An Empirical Investigation of Mispricing in Stock Futures at the National Stock Exchange

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Abstract

This paper is an attempt to study the mispricing in stock futures of India. The cost of carry model was operationalized in the present study. Any deviation from the theoretical price so arrived at connotes mispricing. In-depth analysis was conducted with respect to the frequency and magnitude of mispricing. Furthermore, the results were charted across variables like maturity and with respect to basis. Non parametric tests were applied to establish statistical significance of the findings. The findings indicate that there existed significant mispricing in the stock futures studied. Most of the stock futures contracts were underpriced. These mispricing signals seemed to be largely unutilized by the arbitrageurs due to short selling restrictions at Indian bourses. A clear relationship was observed between basis and mispricing as well as maturity and mispricing. The implications of the findings can be manifold for all the participants in the derivatives market. The paper concluded with limitations of the study and directions for future research.

Keywords: **cost of carry, futures mispricing , non-parametric tests , Indian derivatives**

JEL Classification: C12, E44, G13

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The futures segment constitutes an important part of the derivatives market. The prices in futures markets are derived from the spot market; thus, any change in demand or supply scenario in the spot market affects the prices in the futures market. In turn, the futures market is seen to tentatively forecast the spot market. Thus, the variations in the futures market are more as compared to the variations in the spot market (MacKinlay & Ramaswamy, 1988) .

This phenomenon where the futures market derives its prices from the spot market may lead to inefficiency of the market (Misra, Kannan, & Misra, 2006). An efficient market is the one in which the spot-futures parity exists. Violation of such parity would be indicated by a difference in observed and fair prices, which in turn would give rise to risk-free profit making opportunities. These opportunities can be utilized by the three major participants of the market- arbitrageurs, hedgers, and speculators. They look for such instances and avail them, resulting in profits and minimization of the difference in observed and fair prices, thus correcting deviations in the market. However, many a time, market frictions, such as transaction costs inhibit the arbitrageurs from earning profits. Therefore, it becomes imperative for them to deal in volumes to make a profit.

At Indian bourses, short-selling is restricted to intra-day in the spot market. Therefore, any such strategy that necessitates short-selling of the underlying beyond the intra-day cannot be applied. This limits arbitrage between

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markets and leads to deviation between observed prices and theoretical prices, leading to more instances of underpricing as compared to overpricing.

Many studies have been conducted on the mispricing of futures using the cash-and-carry model (Brailsford & Hodgson, 1997 ; Chung, 1991; Tharavanij, 2012; Wang & Hsu, 2005; Wang, 2011). These studies reported conflicting results in terms of the efficacy of the model in predicting correct prices. Hence, it is important to study the efficiency in the futures market since correct pricing entails better price discovery. Also, inefficiency leads to poor hedging. This study is an attempt to analyze the mispricing, if any, in the Indian futures market and attempts to explore various facets and reasons for the same.

Literature Review

Tests of market efficiency have been the subject matter of many studies in the past. The area is equally appealing to academicians and practitioners. A review is presented below.

MacKinlay and Ramaswamy (1988) used the S&P 500 stock index futures' intraday transaction data. They empirically found that the variability in the prices of index futures was more as compared to the variability in the spot prices of the index itself. The autocorrelation was induced for controlling the non-synchronous prices in the index quotes. Chung (1991) used the cash and carry model to test the efficiency of Major Market Index (MMI) futures market. The study concluded that the earlier studies had exaggerated the degree and frequency of profitable arbitrages in the index futures market. This might be true for young markets, but as the market matures, the profit margins are reduced by elements like transaction costs, and so forth.

Buhler and Kempf (1994), using German index, DAX, and DAX futures data, suggested that given the arbitrage, opportunities were comparatively more on contracts far from expiry. However, the arbitrageurs did active trading on the contracts near to expiry because the risk was less at that time. However, this was practiced only when the intensity of mispricing was so high that it covered the risk premium as well as the transaction costs and still left appropriate amount of profits to be realized. Neal (1996), with the use of S&P 500 transactions data, estimated that the arbitrage profit was very small and just covered the transaction costs involved. This happened as the arbitrageurs liquidated their positions early and as the time to expiry came near, very few profit makers were left as the deviation from the fair price narrowed down.

