices in U.K {STAN (LSE)} from 30-6-2011 to 30-6-2014. The result shows that IDR and its underlying shares are stationary at first difference and not normally distributed. There is no long term relationship between IDR and the underlying share price of Standard Chartered PLC. VAR results indicate that the performance of the bank's share price depends upon the lagged values in the respective markets. Additionally, impulse response function reveals that there is significant and higher response to the shock of STAN (NSE) to STAN (NSE) and significant and higher response of STAN (LSE) to the shock of STAN (NSE) when compared to its own values. The major conclusion of the study is that price discovery happens in the respective markets and investors' can study their respective markets for appropriate strategies.

Introduction

Cross listing of shares is becoming an important financing strategy for companies across the globe and particularly in India. Cross listing of shares is when a company lists its equity shares on one or more foreign stock exchange in addition to its domestic exchange. Indian stocks are listed in foreign exchanges like NYSE, NASDAQ. The instrument used for raising money from U.S Investors and getting listed in U.S bourses is called as American Depository Receipts (ADR). Global Depository Receipts (GDR) is issued to non- U.S investors and such receipts are either listed in London/Luxembourg Stock Exchanges. Most of the Indian companies have raised money through issue of ADR/GDR to foreign investors. Cross listing offers the benefit of fungibility. Fungibility refers to inter-changeability of shares. For instance, if an individual purchases a share of ABC stock in its home country or in foreign country, it should be accepted at either location as ABC stock. Currently, ADR/GDR instruments are two way fungible. Due to globalisation and deregulation of financial markets in the last two decades, there has been a considerable rise in cross listings ***(Musaba et al., 2013)***. Similarly, foreign companies raise money from Indian investors and get the security listed either in BSE/NSE in addition to its listing in the home country. Such issues are called Indian Depository Receipts (IDR).Till date, there is only one foreign

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company which has raised funds from India. It is Standard Chartered Bank, headquartered in U.K in the year 2011. Cross listing of shares offers multiple benefits such as lowering cost of capital through enhanced liquidity, reduced transaction costs, and enhanced ability of foreign investors to diversify portfolios and afford access to extensive range of investors ***(Yong et al., 2012).***

In India, the Capital Market has witnessed considerable revolution with liberalisation measures, and the exploration of the nature of integration with other developed and emerging markets would not only give ideas about possible gain out of portfolio diversification, but may also afford some indication of the vulnerability of the country's stock market in case of a regional financial crisis and subsequent reversals of capital flows from the region ***(Lakshmi et al., 2013).*** Co-integration between Indian and global stock markets through issue of ADR/GDR/IDR has increased considerably, necessitating the importance of the present study. If the markets are informationally efficient, the prices of the underlying shares truly reflect the prices of IDRs; a shock in the underlying shares should be reflected in the prices of IDRs by the same calendar day. This would help the investors plan their investments accordingly. The objective of the present study is to explore the short term and long term relationship between the underlying shares and IDRs. With this background, the remaining part of the study is organised as follows- Review of Literature, Data and Methodology, Analysis and Interpretation and Conclusion

Review of Literature

According to ***Chakrabarthy (2003)***, Depositary Receipts have emerged as a favoured vehicle to access developed stock markets for many emerging market companies. India has been no exception. While several Indian companies have issued American Depositary Receipts (ADRs) in the 1990s, only a few of these securities are listed on US exchanges. The author studied the return and volume dynamics of these exchange-listed ADRs of Indian origin. It was found that the underlying stock returns, exchange rate and market indices in the US and India together often explain less than half the movement in ADR returns. Returns and volumes also exhibit low cross-border correlations. Indian ADRs often enjoy large premiums, indicating effective market segmentation between the two countries. Finally, ADR issuance often has a temporary positive effect on the underlying stock price, but usually does not materially alter the stock's relationships with the US and Indian markets. ***Wong et al., (2004)*** have empirically investigated the long-run equilibrium relationship and short-run dynamic linkage between the Indian stock market and the stock markets in major developed countries by examining the Granger causality relationship and the pair-wise, multiple and fraction co-integrations between the Indian stock market and the developed stock markets such as US, UK and Japan. The findings of the study reveal that the Indian stock market is statistically, significantly co-integrated with stock markets of United States, United Kingdom and Japan. There is existence of a unidirectional granger causality running from the US, UK and Japanese stock markets to the Indian stock markets. ***Kumar(2006)***, in his paper assessed the impact of listing of ADRs/GDRs on the returns of the firm's underlying domestic shares by using a sample of 68 Indian DR programs that listed on the foreign markets between 1st January, 1996 and 30th June, 2001. It was found that the impact on the returns available from the underlying domestic shares depends on the listing venue of

