Trends in Future Markets Efficiency in India

by

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Acknowledgements

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Abstract

In this paper, I analyze trends in future market efficiencies in India. The premium between actual future prices and calculated future prices has declined continuously over my entire sample period from January 2006 to April 2017. This paper analyzes four main factors namely number of contracts traded, Amihud illiquidity measure, realized volatility, and open interest that could have led to this decline in stock. I even consider two other factors: tax treatment of futures vs. delivery of spot and the lifting of the ban of short sales constraints.

Broad Question/Issue/Hypothesis

My initial question for the thesis proposal was "The Effect of Short Sales Constraints on Future Prices and the potential opportunity for Future Price Arbitrage." However, upon analyzing my data it turned out that the lifting of short sales constraints, which occurred on April 21, 2008 in the Indian stock market, had almost no impact on the future prices. Futures markets continued to trade at a significant premium relative to the spot price. This effect might be explained by Miller's theory (1977) that stocks are already overpriced owing to short sales constraints. The lifting of short sales constraints causes a further increase in spot prices resulting in the spot markets becoming even more artificially inflated. This may help explain the decrease in premium between futures prices and spot prices after the short sales ban was lifted. My paper as mentioned earlier seeks to understand this constant decline in premium across my entire sample of ten stocks for the period of January 2nd, 2006 to April 20th, 2017.

Data/Methodology

1. **Background of Stocks**

My initial selection of 25 stocks include: Abnuovo (Aditya Birla Nuovo), Ambuja Cement, Auropharma, Bata India, BHEL, Cipla, Dabur India Federal Bank, Godrej, Grasim, HeroMotocop, Hindalco, Infosys, Jet Airways, JSW Steel, Lupin, Kotak Mahindra Bank, McDowell – N, M&M, ONGC, Reliance Industries, Reliance Power, TCS, Tata Steel, and Tata Chemicals. I wanted to take big name stocks from different sectors to get a well-diversified sample and ensure that the stocks I selected were included in the original list of stocks for which short sales were allowed after the ban was lifted. However, while collecting the data I noticed that listing and de-listing of stocks made future prices unavailable for intermittent periods. An example is Bata India whose future prices were available for May 26, 2009 – October 28, 2010 and then again unavailable prior to December 29, 2006.

My final stock list includes the following ten Indian companies.[1]

1. **Cipla Ltd:** a global pharmaceutical and biotech company that manufactures and sells pharmaceuticals and personal care products.
2. **Dabur India Ltd:** India's largest Ayurvedic medicine manufacturer and global provider of products including: soaps, detergents, hair oils and tooth powders etc.
3. **Grasim Industries Ltd:** a subsidiary of the Aditya Birla Group, which focuses on manufacturing a diverse number of products including cement, chemicals, textiles, and Vicose Staple Fiber (VSF).
4. **Hindalco Industries Ltd:** a subsidiary of the Aditya Birla Group, which focuses on an aluminum production and copper manufacturing worldwide.

[1] Descriptions are taken from the security description on Bloomberg

5. **Infosys Ltd:** a multinational company that provides software services in e-business, supply chain solutions, and IT consulting.
6. **Kotak Mahindra Bank Ltd:** a private sector commercial bank offering financial services both in India and oversees.
7. **Reliance Industries Ltd:** a multibillion dollar conglomerate that manufactures several products including synthetic fibers, textiles, and petrochemicals.
8. **Tata Chemicals:** a subsidiary of the Tata Group that focuses on manufacturing salt, heavy chemicals, pharmaceuticals, and fertilizers.
9. **Tata Consultancy Services Ltd:** a global info-tech service firm that provides consulting and other IT services to its diverse client base.
10. **Tata Steel Ltd:** a subsidiary of the Tata Group that focuses on steel making and manufactures metallurgical machinery.

2. Background of Futures Markets

In India, there are two main exchanges: Bombay Stock Exchange (BSE) and National Stock Exchange (NSE).

Futures trading started on these exchanges around the same time. On June 9, 2000, the BSE traded the first Exchange-traded Index Derivative contract (BSE Sensex futures) in India. On June 1, 2001, BSE introduced Index Options on the Sensex. On June 9, 2001, trading in stock options on 31 stocks was initiated. From November 9, 2002, Single Stock Futures trading commenced.[2]

[2] http://www.bseindia.com/markets/Derivatives/DeriReports/introduction.aspx?expandable=5

Similarly, On June 12, 2000, the NSE started trading index futures derivatives. The futures contracts are based on the popular benchmark Nifty 50 Index. On June 4, 2001, NSE initiated trading in Index Options on the Nifty 50. On July 2, 2001, NSE became the first exchange in India to start trading individual securities options. Lastly, on November 9, 2001 NSE introduced futures on individual securities.[3]

I use the NSE data for my research analysis as it is the most liquid exchange with about three-quarters of all trading.

The Securities and Exchange Board of India (SEBI) banned short selling in the Indian stock market in March 2001 partly because a stock price crash possibly due to an insider trading scandal. [4]

Shortly after, solely retail investors were allowed to short sell. SEBI, in 2005, suggested that institutional investors like mutual funds should also be allowed to short-sell. SEBI then issued short selling guidelines for institutional investors in July 2007 and short selling for institutional investors was re-permitted on April 21, 2008.[5]

In India, shorting stock directly in the spot market is not allowed. To short stock, a person, can borrow it or trade it intraday or through options. Therefore, the introduction of shorting single stock futures is a very interesting phenomenon to me. Although more liquid than options, shorting futures requires a minimum margin exposure and the time-period for your short is generally limited to expiry (usually around 30 days). These complexities and trends in future market efficiencies are very interesting to me.

[3] https://www.nseindia.com/products/content/derivatives/equities/about_equity_der.htm
[4] There were claims that the president of BSE, Anand Rathi had used confidential information from BSE's surveillance department to personally benefit and contribute to volatility. SEBI later absolved Mr. Rathi of any wrongs.
[5] http://www.investopedia.com/ask/answers/09/short-selling-india.asp

3. Data: Collection & Methodology

My methodology used in this paper is simple. I first calculate the futures prices using the cost of carry formula, which is $F= Se^{rt}_1$ for non-dividend months and $F=e^{rt}_1(S-De^{-rt}_2)$ for dividend paying months where

F=Future Prices

S=Spot prices

R=Interest Rate (Mumbai Interbank Overnight rate)

T_1=Time to Expiry

T_2=Difference in Time to Expiry and Dividend pay out

D=Dividends

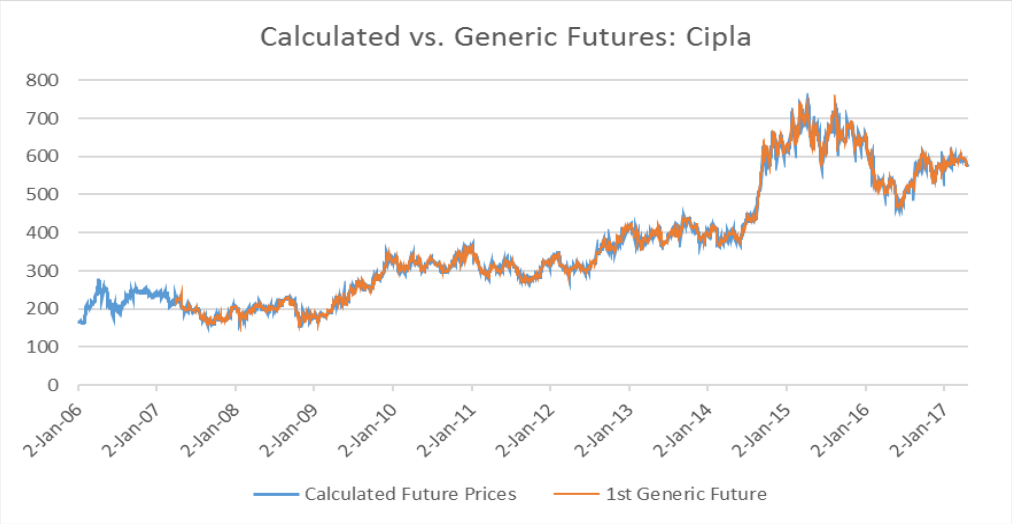
My data for the spot prices of stocks was extracted from the Bloomberg Terminal at NYU Stern School of Business. The data for dividends was collected from Moneycontrol.com The overnight interest rate (Mumbai Interbank Rate) to calculate the Future Prices was also extracted from Bloomberg. Expiry dates and the actual future prices were extracted from NSE's website.

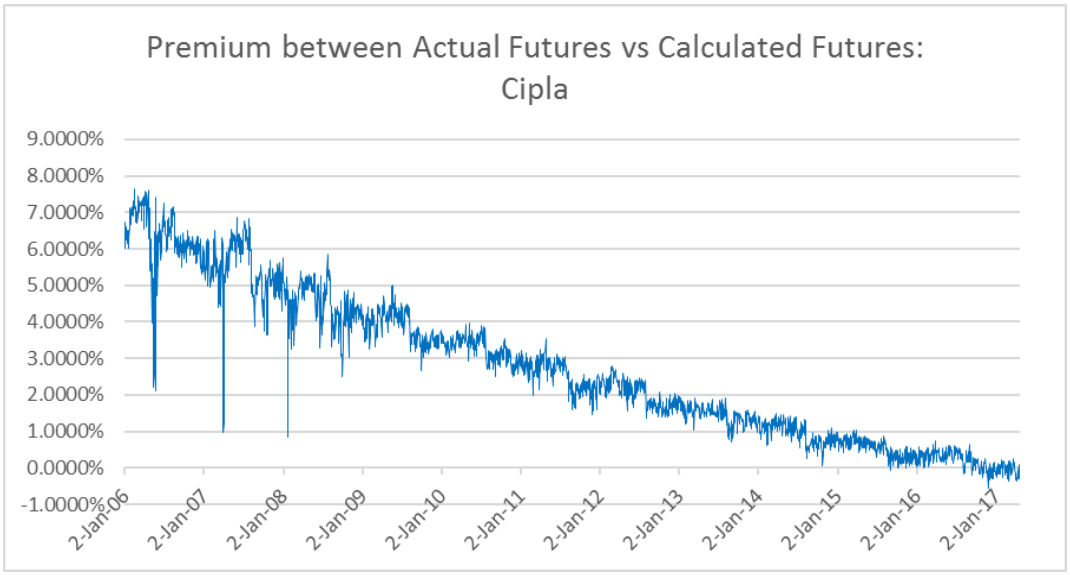
I then extracted the actual 1-month futures price daily available through NSE's Bhavcopy with the help of a macro. I then computed the difference in actual future prices and calculated future prices and divided it by the actual futures get the premium the actual futures were trading at with respect to the calculated futures. The premium was measured in percentage. I then analyzed the decrease in this percentage over time for my sample of 10 stocks. In all cases we see that the premium is significantly reducing since the futures markets are probably getting more efficient.