Brailsford and Hodgson (1997) argued that some static information like excess volatility near the expiry date resulted from high arbitrage opportunities. A static cash and carry model explained that every reason for the mispricing in the futures market is not true, but there are several other reasons for volatility and mispricing in these dynamic and complex markets. Fung and Draper (1999) concluded that mispricing instances reduced when the short selling constraints were relaxed. With strict short selling restrictions, the magnitude of mispricing increased. Garett and Taylor (2001), in their study of FTSE 100 index futures market, concluded that neither arbitrage activity nor microstructure effects helped in the prediction of mispricing that happened on a daily basis.

Vipul (2005) studied futures and equity transactions on NIFTY for a time span of 3 years and concluded that there was no fixed pattern or magnitude of mispricing, and it kept on changing from time to time. Due to the unpredictable and dynamic nature of the market, there are an ample number of arbitrage opportunities for the arbitrageurs. It was also observed that the volatility in the market increased in the last week as investors started winding up their positions. Furthermore, as a result of short selling restrictions in Indian markets, instances of underpricing exceeded that of overpricing.

Wang and Hsu (2005) investigated the relevance of cost of carry model in different types of markets. For a sample study, S&P 500 index futures market and TAIFEX futures market were considered, which were classified as developed and emerging markets, respectively. It was found that cost of carry model was relevant for developed markets. Misra et al. (2006) reported that in case of NSE futures market, the spot-futures parity relationship stood null. There were instances of mispricing which were well encashed by the arbitrageurs in the form of arbitrage profit. On different parameters undertaken for the study, it was found that the arbitrage profit was high for

undervalued futures, far month futures, highly liquid futures, and when change in open interest was high.

Vipul (2008) found that the financial activities in the stock futures market cannot be predicted by the direction of mispricing in futures. Razak and Bacha (2009) studied the efficiency of Malaysia's IRF, KLIBOR. They opined that overpricing instances were maximum as compared to that of underpricing, but the magnitude of underpricing and degree of its volatility was high as compared to overpricing.

Fassas (2010) confirmed the existence of deviations from fair price in FTSE/ATHEX-20 index futures contracts of Greece, thereby providing an opportunity for arbitrage profits. Cummings and Frino (2011) favoured a tax-adjusted model to test the efficiency of the market as it provided unbiased estimates of futures prices. Also, short selling restrictions in the market led to high transaction costs. Wang (2011) conducted a study with SGX FTSE Xinhua China A50 and HKEx H-share index futures markets to test the cost of carry model and found that it was not fit for the markets with high volatility. Tharavanij (2012) studied the 'SET50 futures' - the Thai stock index futures and concluded that the cost of carry model explained the SET50 futures prices extremely well, and its assumptions and limitations cannot be ignored.

It can be deduced from the above discussion that the efficiency of futures market using the cost of carry model has been studied across the globe in the past. However, at Indian bourses, there seems to be a dearth of literature, perhaps on account of the newness of the market. Also, most of the studies pertain to index futures. The present study attempts to fill this gap by studying the pricing efficiency in the futures market for the most liquid stock futures over a two-year period - from January 2012- December 2013.

Theoretical Framework

In the present study, the Cash and Carry Model has been used for the pricing of stock futures. According to the model, the futures price is equal to the compounded spot price of the underlying stock, which involves the cost of carrying the underlying till the expiration period of the contract. It can be denoted by:

$$F_0 = S_0 e^{rT} \quad (1)$$

where,

F_0 = Futures price at present,

S_0 = Spot price of the stock at present,

r = Risk free interest rate,

T = Time to expiry in years,

e^{rt} = denotes the cost of carrying the underlying till expiry date.