the DR programs—while the GDR listings adversely affect the returns, ADR listings do not seem to have any significant impact on the returns available from the underlying domestic shares. ***Subha et al., (2010)*** in their study tested whether the Indian stock market is interdependent on the American Stock Markets. The New York Stock Exchange is the largest stock exchange in the world in terms of Market Capitalization. Many Indian companies have listed their shares in America. The extent of co-integration between the major Indian stock exchanges with the leading stock markets of America like NYSE, S&P500 and the NASDAQ was tested using the Engle Granger test of Co-integration. The data collected was for the time period Jan 1st 2000 to 31st Dec 2008. The authors concluded that there was no co-integration between the market ***Bhunia (2012)*** analysed the short-term and long-term relationships between BSE 100 index and crude price by using various econometric techniques and found that crude prices and BSE index had long term relationship. The study concluded that there was one way causality from the BSE 100 index to crude price, but crude price was no granger causing BSE index.

Foucault et al.,(2012) in their study found corporate investment to stock price is higher for firms cross listed in the U.S than for firms non cross listed with 633 firms from 39 countries analysed for the period 1989-2006. Their hypothesis suggested that a cross listing had a positive impact on the investment to price sensitivity which in turn assists managers to acquire more informative feedback from the stock market. ***Chopade et al., (2012)***, in their paper attempted to find out the role of two markets involved with the depositary receipts. The depositary receipts are traded independently in the host market where they are issued. At the same time these depositary receipts are equivalent to the underlying stocks in the home country. The study had explored if the returns generated from these depositary receipts are affected by both the markets, and if so which market plays predominant role in determining these returns. Returns of 35 GDR of Indian companies have been taken up for the period April 2009 to April 2010. It was found that the returns from the underlying securities affect the returns of the respective GDRs but not vice-versa. The study also further shows that the informational factors of the home market (market where securities are issued) have more prominent effect on the GDR returns than those of the host market (market where GDR are issued). The long run and short-run performance of 192 Australian cross-listed firms relative to their rivals was examined by the author. The study revealed that in short-run, the mean cumulative abnormal returns are statistically significant for the cross-listed firms during the long-run analysis. Further analysis revealed liquidity gains are mostly not a factor for cross listed firm's abnormal returns ***(Yong et al., 2012)***. ***Lakshmi et al., (2013)*** investigated the long run relationship between ADRs and the underlying shares of Indian companies for the period 2007-2009 and found that ADR prices are influenced by the domestic stock price as well as domestic index returns. The short term dynamics of the ADR portfolio are influenced by the deviation from the long-run equilibrium and the lagged changes of all. ***Patel (2014)*** investigated the dynamic linkages between American Depository Receipts and their respective underlying stock returns of Indian Stock Market. The empirical results showed that both the underlying stocks and ADRs are level stationary and a long run relationship exists between them. Granger causality test uncovered that ADRs lead underlying stocks. Major conclusion of the study was that the price discovery takes place in ADR market and the arrival of new information disseminates faster in ADR market.

Methodology

Table I : Details of IDR Employed in the Study

Company	Symbol	Exchange	Year of Issue	IDR: Domestic Share	Industry
Standard Chartered PLC	STAN	NSE	June 2011	10:1	Banking

Data and Period of Study

Table I shows the details of the IDR issue of Standard Chartered PLC in India. The daily closing price of Standard Chartered PLC in India and U.K was extracted from Capital Line database. The period of study is from 30-6-2011 to 30-6-2014. A total of 749 observations were used for the purpose of study. As, the daily closing price of the bank in U.K is quoted in pound sterling, an average exchange rate of £= 90Rs is presumed for converting pounds into rupees. The natural logarithms of the daily closing prices in NSE and LSE have been taken before commencing the analysis. In the ensuing pages, STAN symbol will be used to refer to Standard Chartered PLC. STAN (NSE) refers to the closing price of Standard Chartered Bank in National Stock Exchange, India and STAN (LSE) refers to the closing price of the bank in London Stock Exchange, U.K.