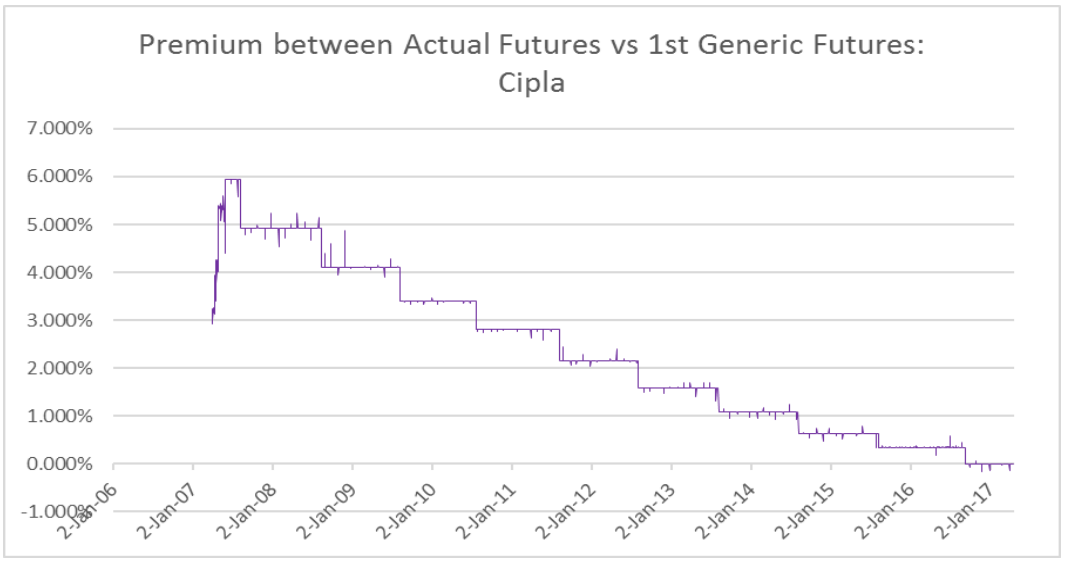
Bloomberg also contained data from the NSE regarding 1st generic futures. I believe these too are calculated in a similar manner as my calculated futures price closely matched the 1st generic future prices on Bloomberg. The difference in prices for certain days was 0.00%. However, my graphs for decreasing premium are much smoother than the ones constructed using 1st generic futures as therein we see the premium seems to decline in a stepwise manner over time.

Below are the graphs comparing the calculated futures versus 1st generic futures, premium between actual and calculated futures, and premium between actual and 1st generic futures for my list of 10 stocks

1. **CIPLA LIMITED**

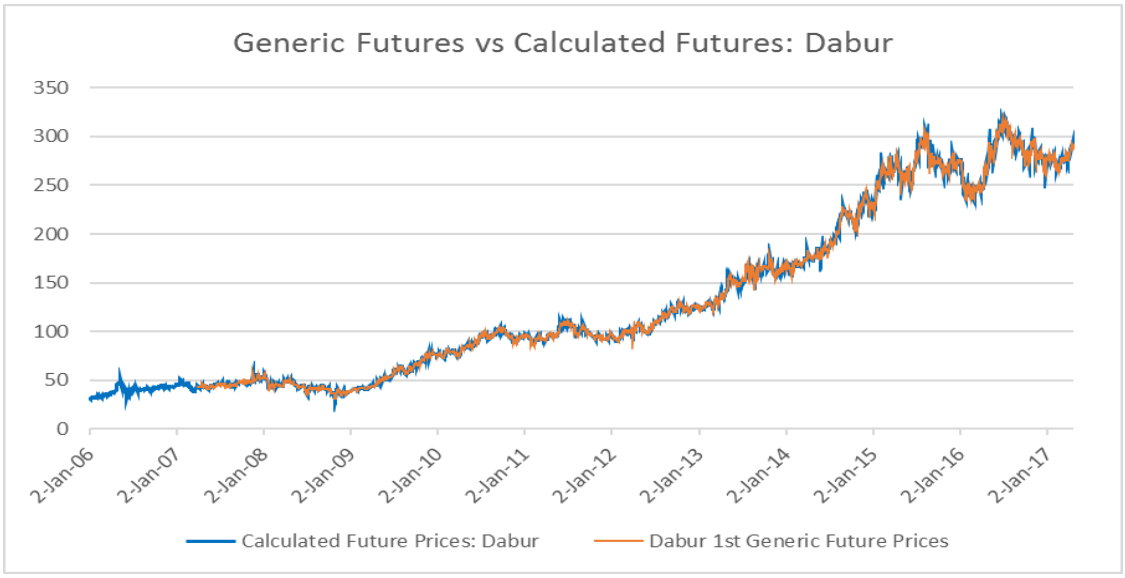


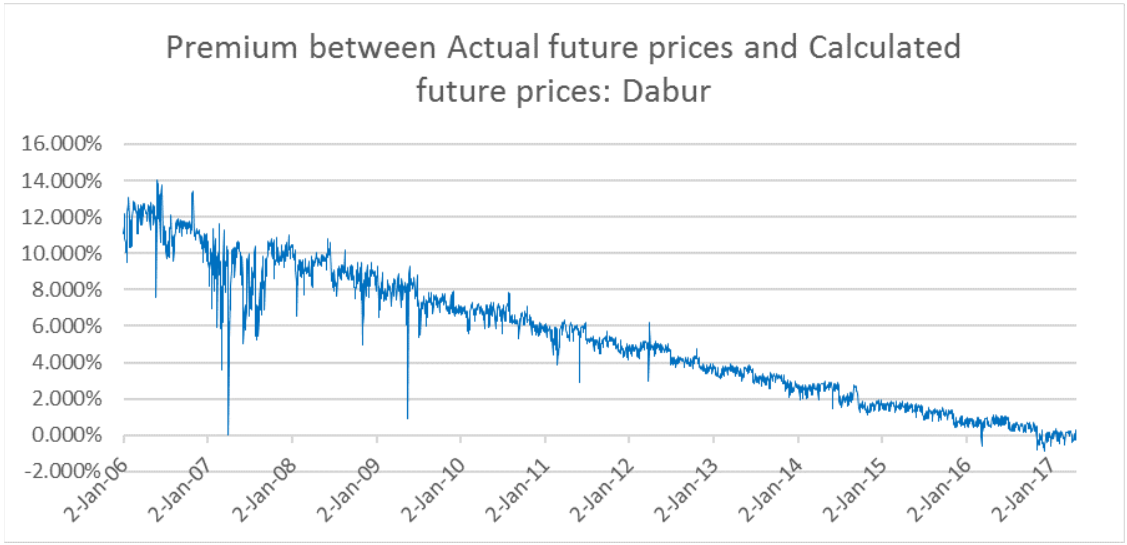


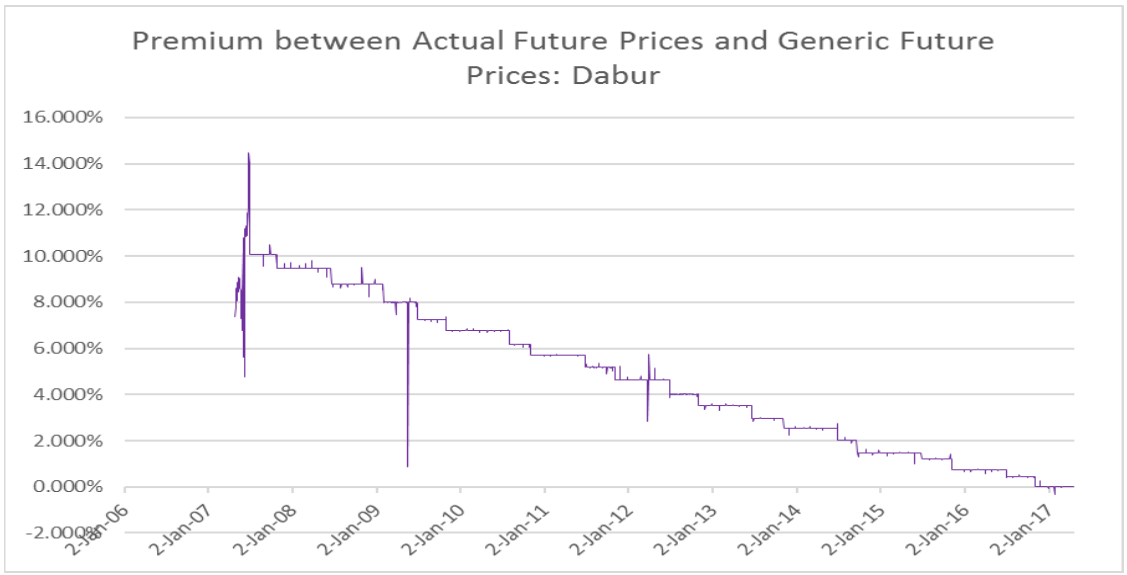


In the graphs above, we notice that the premium declines throughout the entire sample period in a pretty uniform manner except for the years of the financial crisis (2007-2008).

2. DABUR INDIA LIMITED

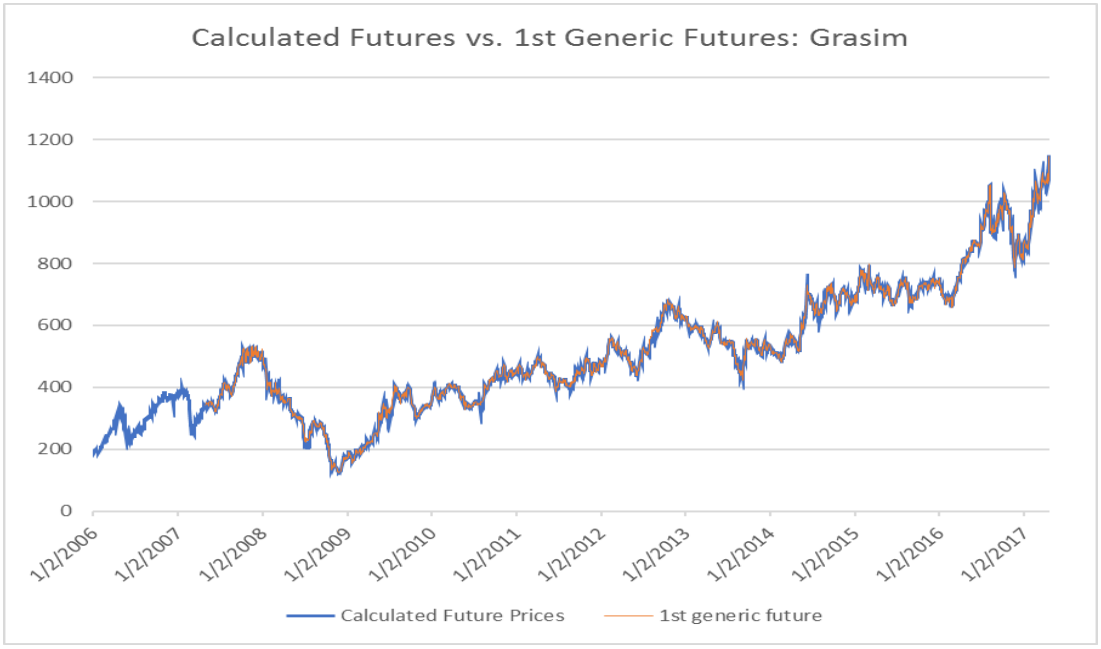

Generic Futures vs Calculated Futures: Dabur
350
300
250
200
150
100
50
0
2-Jan-06
2-Jan-07
2-Jan-08
2-Jan-09
2-Jan-10
2-Jan-11
2-Jan-12
2-Jan-13
2-Jan-14
2-Jan-15
2-Jan-16
2-Jan-17
Calculated Future Prices: Dabur
Dabur 1st Generic Future Prices