Declaration of dividends affects the prices of the underlying stocks. The adjustment is made as following :

$$F_0 = (S_0 - D')\, e^{rT} \quad (2)$$

where,

D' = discrete dividend

$$D' = De^{rT} \quad (3)$$

where,

D = Dividend yield of the stock (in ₹), other notations being the same as mentioned above.

Thus, for determining the theoretical stock futures price, the equation 2 is used in the study.

The difference between the observed price (also called as fair price) and the theoretical price is deemed as mispricing. Mispricing leads to arbitrage opportunities. Many a time, the magnitude of mispricing is not very high,

especially after considering transaction costs and bid-ask spreads. Thus, the arbitrage opportunities could largely be unexploitable. When the theoretical price is less than the actual futures price, then the market is said to be overpriced or is indicative of positive mispricing. On the other hand, if the model price is more than the actual price, then the market is deemed to be underpriced or is a signal of negative mispricing.

If the stock futures are underpriced, the arbitrageur will take a short position on the futures contract and will go long in the spot stock, that is, will buy now at a low price and will sell in the future at a high price. Similarly, in case of overpricing of a stock futures contract, an active arbitrageur will take a long position on the futures contract and will go short on the underlying stock in the spot market, that is, will agree to buy at a low price on a future date and sell now at a high price, thereby making a risk-free profit. However, due to short-sales constraints in financial markets like India, this strategy cannot be applied. Thus, an overall overpricing may indicate arbitrage opportunities arising out of short sales constraints.

Research Design

The study focuses on the mispricing of stock futures. The most liquid stock futures were identified using the reports from the official website of the National Stock Exchange (NSE), www.nseindia.com. The daily transaction data of the stock futures dated January 1, 2012 to December 24, 2013 were used. Data were extracted on the basis of the expiry of the contract. Only near month contracts were considered for the study since the volumes are concentrated around shorter maturity at NSE.

The study is ex-ante in nature. Analysis of mispricing in each stock was conducted individually and comparatively. The total number of observations was 2445 to begin with. From this, the observations pertaining to expiry days were removed as the volatility increases on the expiry date. The final observations came out to be 2380. The data pertaining to the study is of three categories: First, the spot market data which includes the value of the underlying and dividend yield (adjustments made from effective date to expiry date); second, the futures market data, including the futures price, number of contracts traded, open interest, expiry date; and finally, the third being the one-month MIBOR data which has been used as the risk-free rate of interest (compounded). As the bank and stock market holidays differ, so for dates when MIBOR was unavailable, the previous day's rate was considered. These data were obtained from www.nseindia.com.

A mispricing signal is recorded when the observed futures price deviates from the cost of carry model. The "underpricing" connotes that the observed market price is less than the theoretical price, whereas "overpricing" is recorded in the reverse scenario. For the analysis of the data along with the descriptive study, non-parametric tests were employed on account of non-normality of data.

Data Analysis and Results

In consistence with the model stated in the theoretical framework, an analysis was conducted on various aspects-such as on the frequency and magnitude of mispricing, the basis, and with respect to the days to expiry. The findings are discussed in the following sections :

(1) Mispricing with Respect to Magnitude and Frequency : It can be observed from the Table 1 that with respect to the direction of mispricing, four out of five stocks have an overall negative mispricing. The only stock futures, which is overpriced is, Reliance. Each stock has a high degree of negative mispricing (underpricing), but the number of instances is less. For positive mispricing (overpricing), the number of instances is more than negative mispricing but the magnitude is low, thereby giving an overall negative mispricing. Exception to the above observation is SBI, which has a high frequency of negative mispricing with a high magnitude of negative mispricing, thereby resulting in the highest negative mispricing of ₹-3.66 among all other stocks.

The average magnitude of positive mispricing varies from 31.8% to 64% of the negative mispricing of respective stocks yearly (exception being Reliance and Tata Motors in 2013), hereby explaining the reason for unexploited arbitrage opportunities of positive mispricing. The arbitrage profits obtained from such low magnitude positive mispricing opportunities are not at all profitable in the final transactions as they are unable to cover the transaction costs which result in very little profit or nil profit or may be loss (but minimized).