Normality Test

The Jarque-Bera (JB) test (2003) is used to test whether stock returns and exchange rates individually follow the normal probability distribution. The JB test of normality is an asymptotic, or large-sample, test. This test computes the skewness and kurtosis measures and uses the following test statistic:

$$JB = n [S2 /6 + (K-3)2 /24]$$

Where n = sample size, S = skewness coefficient, and K = kurtosis coefficient.

For a normally distributed variable, S = 0 and K = 3. Therefore, the JB test of normality is a test of the joint hypothesis that S and K are 0 and 3 respectively. To analyse the pattern of distribution of data, skewness and kurtosis have been calculated. Zero skewness implies symmetry in the distribution whereas kurtosis indicates the extent to which probability is concentrated in the centre and especially at the tail of the distribution. Kurtosis measures the peakedness of a distribution relative to the normal distribution. A distribution with equal kurtosis as normal distribution is called 'mesokurtic;' a distribution with small tails is called 'platykurtic' and a distribution with a large tail is called 'leptokurtic.'

Unit Root Test (Stationarity Test)

Empirical work based on time series data assumes that the underlying time series is stationary. Broadly speaking a data series is said to be stationary if its mean and variance are constant (non-changing) over time and the value of covariance between two time periods depends only on the distance or lag between the two time periods and not on the actual time at which the covariance is computed (Gujarati, 2003). A unit root test has been applied to check whether a series is stationary or not. Stationarity condition has been tested using Augmented Dickey Fuller (ADF) test.

Augmented Dickey Fuller (ADF) Test

Augmented Dickey-Fuller (ADF) test has been carried out. This is the modified version of Dickey-

Fuller (DF) test. ADF makes a parametric correction in the original DF test for higher-order correlation by assuming that the series follows an AR (p) process. The ADF approach controls for higher-order correlation by adding lagged difference terms of the dependent variable to the right-hand side of the regression. The Augmented Dickey-Fuller test specification used here is as follows:

$$Yt = b0 + \beta\Delta\ Yt\text{-}1 + \mu 1\ \Delta Yt\text{-}1 + \mu 2\ \Delta Yt\text{-}2 + \ldots\ + \mu p\ \Delta Yt\text{-}p + et \text{----------} (1)$$

Yt represents time series to be tested, b0 is the intercept term, â is the coefficient of interest in the unit root test, ì1 is the parameter of the augmented lagged first difference of Yt to represent the pth-order autoregressive process, and et is the white noise error term.

Johansen's Co-integration Test

The Johansen's Co integration test (1983) is used to test the presence of long term equilibrium relationship between the spot and future market of the currencies. The Vector Error Correction Model (VECM) is used to analyse the whether error correction mechanism takes place if some disturbance comes in the equilibrium relationship. If there is no co-integration, the variables have to be differenced d times and a VAR model is constructed where in each variable has an equation has explaining its evolution based on its own lags and lags of other variable model. All the above analyses are carried out using E-views package.

Variance Decomposition

In the applications of multivariate time series analysis, a variance decomposition or forecast error variance decomposition (FEVD) is used to aid in the interpretation of a vector autoregression (VAR) model once it has been fitted. The variance decomposition indicates the amount of information each variable contributes to the other variables in the autoregression. It determines how much of the forecast error variance of each of the variables can be explained by exogenous shocks to the other variables. In other words, variance decomposition is applied to explain the percentage of forecasting error that can be explained with the help of variances in its previous behavior as well as the behavior of other series. In the general linear model, the relationship between the two variables is capture by the linear equation:

$$Y = a + bX + c \text{ ---------- } (2)$$

Y = dependent variable or response variable, and X = independent variable or explanatory factor.

For every change of X, there is a corresponding change in Y. The focus of variance decomposition is on the response variable: Y. Specifically, the variance of Y, which is given by:

$$Var(Y) = E(Var[Y|X]) + Var(E[Y|X]) \text{ ---------- } (3)$$

In the relationship between X and Y, the variance of Y (dependent variable) is comprised of

(i) the expected variance of Y with respect to X, plus

(ii) the variance of the "expected variance of Y" with respect to X.

The variance of Y is its expected value plus the "variance of this expected value." This can be written as:

E(Var[Y|X]) = explained variation directly due to changes in X

Var(E[Y|X]) = unexplained variation comes from somewhere other than X.