Premium between Actual future prices and Calculated future prices: Dabur
16.000%
14.000%
12.000%
10.000%
8.000%
6.000%
4.000%
2.000%
0.000%
-2.000%
2-Jan-06
2-Jan-07
2-Jan-08
2-Jan-09
2-Jan-10
2-Jan-11
2-Jan-12
2-Jan-13
2-Jan-14
2-Jan-15
2-Jan-16
2-Jan-17

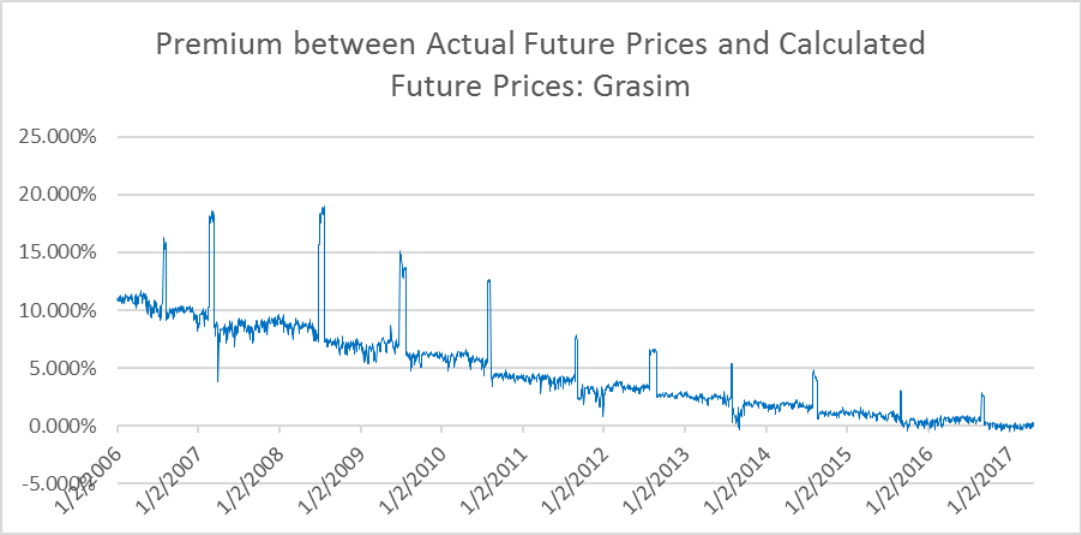

Premium between Actual Future Prices and Generic Future Prices: Dabur
16.000%
14.000%
12.000%
10.000%
8.000%
6.000%
4.000%
2.000%
0.000%
2-Jan-06
2-Jan-07
2-Jan-08
2-Jan-09
2-Jan-10
2-Jan-11
2-Jan-12
2-Jan-13
2-Jan-14
2-Jan-15
2-Jan-16
2-Jan-17

For Dabur the premium on 18 May 2009 is extremely low as the market rallied over 17% this day owing to an unexpected victory by the United Progressive Alliance's (UPA) in the general elections.[6] This resulted in the markets being closed as initially trading was halted for two hours owing to the Index's hitting the upper cicuits resulting in the triggering of automatic suspension. However, shortly after re-opening the circuit breakers were triggered again as the Sensex rocketed 17.34%, Nifty rose 17.77% and S&P CNX Defty, which the S&P CNX nifty measured in dollars, hit the upper circuit of 20.53% halting trading for the day[7]. Liquidity was really low as suggested by the Amihiud Illiquidity measure, which spikes significantly for this day across all stocks. (This is shown in a later section of the paper)

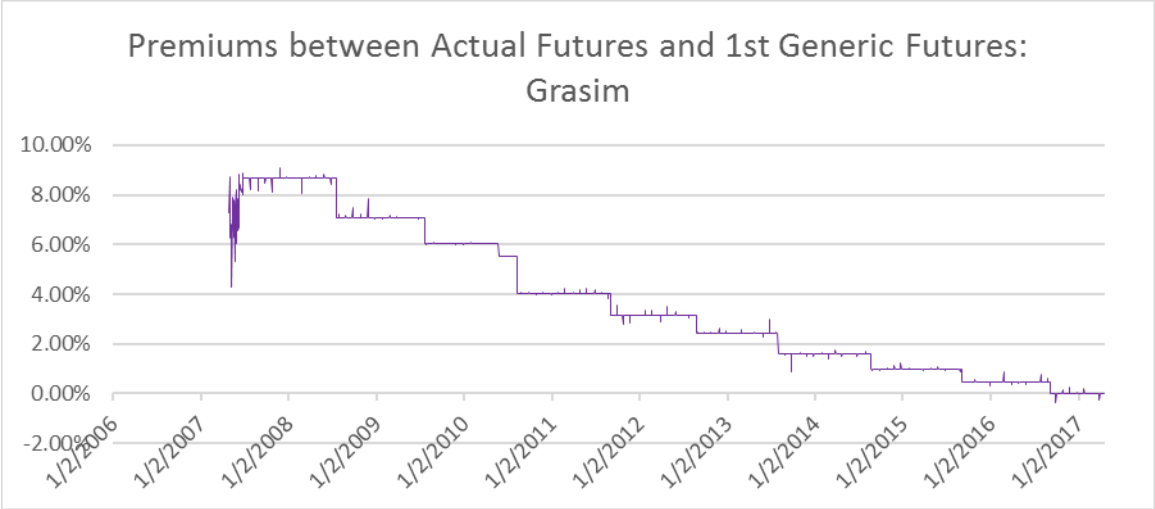
3. GRASIM INDUSTRIES LIMITED



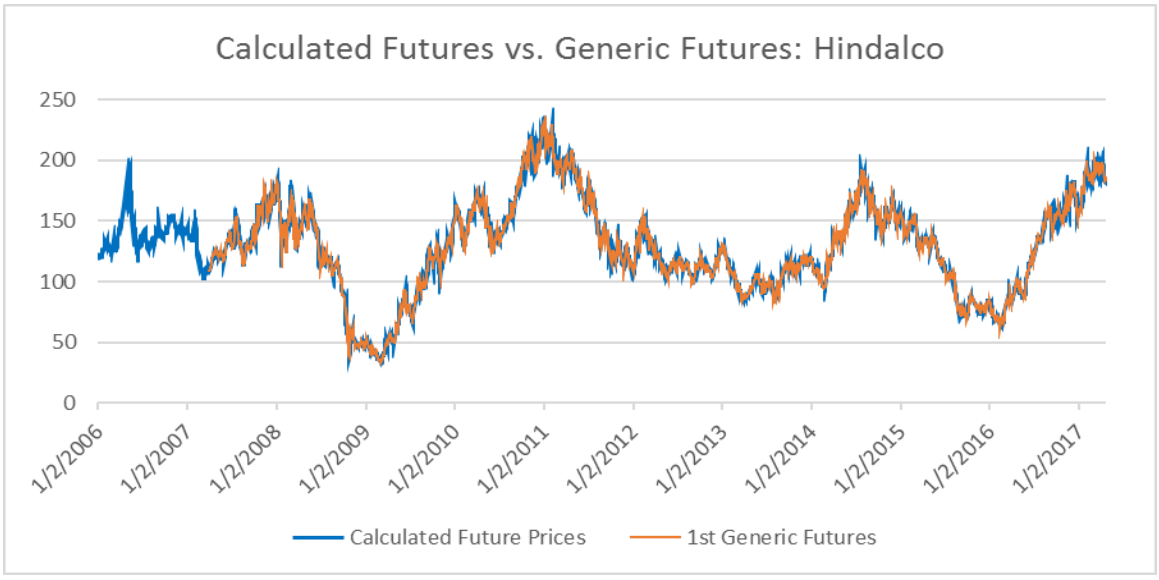
[6] http://content.time.com/time/world/article/0,8599,1899178,00.html
[7] http://business.rediff.com/slide-show/2009/may/18/slide-show-1-sensex-rockets-on-upa-victory.htm

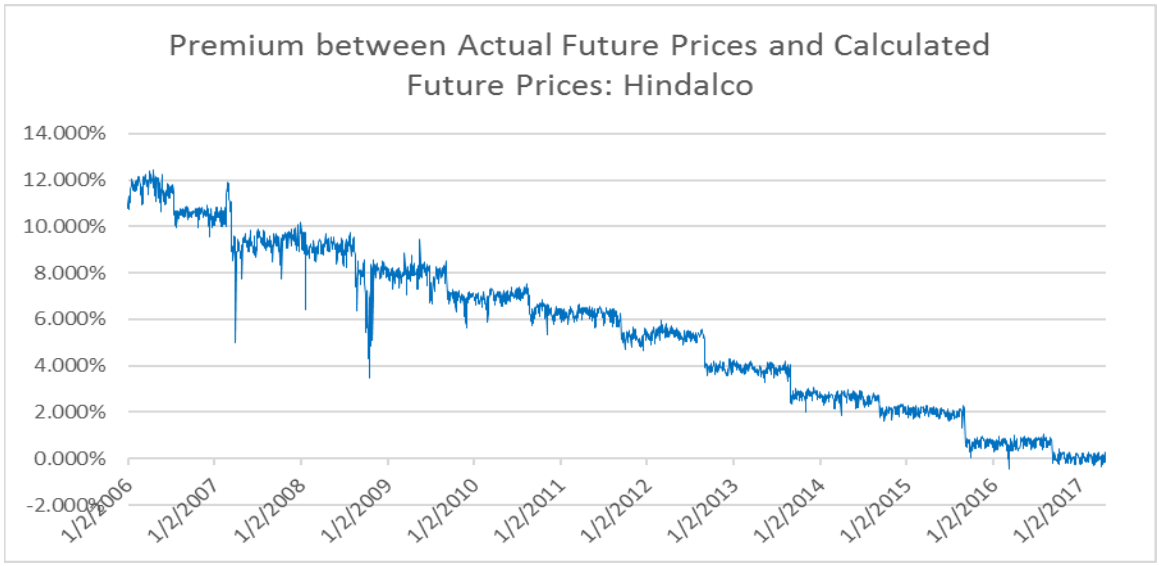


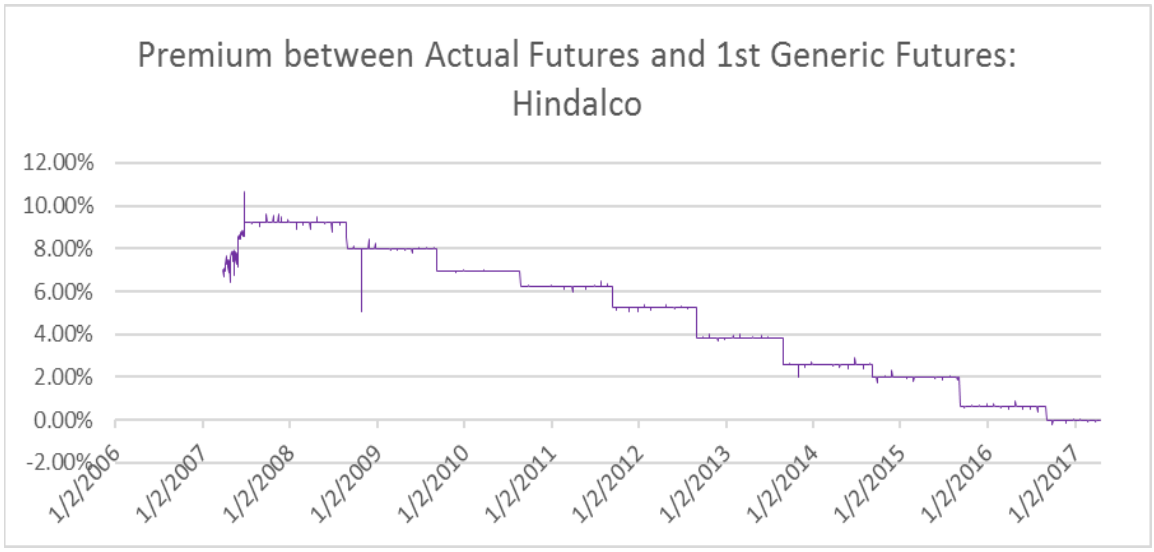
In the graph above the frequent, almost constant spike in premium is owing to dividends being paid out on those days. This is interesting as it reflects that Calculated Future prices considering dividends don't accurately reflect the actual future prices for Grasim.