The magnitude of negative mispricing is at least 1.5 times more than that of positive mispricing for all stocks in both the years (exception being Reliance and Tata Motors in 2013) and in case of ICICI in 2013, it is more than three times the positive mispricing. This high magnitude can be explained by constraints on efficient arbitrage in India, including the high costs of brokerage, government, exchange, and regulatory fees (Slivka, Wu, & Shah, 2012). These result in high transaction costs, which make the arbitrage opportunities unattractive, as they are unable to yield realizable profits after considering these costs. Also, constraints on short selling forbid investors to take advantage of negative mispricing. Other qualitative and quantitative reasons may be involved in such mispricing, like magnitude of dividends announced, variations in demand and supply of securities due to competitive products or unexpected changes in the management, government policies or laws, and so forth.

These observations are in consensus with the past studies like Razak and Bacha (2009), who stated that overpricing instances are more as compared to that of underpricing. Also, the magnitude of underpricing and degree of its volatility is high as compared to overpricing, which is very much similar to the present study. We also observed a high magnitude of negative mispricing which could be due to the restrictions on short selling results, as stated by Fung and Draper (1999). Chung, (1991), Neal (1996), and Garrett and Taylor (2001) stated that because of high costs involved, the profits are negligible, which result in unexplored arbitrage opportunities, and in turn, the inefficiencies in the market exist. These opportunities can only be exploited by playing in volumes, as they will make the costs negligible and profits realizable.

From the above observations, it is evident that the stocks involved in the study have deviations in their prices away from the fair prices. It is necessary to confirm whether the observations are significant or are by chance events. For testing the significance, statistical tools need to be deployed. Firstly, the descriptive statistics is presented as follows:

From the Table 2, it can be observed that the mispricing series depict a negative skew. There is also the case of excess kurtosis for all the stocks with the exception of Infosys. Normality tests need to be applied to validate the non-normality further. For this, one-sample Kolmogorov-Smirnov test, a non-parametric one sample normality test was applied (Table 3). All the stock futures show statistical significance, that is, the data is not normal and has *p* - value less than 0.5. Thus, the hypothesis that the sample is drawn from a normal population is rejected.

Since the data are not normal, non-parametric tests are conducted to validate the findings. Wilcoxon signed - rank test was applied to discern whether there is a significant difference between the theoretical price (as calculated by the cash-and-carry model) and the observed price. The Tables 4a and 4b indicate that the null hypothesis is rejected for SBI and Reliance. For the other three stocks, the results indicate that there is no significant mispricing at the 5% alpha level, and hence, the null hypothesis cannot be rejected.

(2) Mispricing with Respect to Days to Expiry (DTE) : The Table 5 classifies the instances of mispricing of five selected stocks with respect to the number of days to expiry. It is observed that the instances of mispricing decrease with the number of days to expiry. As and when the expiry is reached, the investors start closing their positions, and this leads to the reduction in instances of mispricing. When days to expiry are less, then profit is riskless and hence, most of the investors square off their positions near to the expiry date and the inefficiencies in the market also reduce when the expiry is near.

When the expiry is far off, then the arbitrage profit is also large. Hence, some investors trade-off then only, making huge profits, leading to the reduction in instances and magnitude of mispricing. The investors who are not sure and want to make riskless profit, they wait until the last week and then start winding up their positions. At this instance, liquidity and volatility are very high in the market (Vipul, 2005). However, as the profits are also very