Impulse Response Function

Impulse response function (IRF) of a dynamic system is its output when presented with a brief input signal, called an impulse. More generally, an impulse response refers to the reaction of any dynamic system in response to some external change. In other words, the impulse response explains the responsiveness of the endogenous variable in the system to shocks to each of the other endogenous variables.

Hypotheses

The following are the hypotheses developed for the present study-

H_1- The series namely, STAN (NSE) and STAN (LSE) is not normally distributed.

H_2- Unit root exists in both the series

H_3- There is long term relationship between STAN (NSE) and STAN (LSE).

Analysis and Interpretation

Table II : Descriptive Statistics

Particulars	STAN(NSE)	STAN(LSE)
Mean	4.645	9.484
Median	4.707	9.482
Maximum	4.883	9.713
Minimum	4.238	9.261
Standard Deviation	0.1667	0.0899
Skewness	-0.504	0.046
Kurtosis	1.938	2.453
Jarque Bera	66.903	9.57
Probability	0.00	0.00

Table II shows the descriptive statistics of daily closing values of STAN (NSE) and STAN (LSE) for the period selected for the study. It can be seen that the closing price STAN (NSE) varies from 4.238 to 4.883 thereby stating that there is no much fluctuation in the daily closing values. Similarly, the closing price of STAN (LSE) varies between 9.261 to 9.713. The mean value of STAN (NSE) is 4.645 and in LSE 9.484 respectively. Skewness is negative STAN (NSE) indicating a relatively long left tail when compared to the right one. Skewness is positive for STAN (LSE) indicating a relatively long right tail when compared with to the left one. Kurtosis with 1.938 for STAN (NSE) and 2.453 in STAN (LSE) indicates short tails and the distribution is platykurtic'. The findings are similar to the existing literature and with a high Jarque-Bera statistic, it can be confirmed that the returns series is not normally distributed. Hence, H_1 is accepted

Table III : ADF Unit Root Test for STAN (NSE) and STAN (LSE)

Particulars	't'Value (NSE)	Probability(NSE)	't'Value (LSE)	Probability(LSE)
At level	-1.5945	0.4849	-2.867	0.0697
At first difference	-27.908	0.000*	-22.335	0.0000*

***significant @ 1%.**

It is a fact that many financial time series data are random walk or non-stationary time series and contain unit root. Test of unit root in the values of STAN(NSE) and STAN(LSE) is essential as the presence of unit root may give invalid inferences in the analysis. ADF (Augmented Dickey-Fuller Test) is the popular test for unit root testing of time series.

Table III shows the results of ADF test and the result indicates that the closing price of STAN (NSE) and STAN (LSE) are non-stationary at level form and hence hypothesis (H_2) is accepted. The data becomes stationary at their first difference and is statistically significant.

Table IV: Johansen's Co-Integration Test of STAN (NSE) and STAN (LSE)

Co integration Between	Lag length selected	Co integration test using	No. of Co integrating Equations (CEs)	Eigen Value	Statistic	Critical value at 5%	Probability**
Daily Closing of STAN (NSE) and Daily Closing of STAN (LSE)	1 to 4 (in first difference of 2 series)	Trace test	H_0: r=0 (None)	0.007923	8.0555	15.494	0.4595
			H_1: r ≤ 1 (At most 1)	0.00288	2.1455	3.841	0.1430
		Max-Eigen Value test	H_0: r=0 (None)	0.00297	5.9099	14.26	0.6248
			H_1: r ≤ 1 (At most 1)	0.00288	2.1455	3.841	0.1430

Max-eigenvalue test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

The co- integration test was introduced by Granger (1981, 1983) and Engle and Granger (1987) to explain stationary equilibrium relationship among the non-stationary variables. The co-integration test is useful in analyzing the presence of a stationary linear combination among the non-stationary variables of the same order. If such a combination is found, an equilibrium relationship is said to exist between the variables. The Johansen co-integration test is applied in the research study to study long term relationship between the prices STAN (NSE) and STAN (LSE) .The result of the Johansen's Co-Integration Test are shown in table IV. The trace statistics for the calculated Eigen value is less than the table value for the closing prices of STAN (NSE) and hence the null hypothesis of no co-

integration is accepted. The results are similar for STAN (LSE) and hence the result indicates the absence of long term relationship between the prices of STAN (NSE) and STAN (LSE). There exists no long term equilibrium relationship between the indices and hence hypothesis (H_3) is rejected.