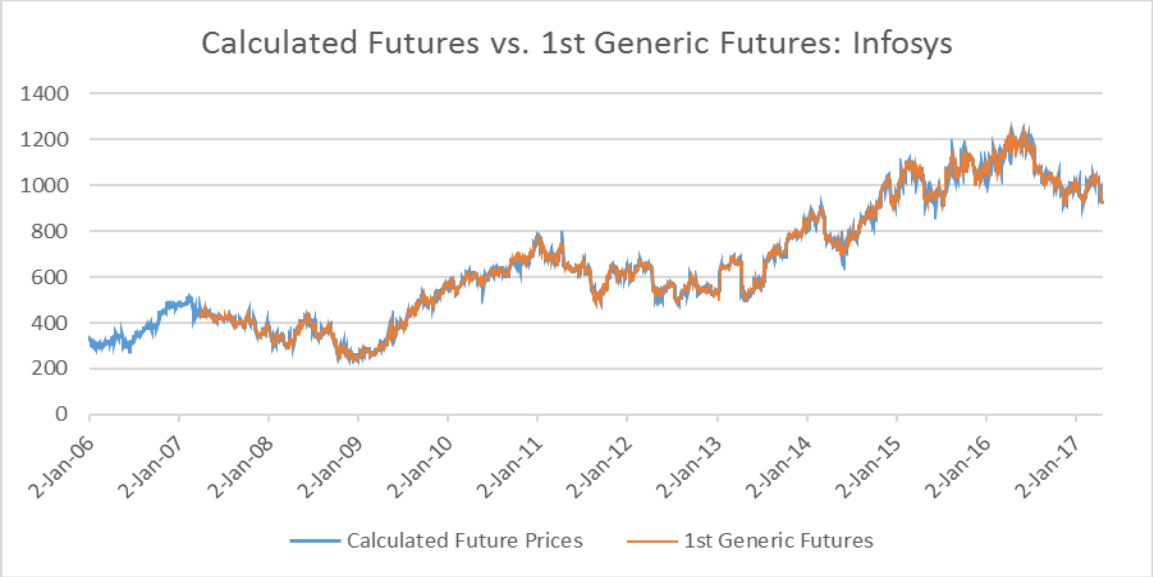
4. HINDALCO INDUSTRIES LIMITED

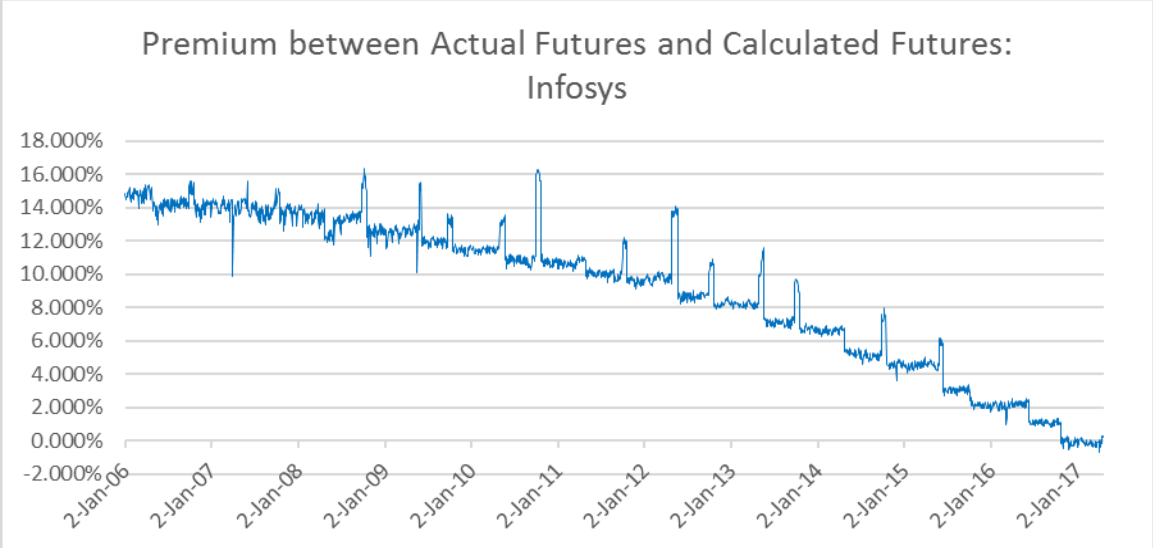

Calculated Futures vs. Generic Futures: Hindalco
250
200
150
100
50
0
1/2/2006
1/2/2007
1/2/2008
1/2/2009
1/2/2010
1/2/2011
1/2/2012
1/2/2013
1/2/2014
1/2/2015
1/2/2016
1/2/2017
Calculated Future Prices
1st Generic Futures


Premium between Actual Future Prices and Calculated Future Prices: Hindalco
14.000%
12.000%
10.000%
8.000%
6.000%
4.000%
2.000%
0.000%
-2.000%
1/2/2006
1/2/2007
1/2/2008
1/2/2009
1/2/2010
1/2/2011
1/2/2012
1/2/2013
1/2/2014
1/2/2015
1/2/2016
1/2/2017

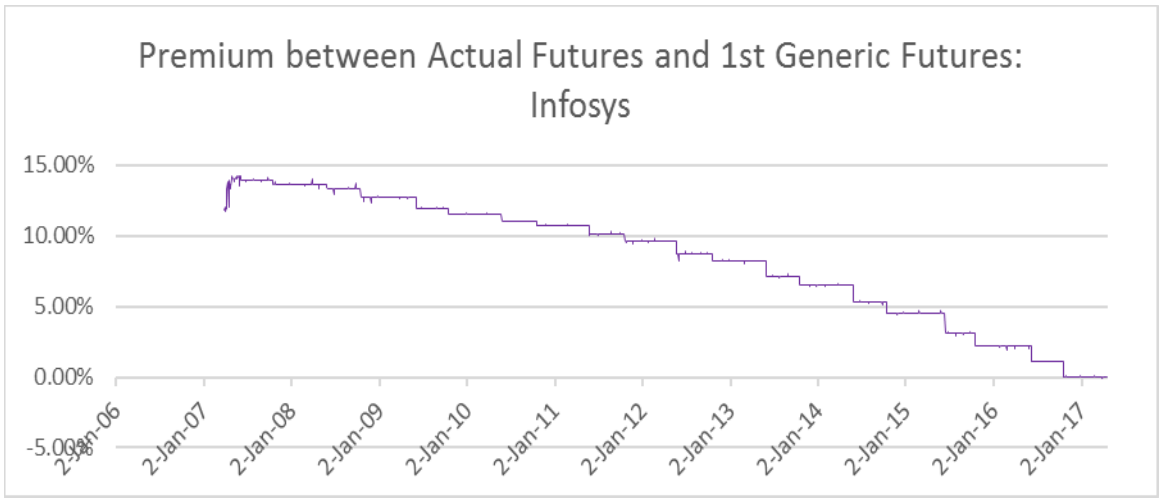

Premium between Actual Futures and 1st Generic Futures: Hindalco
12.00%
10.00%
8.00%
6.00%
4.00%
2.00%
0.00%
-2.00%
1/2/2006
1/2/2007
1/2/2008
1/2/2009
1/2/2010
1/2/2011
1/2/2012
1/2/2013
1/2/2014
1/2/2015
1/2/2016
1/2/2017