Table 1. Mispricing of Stock Futures : Directional and Overall

		Nos.	Mean Mispricing	Std. Deviation	Minimum	Maximum
ICICI						
2012	Overpricing	139	1.97	1.35	0.01	6.47
	Underpricing	98	-6.19	6.51	-20.78	-0.07
		237	**-1.41**	**5.89**	**-20.78**	**6.47**
2013	Overpricing	162	3.92	2.83	0.11	13.88
	Underpricing	74	-7.75	8.64	-24.24	-0.04
		236	**0.26**	**7.62**	**-24.24**	**13.88**
	Total	**473**	**-0.57**	**6.85**	**-24.24**	**13.88**
INFOSYS						
2012	Overpricing	117	6.67	6.45	0.19	34.95
	Underpricing	120	-10.50	11.58	-42.29	-0.28
		237	**-2.02**	**12.73**	**-42.29**	**34.95**
2013	Overpricing	124	6.63	6.38	0.00	29.03
	Underpricing	112	-10.36	10.42	-42.25	-0.14
		236	**-1.43**	**12.04**	**-42.25**	**29.03**
	Total	**473**	**-1.73**	**12.38**	**-42.29**	**34.95**
RELIANCE						
2012	Overpricing	143	1.54	0.96	0.00	4.64
	Underpricing	94	-2.86	3.14	-9.17	-0.01
		237	**-0.21**	**3.01**	**-9.17**	**4.64**
2013	Overpricing	149	2.48	2.64	0.04	10.79
	Underpricing	87	-2.28	2.95	-11.42	-0.01
		236	**0.73**	**3.59**	**-11.42**	**10.79**
	Total	**473**	**0.26**	**3.34**	**-11.42**	**10.79**
SBI						
2012	Overpricing	96	5.27	7.12	0.08	35.71
	Underpricing	141	-10.98	10.34	-40.93	-0.12
		237	**-4.39**	**12.16**	**-40.93**	**35.71**
2013	Overpricing	117	4.06	5.44	0.01	43.84
	Underpricing	119	-9.78	12.88	-49.62	-0.01
		236	**-2.92**	**12.08**	**-49.62**	**43.84**
	Total	**473**	**-3.66**	**12.13**	**-49.62**	**43.84**
TATA MOTORS						
2012	Overpricing	108	0.61	0.92	0.01	4.53
	Underpricing	129	-1.11	1.16	-5.00	-0.01
		237	**-0.32**	**1.36**	**-5.00**	**4.53**
2013	Overpricing	136	0.85	0.75	0.01	3.87
	Underpricing	100	-0.61	0.51	-2.59	0.00
		236	**0.23**	**0.98**	**-2.59**	**3.87**
	Total	**473**	**-0.05**	**1.22**	**-5.00**	**4.53**
	Grand Total	**2365**	**-1.15**	**8.60**	**-49.62**	**43.84**

Table 2. Descriptive Statistics for Differences Between Observed Price and Theoretical Price

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness	Kurtosis
ICICI	473	-24.24	13.88	-.574	6.851	-1.669	2.590
INFOSYS	473	-42.29	34.95	-1.729	12.380	-.870	1.721
RELIANCE	473	-11.42	10.79	.258	3.342	-.659	3.330
SBI	473	-49.62	43.84	-3.657	12.128	-.944	3.296
TATA MOTORS	473	-5.00	4.53	-.046	1.217	-.225	3.574

Table 3. One-Sample Kolmogorov - Smirnov Test

		ICICI	INFOSYS	RELIANCE	SBI	TATA MOTORS
N		473	473	473	473	473
Normal Parameters [a,b]	Mean	-.574	-1.729	.258	-3.657	-.046
	Std. Dev.	6.851	12.380	3.342	12.128	1.217
Most Extreme Differences	Absolute	.197	.141	.127	.173	.095
	Positive	.096	.075	.120	.156	.095
	Negative	-.197	-.141	-.127	-.173	-.088
Kolmogorov-Smirnov *Z*		4.828	4.281	2.756	3.755	2.070
Asymp. Sig. (2-tailed)		.000	.000	.000	.000	.000

a. Test distribution is Normal.

b. Calculated from data.