Table V: Vector Autoregressive Results
Standard errors in ( ) & t-statistics in [ ]

Variables	STAN(NSE)	STAN(LSE)
NSE(-1)	0.973954(0.03654)[26.5165]*	0.044500(0.03565)[1.28414]
NSE(-2)	0.019690(0.03654)[0.53593]	-0.041660(0.03566)[-1.16818]
LSE(-1)	-0.018948(0.03776)[-0.50174]	0.944590(0.03666)[25.7682]*
LSE(-2)	0.015774(0.03776)[0.41774]	0.033401(0.03665)[0.91125]
C	0.059889(0.07527)[0.79657]	0.195183(0.07306)[2.67149]

***Significant @ 1%**

As there is no long term relationship between the markets, a Vector Autoregressive Approach is constructed to study the relationship between the closing prices of STAN (NSE) and STAN (LSE). The following table (Table V) presents the result- The VAR results indicate that STAN (NSE) depends upon the lagged term of its own value. For instance, 97.3 % variation in the current price of STAN (NSE) is explained by the previous day closing price. The variance explained by its own term is statistically significant @1%. Similarly, the closing price of STAN (LSE) depends upon the lagged term (one) of its own value. 94.4 % variation in the current price of STAN (LSE) is explained by the previous day closing price. The variance explained by its own values is statistically significant @1%.

Table VI : Variance Decomposition Index of STAN (NSE) and STAN (LSE)

	Standard Chartered PLC closing prices			
Period	Variance Decomposition of STAN (NSE)		Variance Decomposition of STAN(LSE)	
	STAN (NSE)	STAN(LSE)	STAN(LSE)	STAN (NSE)
1	100	0.00	99.952	0.0475
2	99.982	0.171	99.742	0.257
3	99.974	0.0255	99.668	0.331
4	99.967	0.0324	99.621	0.378
5	99.960	0.039	99.585	0.414
6	99.954	0.0456	99.555	0.444
7	99.947	0.0525	99.528	0.471
8	99.940	0.059	99.502	0.497
9	99.933	0.066	99.477	0.522
10	99.92	0.0737	99.543	0.546

Variance decomposition explains the percentage of forecasting error that can be explained with the help of variances in its previous behaviour as well as the behaviour of other series. The results of variance decomposition of STAN's closing prices in NSE and LSE for ten lags are shown in Table VI. The results indicate that the forecasting error in STAN (NSE) is mainly explained by the lagged values of STAN (NSE) and the forecasting error of STAN (LSE) is explained by the lagged values of STAN (LSE). Therefore, the lagged values of STAN (NSE) and STAN (LSE) are endogenous variables. The rate of variance decomposition is higher in the case of STAN (LSE) when compared to the STAN (NSE). Therefore, it can be concluded that the STAN (NSE) series is exogenous in nature