5. INFOSYS LIMITED

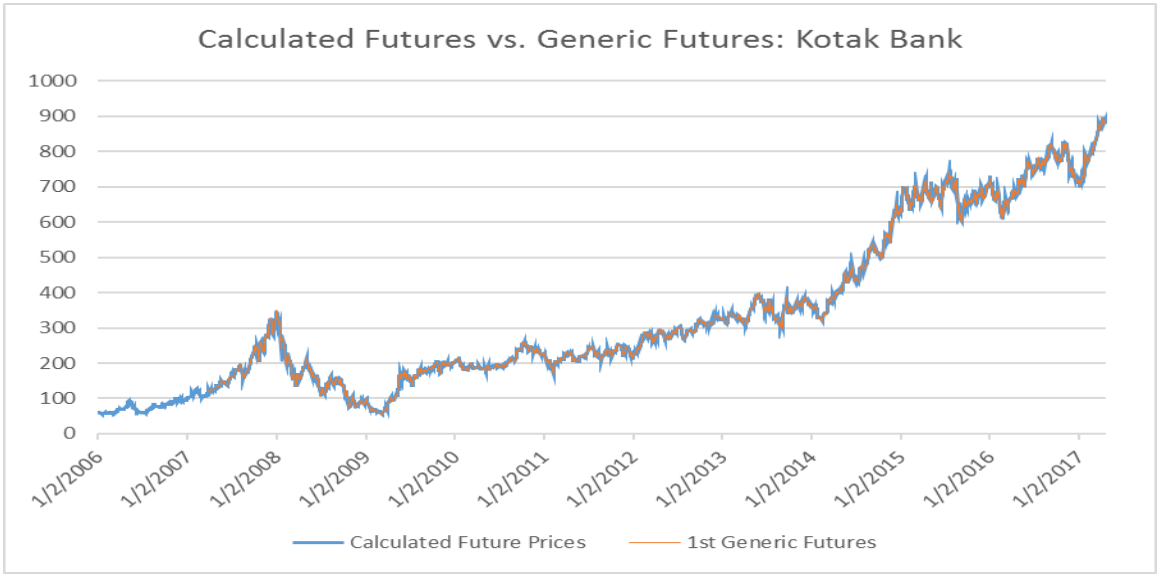


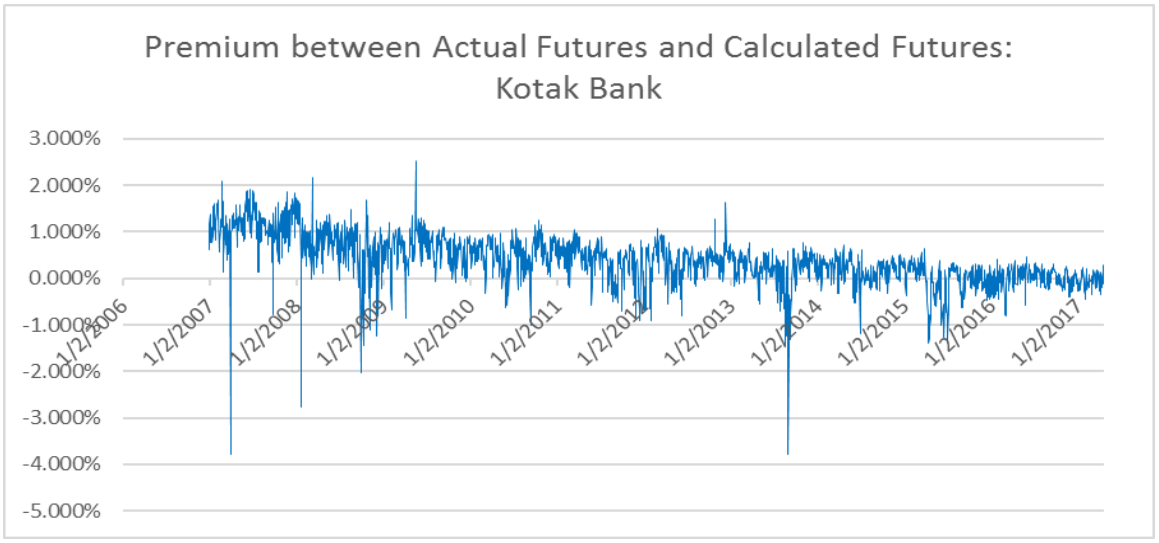


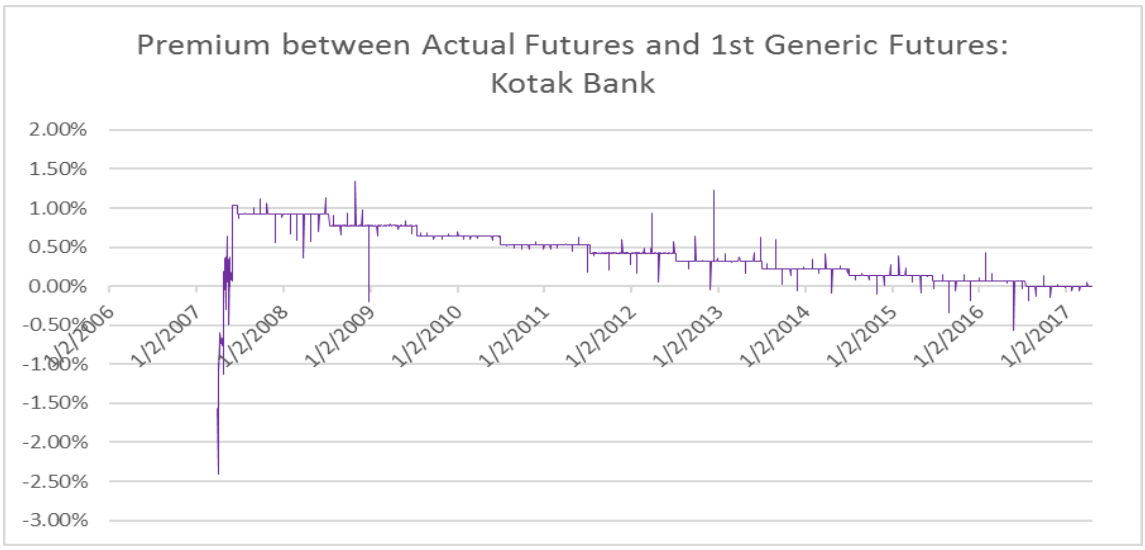
In the graph above for Infosys, we see a similar result like for Grasim. There is a spike in premium on dividend days again raising the issue for stocks with large dividend pay outs the cost of carry formula using discounted dividends does not accurately reflect the actual future prices