Table 4(a). Wilcoxon Signed Ranks Test for Differences Between the Observed Price and the Theoretical Price

		N	Mean Rank	Sum of Ranks
ICICI	Negative Ranks	203	270.21	54852.00
	Positive Ranks	270	212.03	57249.00
	Total	**473**		
INFOSYS	Negative Ranks	232	253.68	58854.00
	Positive Ranks	241	220.94	53247.00
	Total	**473**		
RELIANCE	Negative Ranks	181	229.73	41581.50
	Positive Ranks	291	240.71	70046.50
	Total	**473**		
SBI	Negative Ranks	260	266.60	69317.00
	Positive Ranks	213	200.86	42784.00
	Total	**473**		
TATA MOTORS	Negative Ranks	229	247.17	56601.00
	Positive Ranks	244	227.46	55500.00
	Total	473		

Negative Ranks: When Closing Price < Futures Price

Positive Ranks: When Closing Price > Futures Price

Table 4(b). Wilcoxon Signed Ranks Test: Test Statistics

	ICICI	INFOSYS	RELIANCE	SBI	TATA MOTORS
Z	-.403[a]	-.943[b]	-4.800[a]	-4.460[b]	-.185[b]
Asymp. Sig. (2-tailed)	.687	.346	.000	.000	.853
a. Based on negative ranks					
b. Based on positive ranks					

Table 5. Mispricing with Respect to Days to Expiry

	DTE	Nos.	Mean Mispricing	Std. Deviation	Minimum	Maximum
ICICI	1 to 7	112	0.21	6.44	-20.84	13.88
	8 to 14	116	0.11	6.43	-20.12	8.47
	15 to 21	115	-0.90	6.82	-24.24	9.60
	More than 21	130	-1.57	7.48	-23.19	9.29
	Total	**473**	**-0.57**	**6.85**	**-24.24**	**13.88**
INFOSYS	1 to 7	112	3.02	10.22	-25.66	34.95
	8 to 14	116	-0.36	12.20	-38.03	29.03
	15 to 21	115	-2.88	12.11	-42.29	19.60
	More than 21	130	-6.02	12.94	-42.25	15.79
	Total	**473**	**-1.73**	**12.38**	**-42.29**	**34.95**
RELIANCE	1 to 7	112	0.59	2.99	-9.17	10.67
	8 to 14	116	0.54	3.19	-9.10	10.79
	15 to 21	115	0.66	3.02	-9.52	9.89
	More than 21	130	-0.63	3.86	-11.42	9.79
	Total	**473**	**0.26**	**3.34**	**-11.42**	**10.79**
SBI	1 to 7	112	2.04	11.61	-41.65	43.84
	8 to 14	116	-4.11	12.51	-49.62	11.06
	15 to 21	115	-5.52	11.55	-38.53	9.52
	More than 21	130	-6.51	11.19	-44.73	12.09
	Total	**473**	**-3.66**	**12.13**	**-49.62**	**43.84**
TATA MOTORS	1 to 7	112	0.28	1.11	-2.60	4.50
	8 to 14	116	0.04	1.12	-3.87	4.53
	15 to 21	115	-0.15	1.23	-4.23	2.86
	More than 21	130	-0.32	1.31	-5.00	3.87
	Total	**473**	**-0.05**	**1.22**	**-5.00**	**4.53**

less, hence, it is necessary to calculate whether the opportunity is even worth availing.

These observations are in consensus with the findings of Buhler and Kempf (1994), Neal (1996), and Misra et al. (2006), who stated that profit is more in the far month than in the near month, and profit decreases in the near month, and if it does not cover the transaction, then it is better left unexplored. These findings were tested for statistical significance using the Kruskal - Wallis test, the post hoc test, and Dunn's multiple comparisons test. The results are presented in the Tables 6(a), 6(b), and 6(c).