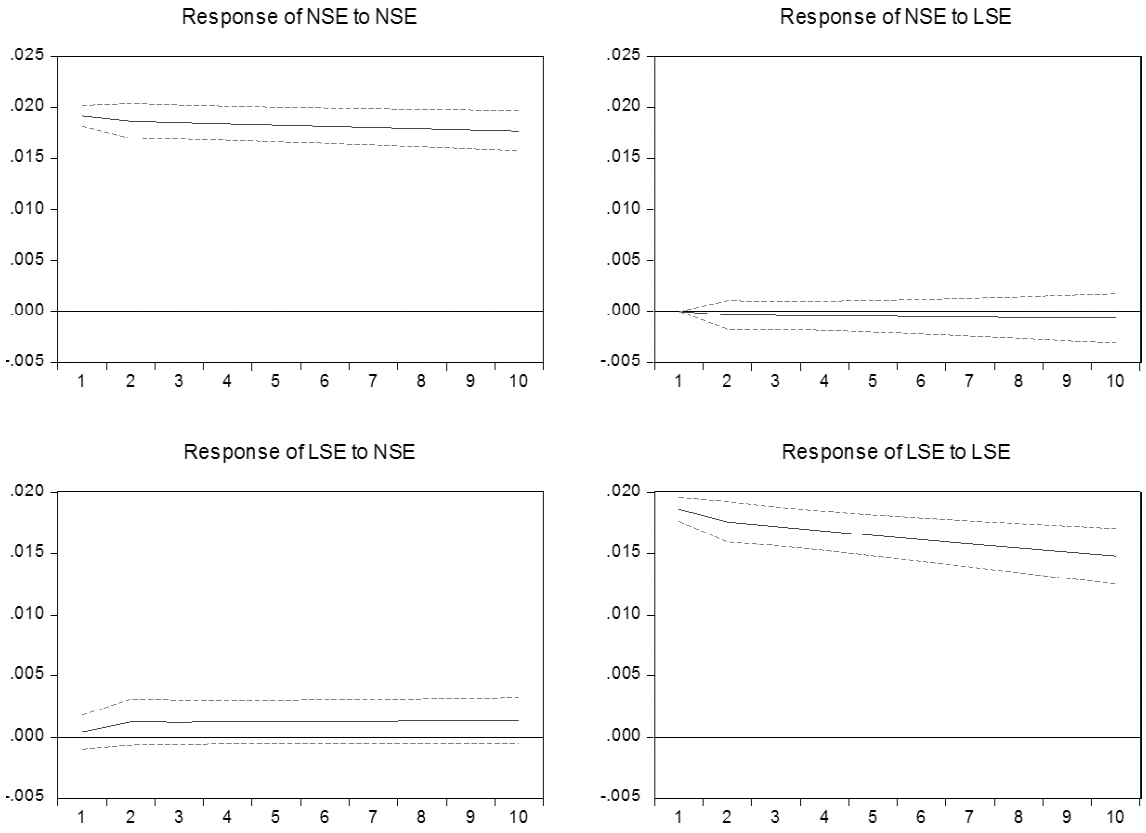

Figure I : Impulse Response Function of STAN (NSE) and STAN (LSE)

The impulse response explains the responsiveness of the endogenous variable in the system to shocks to each of the other endogenous variables. So, for each endogenous variable in the system, a unit shock is applied to the error, and the effects over time are noted. Figure I show the pair wise impulse response relations between STAN (NSE) and STAN (LSE). The results indicate there is significant and higher response to the shock of STAN (NSE) to STAN (NSE). Similarly, there is significant and higher response of STAN (LSE) to the shock of STAN (NSE) when compared to its own values.

Conclusion and Directions for Future Research

The study has found that the series namely STAN (NSE) and STAN (LSE) are not normally distributed. The series is non-stationary at level form and becomes stationary at first difference. Based on the Co-integration analysis, it is found that there exists no long term relationship between IDR {STAN (NSE)} and its underlying shares {STAN(LSE)} during the period of study. The results of the present study are unlike the previous studies relating to ADR/GDR issues. Studies have yielded mixed results viz., presence of long term relationship with information dissemination happening much faster in ADR market than its underlying stocks ***(Patel,2014)*** and returns of home market have prominent impact on GDR returns ***(Chopade et al., 2012)***. VAR results also indicate that STAN's price in NSE depends upon the lagged term of its own value. For instance, 97.3 % variation in the current price of STAN (NSE) is explained by the previous day closing price. The variance explained by its own term is statistically significant @1%. Similarly, the closing price of STAN (LSE) depends upon the lagged term (one) of its own value. 94.4 % variation in the current price of STAN (LSE) is explained by the previous day closing price. The variance explained by its own values is statistically significant @1%. Variance decomposition results revealed that STAN (NSE) is mainly explained by the lagged values of STAN (NSE) and the forecasting error of STAN (LSE) is explained by the lagged values of STAN (LSE). The rate of variance decomposition is higher in the case of STAN (LSE) when compared to the STAN (NSE). Additionally, impulse response function also found that there is significant and higher response to the shock of STAN (NSE) to STAN (NSE). Similarly, there is significant and higher response of STAN (LSE) to the shock of STAN (NSE) when compared to its own values. Though the response of STAN (LSE) is higher to the shock of STAN (NSE), still the markets are integrated in the long run. Therefore, it is of little interest for the investors to identify the market where new information dissemination happens much faster vis -a –vis the other market and accordingly plan their investment strategies. Therefore, the major implication of the study is that price discovery happens in the respective markets and investors in IDR issue need not study the effect of the underlying shares in LSE. Appropriate strategies can be explored by studying the price of Standard Chartered PLC in NSE and LSE respectively.

It is again reiterated that there is only one IDR issue which has happened in India and the results are based on the solitary issue. The time is not far off when more MNCs' opt for the IDR route for listing the stocks in Indian bourses and the introduction of two way fungibility by the regulatory authority will only fuel more issues. If such developments take place, future research can focus on whether long term relationship exists or not. Results may vary if more issues and longer duration are explored and analysed.

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