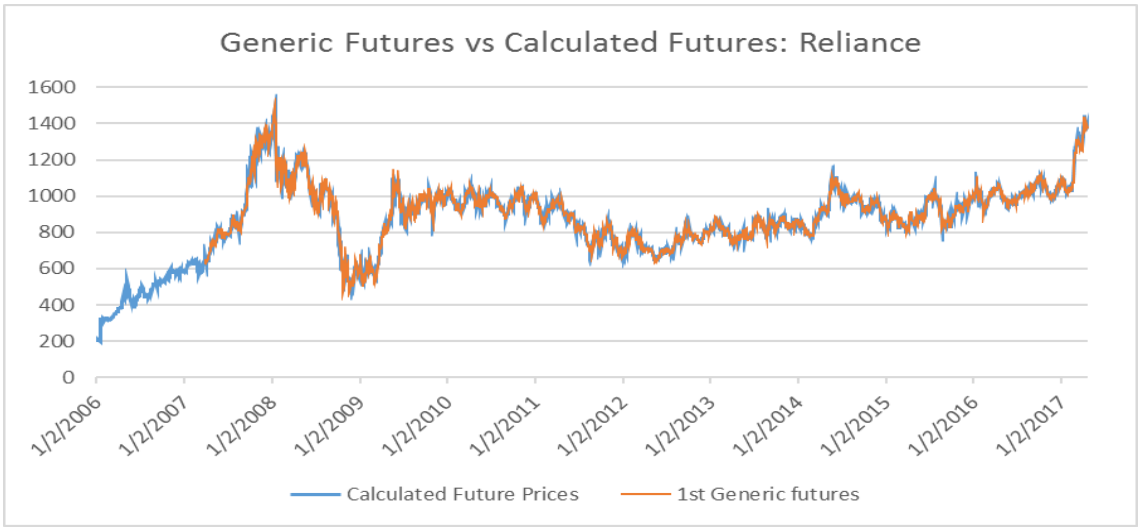
6. KOTAK BANK LIMITED

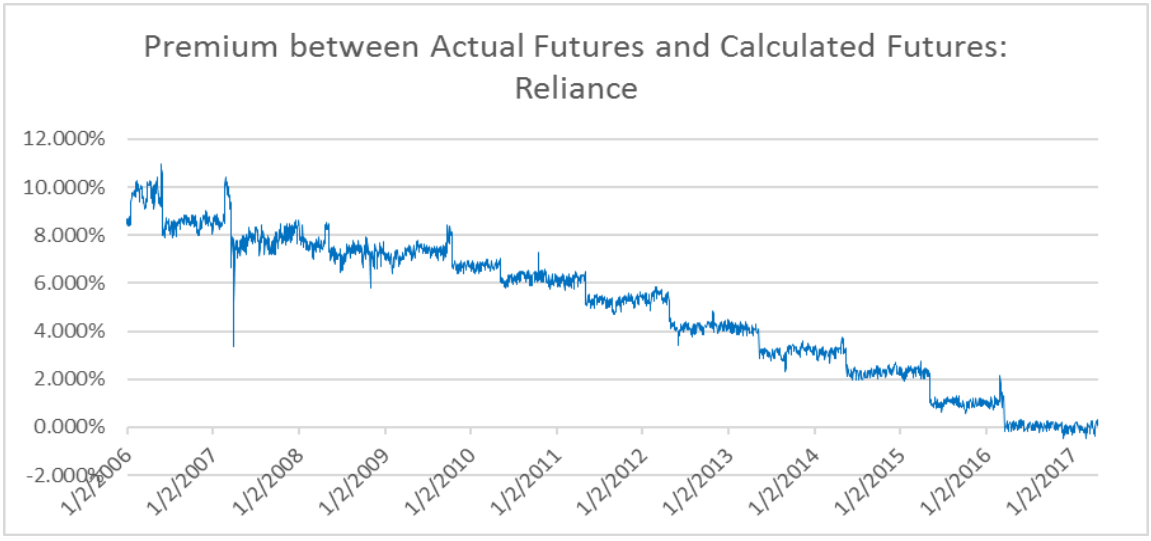


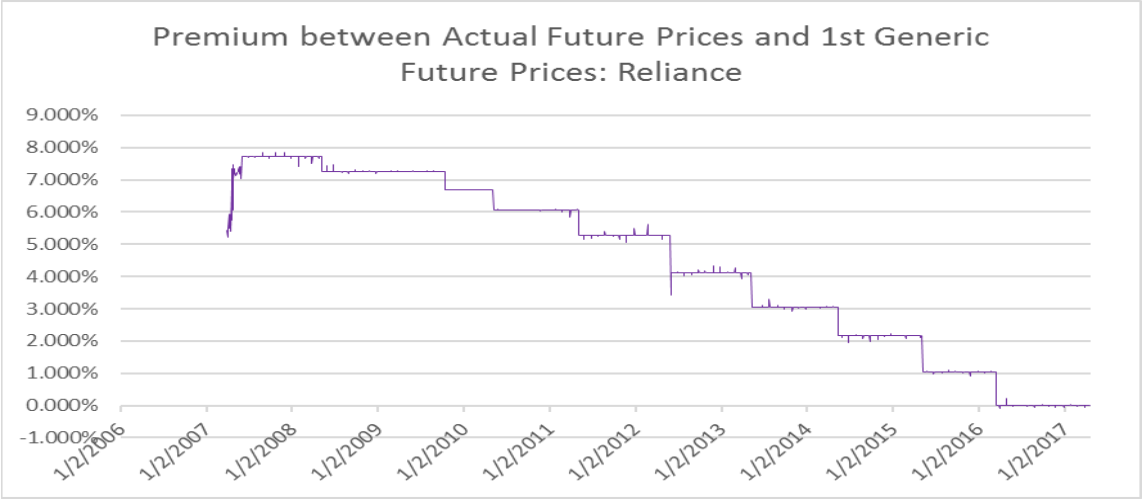




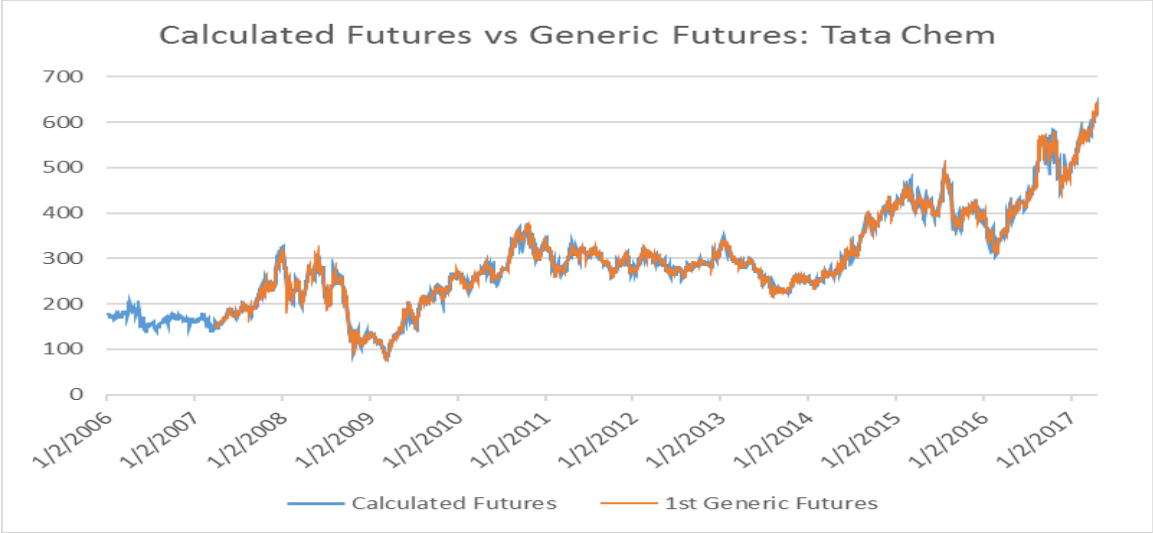
7. RELIANCE INDUSTRIES LIMITED

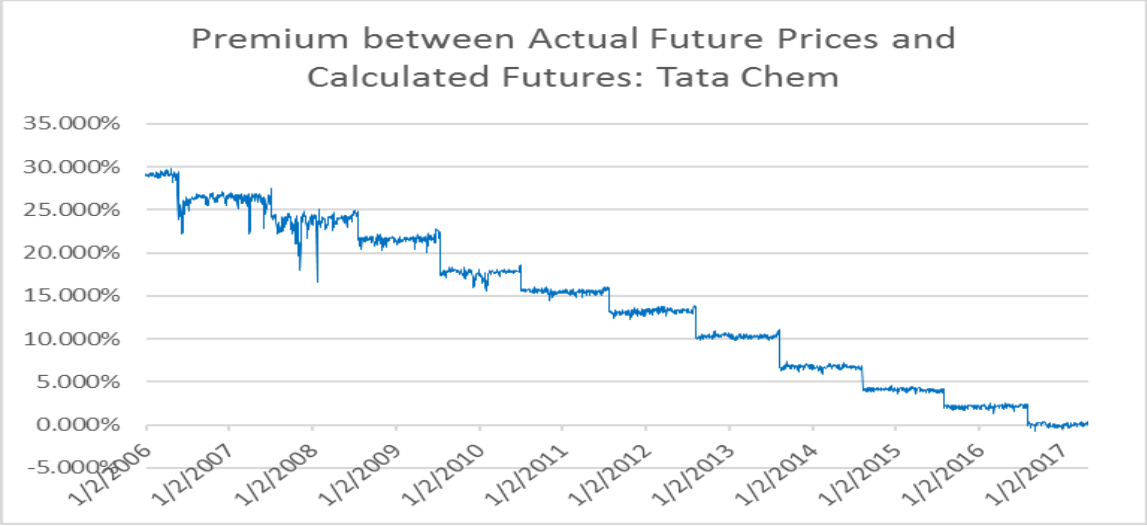


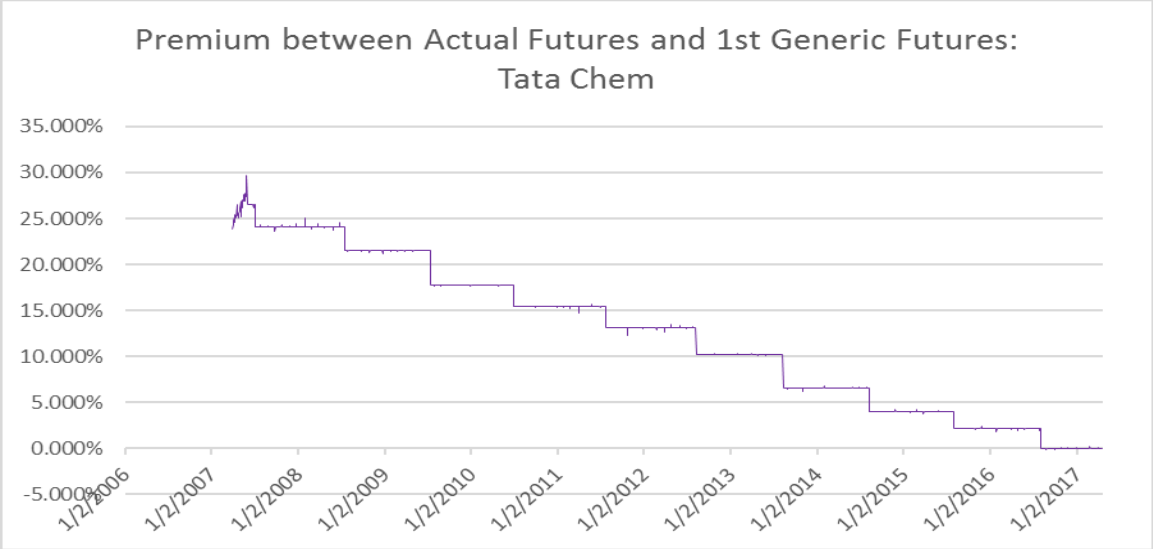




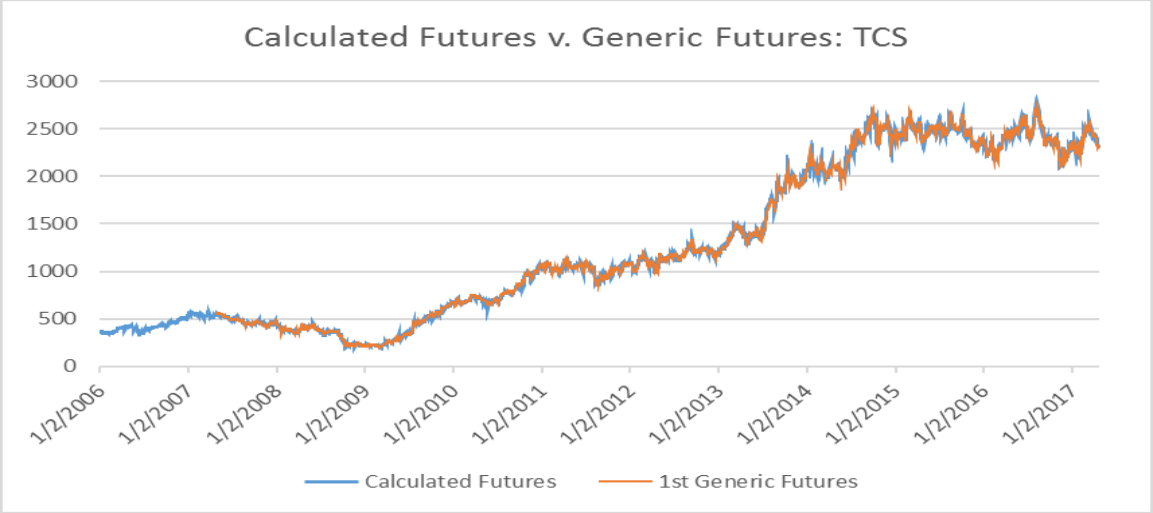
8. TATA CHEMICALS LIMITED

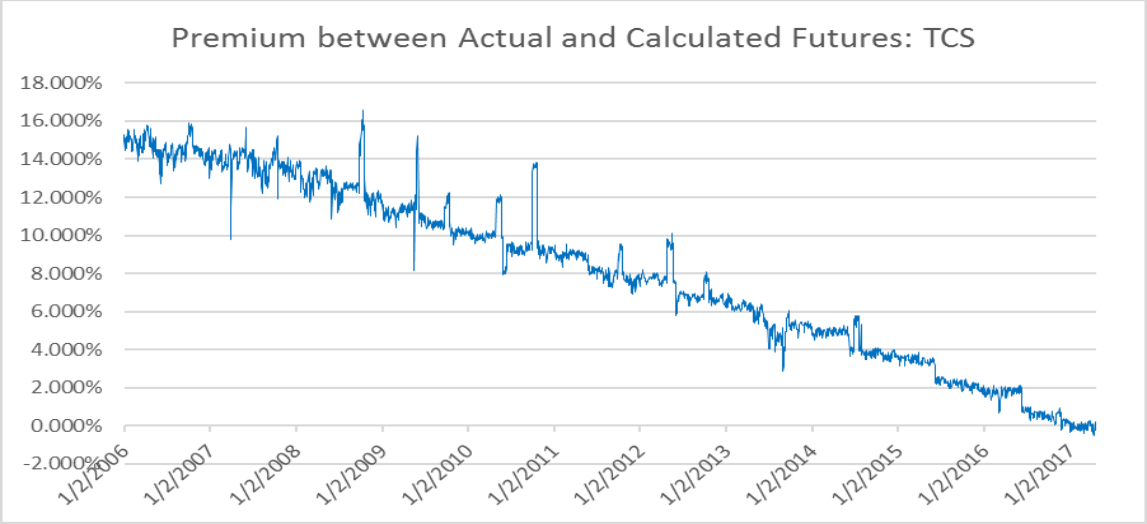




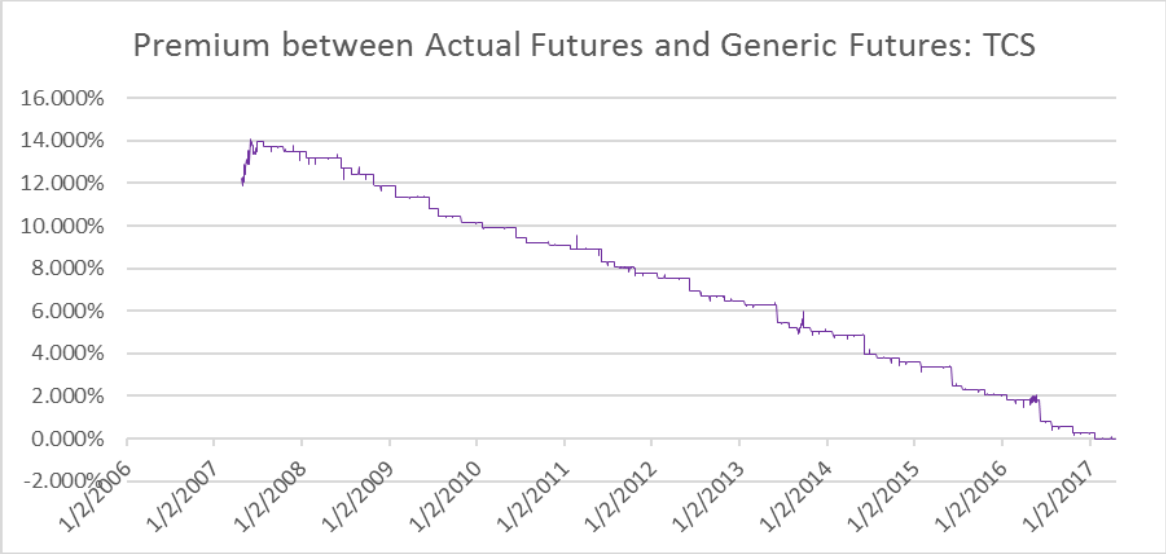


9. TATA CONSULTANCY SERVICES LIMITED

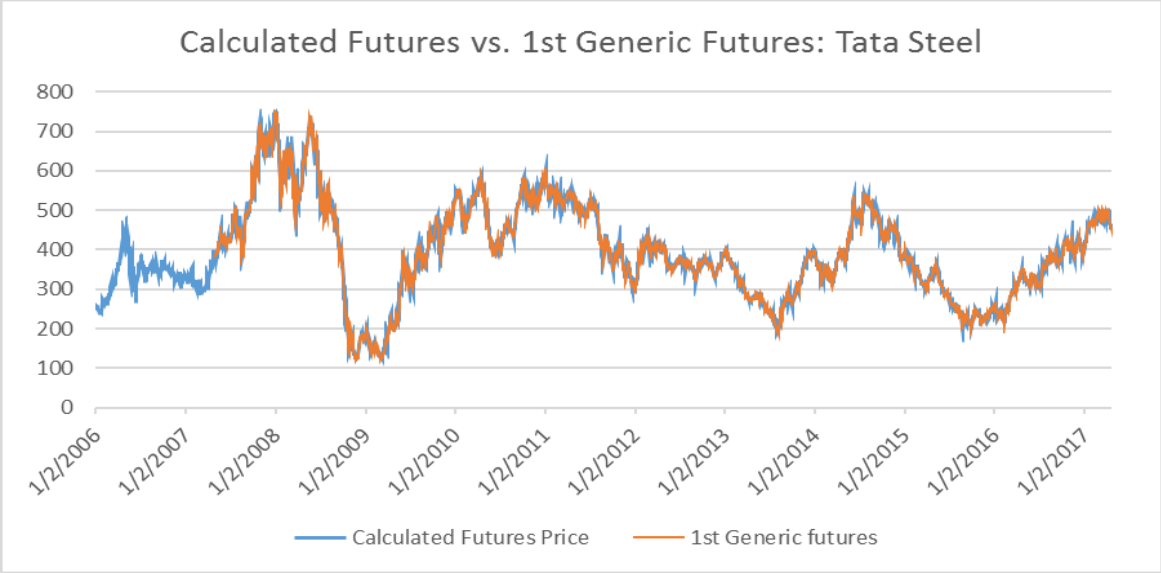


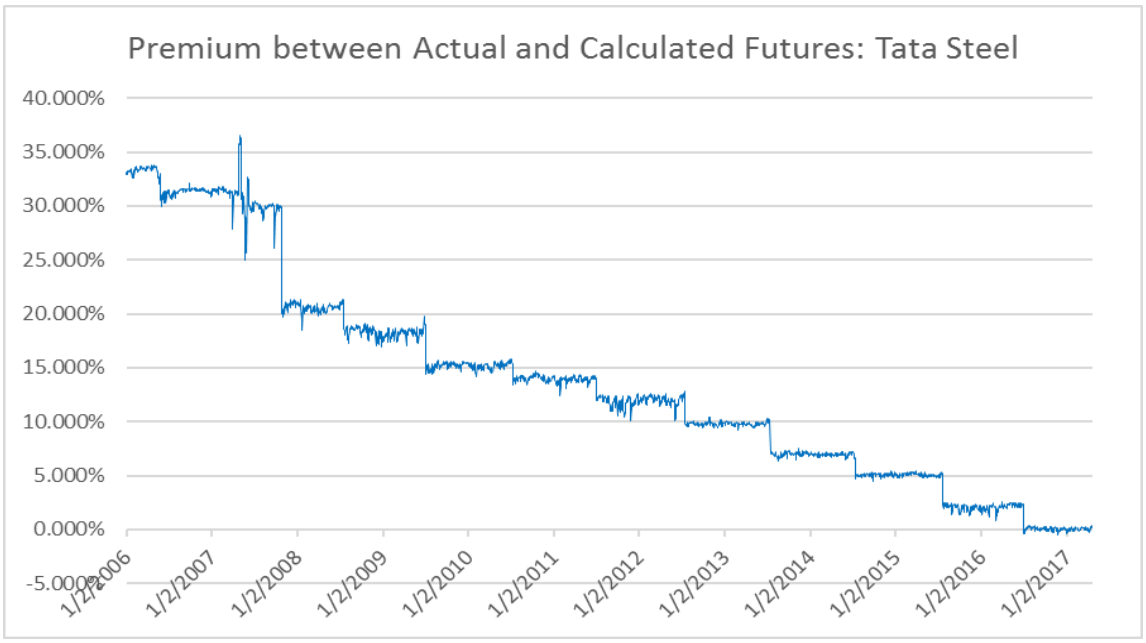


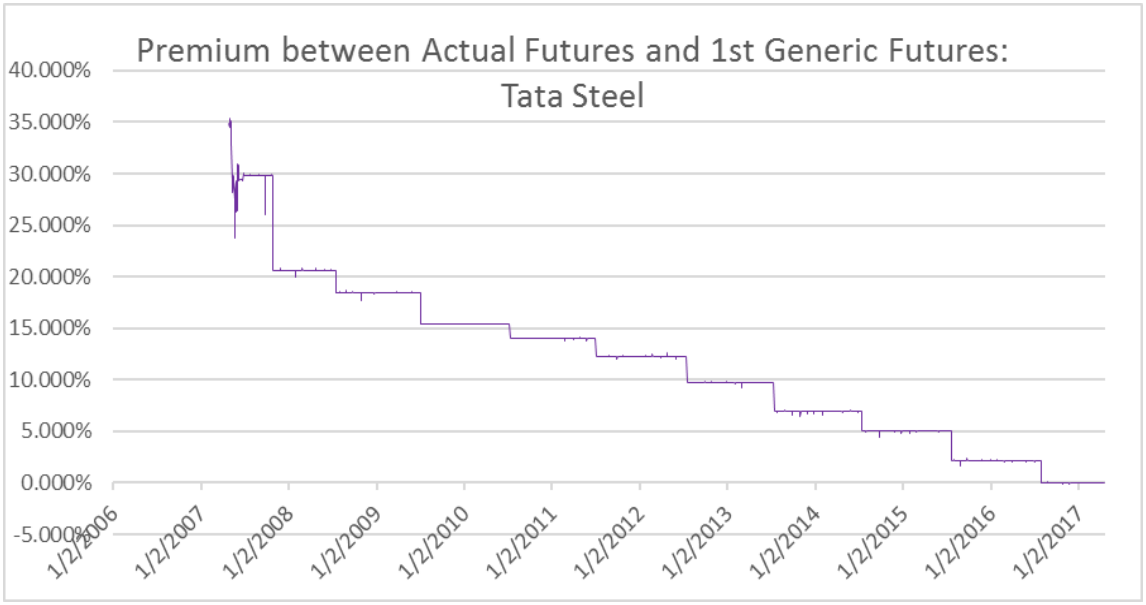
The above graph for Tata Consultancy Services reflects the same phenomena that was evident through the graphs of Infosys and Grasim: that for stocks with large dividends cost of carry formula for pricing futures using discounted dividends may not be a very accurate way to price futures since for these days actual futures seem to command an unnaturally higher premium than calculated futures.



10. TATA STEEL LIMITED







Having observed the decline in premium and compared the differences in premiums between actual and calculated futures vs. actual and 1st generic futures, I now analyze the factors that might have resulted in this decline in premium.

4. Analysis of Factors

The factors I believe have led to efficiency in the future markets as evident by the decline in the premium are the following:

1. **Number of Contracts Traded**: Volume seems to be an obvious and logical factor to analyze the result of declining in premium. One could argue that increase in automation has made trading easier and this has resulted in an increase in efficiency of futures markets and premiums declining. The data for number of contracts traded was available through NSE's website. I extracted this data daily for January 2, 2006 to April 20, 2017.

2. **Open Interest**: One might also argue that the number of outstanding futures contracts available for investors to buy might be an important factor to consider for understanding the efficiencies in future markets. This is because if there are less number of contracts available, then this scarcity might cause the actual futures to trade higher than the calculated futures, which might explain the high premiums. The data for Open Interest was also obtained from NSE's website.

3. **Realized Volatility**: Realized volatility also may account for the efficiency in future markets as a decrease in volatility might make the markets more efficient and result in the actual future prices to correspond more closely with the calculated ones.

I calculated the annualized daily-realized volatility using the formula[8]:

$$\text{Vol} = 100 \bullet \sqrt{\frac{252}{n} \sum_{t=1}^{n} R_t^2}$$

Where:

Vol = Realized volatility