From the Table 6(a) and 6(b), it is evident that the null hypothesis that there exists no significant difference

Table 6(a). Kruskal - Wallis Tests Across Days to Expiry

	Days to Expiry	*N*	Mean Rank
ICICI	1 to 7	112	251.90
	8 to 14	116	258.21
	15 to 21	115	227.37
	More than 21	130	213.76
	Total	**473**	
INFOSYS	1 to 7	112	283.88
	8 to 14	116	255.45
	15 to 21	115	228.82
	More than 21	130	187.39
	Total	**473**	
RELIANCE	1 to 7	112	240.51
	8 to 14	116	243.33
	15 to 21	115	251.67
	More than 21	130	215.35
	Total	**473**	
SBI	1 to 7	112	298.35
	8 to 14	116	245.92
	15 to 21	115	220.84
	More than 21	130	190.47
	Total	**473**	
TATA MOTORS	1 to 7	112	258.82
	8 to 14	116	254.70
	15 to 21	115	228.40
	More than 21	130	210.02
	Total	**473**	

Table 6(b). Kruskal - Wallis Test: Test Statistics

	ICICI	INFOSYS	RELIANCE	SBI	TATA MOTORS
Chi-Square	8.453	32.822	4.907	39.728	10.321
df	3	3	3	3	3
Asymp. Sig.	.038	.000	.179	.000	.016

Table 6(c). Pairwise Differences Using Dunn's Multiple Comparisons (*p* - values)

	ICICI	INFOSYS	SBI	Tata Motors
1-7 & 8 -14	0.728	0.116	0.004*	0.820
1-7 & 15-21	0.176	0.002*	< 0.0001*	0.094
1-7 & More than 21	0.030*	<0.0001*	< 0.0001*	0.006*
8-14 & 15-21	0.086	0.139	0.163	0.144
8-14 & More than 21	0.011*	<0.0001*	0.001*	0.010*
15-21 & More than 21	0.436	0.018*	0.083	0.293

* Denotes significance at the 5% level

between mispricing behavior of different groups of DTE is rejected for all stocks except for Reliance at the 5% significance level. Looking at the Table 6(c), it can be deduced that except for SBI and Reliance, there is no significant difference between the pairs 1-7 and 8 -14 ; for the pairs 8-14 and 15-21, there is no significant difference for any of the stock futures. The post-hoc test reveals that for pairs that are close together in expiry, there exist no significant differences.

(3) Mispricing with Respect to its Basis : An attempt has been made to study the mispricing with respect to the basis, that is, the difference between the spot price and the futures price. If the spot price is greater than the futures price, then basis is said to be positive, and if the futures price is greater than the spot price, then a negative basis exists. Basis is a medium to study the relation between the spot and the futures market and helps in forecasting the futures prices tentatively. There are more instances of negative basis as compared to positive in the sample period of the study. From the Table 7, it can be observed that the magnitude for the mispricing of positive basis is much higher than that of the negative basis. This helps us to conclude that there were more number of events indicating a trending future with high magnitude of negative mispricing. High magnitude of negative mispricing can be explained as a reason for restrictions on short selling. To validate the results statistically, the Wilcoxon signed rank test was applied, and the results are presented in the Tables 8(a) and 8(b). The hypothesis that the mispricing is the same across negative and positive basis has been rejected at the 5% alpha level. To the best of our knowledge, similar effort to ascertain mispricing across the basis has not been carried out in stock futures.

Conclusion

This paper is an attempt to study the mispricing of five stock futures listed on NSE, India for a period of 2 years, that is, 2012 and 2013. The study was conducted on the basis of a number of instances and magnitude of positive

Table 7. Mispricing with Respect to Basis

		Nos.	Mean Mispricing	Std. Dev.	Minimum	Maximum
ICICI	Negative	391	1.92	3.03	-6.39	13.88
	Positive	82	-12.45	7.52	-24.24	-0.52
	Total	**473**	**-0.57**	**6.85**	**-24.24**	**13.88**
INFOSYS	Negative	385	2.30	7.44	-13.98	34.95
	Positive	88	-19.36	14.17	-42.29	26.50
	Total	**473**	**-1.73**	**12.38**	**-42.29**	**34.95**
RELIANCE	Negative	420	1.01	2.33	-6.45	10.79
	Positive	53	-5.68	4.12	-11.42	7.42
	Total	**473**	**0.26**	**3.34**	**-11.42**	**10.79**
SBI	Negative	356	0.98	5.41	-14.49	43.84
	Positive	117	-17.77	15.56	-49.62	40.45
	Total	**473**	**-3.66**	**12.13**	**-49.62**	**43.84**
TATA						
MOTORS	Negative	398	0.24	0.93	-2.33	4.53
	Positive	75	-1.55	1.43	-5.00	3.90
	Total	**473**	**-0.05**	**1.22**	**-5.00**	**4.53**
	Grand Total	**2365**	**-1.15**	**8.60**	**-49.62**	**43.84**