252 = a constant representing the approximate number of trading days in a year

t = a counter representing each trading day

n = number of trading days in the measurement time frame

Rt = continuously compounded daily returns as calculated by the formula:

$$R_t = Ln \frac{P_t}{P_{t-1}}$$

Where:

Ln = natural logarithm

Pt = Underlying Reference Price ("closing price") at day t

Pt–1 = Underlying Reference Price at day immediately preceding day t

I use around 252 days to calculate annualized daily-realized volatility, which helps simplify the calculation.

[8] http://volx.us/volformula.htm

4. **Amihud Illiquidity Measure**: Another essential factor, one might consider accounting for is illiquidity in the markets. I use the Amihud Illiquidity Measure given by the following formula to account for illiquidity[9]:

$$ILLIQ = \frac{|r|}{volume}$$

where:

| r | = absolute daily return

volume: is measured by number of contracts traded

Two other essential factors I considered but did not analyze are:

5. **Short Sales Constraints**: The lifting of the ban on short sales constraints is an essential factor to consider in analyzing the efficiency in future markets. However, from our graphs earlier this factor seems to have had almost no effect on the premium since even after the lifting of the ban, premiums continued to decline. This just indicates that future markets continued to become efficient. For short sales constraints to be an important factor, one would expect to notice the reverse effect on premium.

6. **Tax Treatment of Spot vs. Futures**: The difference in tax treatment of futures versus deliver of spot might also be an essential factor to consider when calculating premium. In India, futures are treated as business income and profits are taxed at 30%. On the other hand, delivery of stock is taxed at 15% and if the

[9] Amihud (2002)

stock is held for more than a year it is considered an investment and the profits are not taxed. However, since there was no change in tax treatment of futures trading versus spot, this factor might not be useful in explaining the declining premium. Another interesting argument to consider would be trading of intra-day spot, to artificially short stocks in the spot market. Although, profits from intra-day trading are also taxed at 30%, the time frame for intraday and futures trading differ. Intra-day trading is limited to one day, whereas 1-month futures contracts may trade for upto 34 days depending upon the expiries. 1-month futures contracts in India trade from the Friday after the expiry of the previous futures contract until the expiry of the current month, which generally falls on the last Thursday of every month. Owing to this difference in time frames, I don't delve into artficially shorting through intra-day trading.

For analyzing the premiums, I use the difference between actual prices and calculated premium since the graphs were smoother as evidenced by the plots earlier. I analyze the four variables mentioned above over six stocks using regressions in Minitab. The data is summarized below:

Measure	TCS	Infosys	Cipla	Dabur	Hindalco	Kotak Bank
No. of Contracts (R^2)	10.4%	0.2%	12.1%	6.4%	1.2%	7.2%
Open Interest (R^2)	4.0%	46.0%	6.7%	8.1%	11.1%	23.9%
Realized Volatility (R^2)	41.3%	20.1%	44.2%	58.2%	17.3%	19.6%
Amihud Illiquidity Measure (R^2)	0.3%	0.3%	0.6%	4.4%	0.2%	0.9%
Regression on all factors (R^2)	43.43%	51.36%	51.68%	68.63%	27.71%	29.26%
Best Subsets Regression (R^2_{adj})	43.4% (3 factors)	51.3% (2 factors)	51.6% (2 factors)	68.6% (4 factors)	27.6% (3 factors)	29.3% (4 factors)
Futures vs. Modified Spot (R^2)	99.4%	98.7%	99.8%	99.7%	98.4%	100.0%

For my final regression of futures versus modified spot, I had to acccount for stock splits since the NSE data hadn't adjusted for these in the future prices.

1. **TCS**: underwent two stock splits took place on 16 June, 2009 and 28 July, 2006, both in the ratio of 1:1.
2. **Infosys**: had three stock splits on July 12, 2006, November 25, 2014, and June 9, 2015. All three were in the ratio 1:1.
3. **Cipla**: had a bonus issue on April 24,2006 in the ratio 3:2

4. **Dabur:** had 1 stock split on 19 january, 2006 in the ratio 1:1 and two bonus ratio's on September 8, 2010 and January 25, 2007 in the ratio of 1:1 and 1:2 respectively.
5. **Hindalco**: had a corporate action on August 27, 2008 for which the adjustment factor was 0.906897
6. **Kotak bank:** had a stock split on September 13, 2010 in the ratio 10:5 and a bonus issue on July 8, 2015 in the ratio 1:1

Below are the coefficients in the final regression with all 4-factors and their subsets. The level of significance for p-values are marked by * p<0.1; ** p<0.05; ***p<.01

Measure	TCS	Infosys	Cipla	Dabur	Hindalco	Kotak Bank
Number of Contracts	-0.000001 ***	0.00000	-0.000002 ***	-0.000009 ***	-0.000001 ***	-0.000000 ***
Open Interest	-0.000000 ***	-0.00000 ***	0.000000	-0.000000 ***	-0.000000 ***	-0.000000 ***
Realized Volatility	0.23885 ***	0.16253 ***	0.17015 ***	0.23648 ***	0.08235 ***	0.006233 ***
Amihud Illiquidity	-63.8	155	3.41	-12.42 ***	9.3	2.220 ***
Constant	0.01858 ***	0.06316 ***	-0.0195 ***	-0.00734 ***	0.03906 ***	0.003509 ***
Multi-	Not	Not	Not	Not	Not	Not present

collinearity	present	present	present	present	present	
Constant	Not meaningful	Not meaningful	Not meaningful	Not meaningful	Not meaningful	Not meaningful

The p-value appears to be significant for almost all factor owing to the large number of observations (2801) since the data set is daily over more than 11 years. One might argue that although the p-value appears to be significant, the coefficient of regressions are not very meaningful for several of the variables like number of contracts traded and open interest since this value is very small. Realized volatility probably looks the most meaningful as a percentage change in realized volatility might be associated with a smaller percentage change in premium.

I compare the average realized volatility over the years between the stocks.

Year	TCS	Infosys	Cipla	Dabur	Hindalco	Kotak Bank
2016	19.79%	25.23%	25.72%	24.50%	44.70%	24.46%
2015	22.66%	25.53%	28.23%	24.92%	40.48%	27.16%
2014	25.62%	26.91%	23.36%	24.68%	40.88%	29.79%
2013	22.90%	33.91%	23.08%	23.03%	35.17%	25.63%
2012	29.69%	29.62%	22.78%	22.08%	42.88%	31.52%
2011	27.73%	24.20%	24.31%	23.48%	38.22%	30.92%
2010	32.24%	25.87%	29.12%	26.65%	50.23%	41.88%
2009	56.02%	44.66%	40.23%	37.80%	71.49%	76.07%
2008	41.91%	39.14%	36.78%	45.24%	58.44%	65.53%
2007	30.86%	27.82%	33.18%	45.91%	40.81%	NA

Realized volatility is high for the years of the financial crisis 2008-2009 and then it decreases over the years.

Lastly, the residual plots from the regression analysis show that although the standard residuals look normally distributed, there is a presence of autocorrelation. This leads us to a completely different topic for research.

Conclusion & Scope for Future Research

In conclusion, the declining premium is an interesting phenomenon but the four factors don't seem to really explain this efficiency in future markets completely. One would have to probably do more analysis on auto-correlation since the we are analyzing time series data.

Thus, it would be very interesting to analyze the graphs of autocorrelation, partial autocorrelation, use ARIMA models to forecast the time series trend and study concepts of memory and weak-form efficiency that probably occur in the data set. However, since this is a completely different topic and owing to lack of time, I don't address it in my study.

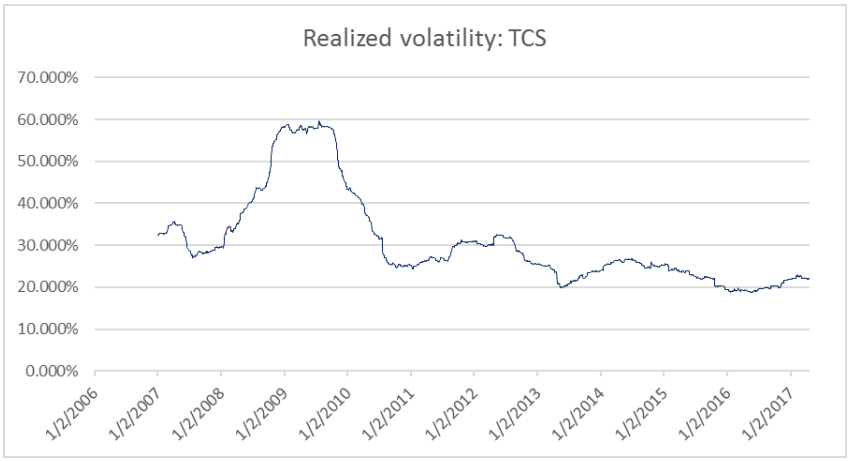
Implications

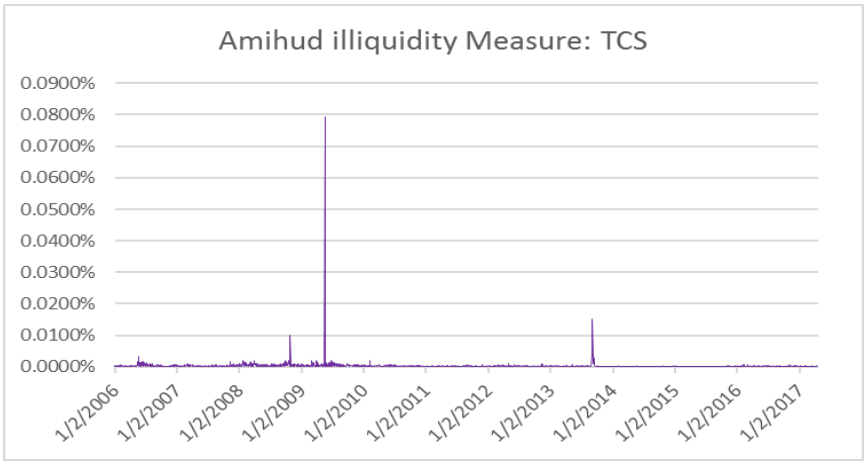
The implications of this research for future policy-makers may be to understand why this efficiency in future markets is occurring in regards to the Indian stock market and how it could be translated to the commodity markets in India, which are not that efficient.

APPENDIX

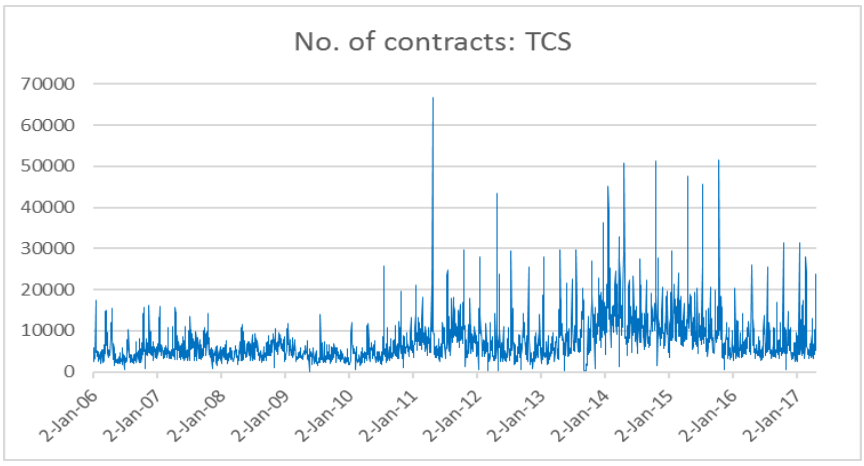
Below are the graphs of realized volatility, Amihud illiquidity measure, open interest, and number of contacts for one stock since they are very similar for the entire sample of stocks.

1. **Tata Consultancy Services Ltd (TCS)**

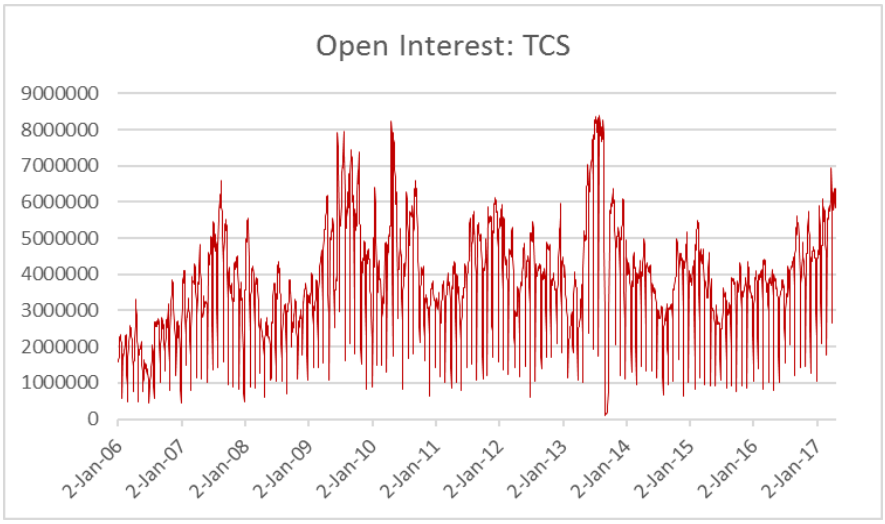




The measure for Amihud Illiquidity for TCS above shows a spike in Amihud illiquidity for May 18, 2009 liquidity. This is owing to the UPA's unexpected victory in the general elections, which resulted in the markets being closed (as I discussed earlier). Besides this day, the Amihud illiquidity suggests sufficient liquidity in the markets.



The spike in number of contracts on 21 April, 2011 is owing to profitable Q4 results for TCS. Additionally several other announcements were made by TCS like increasing wages of its employees by 12-14%[10]



[10] http://www.indiainfoline.com/article/capital-market-commentary-quick-review/sterlite-industries-surges-on-strong-q4-result-114021703303_1.html