Table 8(a). Wilcoxon Signed Rank Test for Differences Across Basis

		N	Mean Rank	Sum of Ranks
ICICI	Negative Ranks	391	227.21	88839.50
	Positive Ranks	82	283.68	23261.50
	Ties	0		
	Total	**473**		
INFOSYS	Negative Ranks	384	235.46	90416.50
	Positive Ranks	88	241.04	21211.50
	Ties	1		
	Total	**473**		
RELIANCE	Negative Ranks	418	238.47	99679.50
	Positive Ranks	53	216.54	11476.50
	Ties	2		
	Total	**473**		
SBI	Negative Ranks	355	232.64	82588.00
	Positive Ranks	117	248.21	29040.00
	Ties	1		
	Total	**473**		
TATA MOTORS	Negative Ranks	391	247.25	96675.50
	Positive Ranks	75	161.81	12135.50
	Ties	7		
	Total	**473**		

Negative Ranks: When Spot Price < Futures Price
Positive Ranks: When Spot Price > Futures Price
Ties: When Spot Price = Futures Price

Table 8(b). Wilcoxon Signed Rank Tests: Tests Statistics

	ICICI	INFOSYS	RELIANCE	SBI	TATA MOTORS
Z	-11.024[a]	-11.671[a]	-14.922[a]	-9.030[a]	-14.534[a]
Asymp. Sig. (2-tailed)	.000	.000	.000	.000	.000

a. Based on positive ranks

and negative mispricing and number of days to expiry. It is observed that the overall mispricing is negative. There were relatively more number of instances of positive mispricing, but the magnitude of negative mispricing was comparatively higher. Thus, there can be two conclusions regarding this :

(i) Firstly, high magnitude of negative mispricing is due to the short selling restrictions in Indian markets; and

(ii) The magnitude of the mispricing is very low. This makes the arbitrage opportunities unattractive as they are unable to cover the transaction costs. For making profits in such instances, one needs to trade in volumes.

Thus, the existing mispricing is a result of such unexplored and unprofitable mispricing causing inefficient markets to exist. Investors can be broadly classified as belonging to either of the categories: risk takers and others who are risk averse. The risk takers expect more profits ; whereas, the risk averse are the ones who would

compromise for low profits. The risk averse wait for the expiry to arrive and close their position with less risk and lesser profits as compared to the early ones. Therefore, as the expiry arrives, mispricing reduces, prices converge, and there is high liquidity in the market as everyone squares off their position.

As far as the basis risk is concerned, there were more number of instances for negative basis showing that the market was in upward trend. The high magnitude of positive basis mispricing exhibited that there were underpricing events because of short selling restrictions.

Implications

The implications of this research can be far-reaching. The efficiency of the stock futures market is questionable; therefore, its effectiveness in hedging and price discovery can be compromised. Traders can spot mispricing with respect to basis and days from maturity and drive away the deviations within the constraints of short-selling. All this indicates that using futures may undermine the efficacy of hedging.

Limitations of the Study and Scope for Further Research

The present study suffers from the limitation that it does not take into account the transaction costs ; hence, the results need to be interpreted with caution. Also, closing prices are used in the study, which can introduce potential biases related to non-contemporaneous trading. The study is based on secondary data, therefore, the results are as good as the source itself.

The study can be extended in many possible ways. Non-price variables like open interest, volumes, and so forth can be studied in relation to the mispricing. More stocks can be studied, and over a longer horizon. The cost - of - carry model can be applied to other instruments like currency futures, interest rate futures, and so forth. Also, pricing efficiency can be studied in stock options, and a study can be conducted regarding cross-market efficiency.

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