Investigating The Efficiency of Indian Equity Futures Market

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Abstract:

The current study investigates the efficiency of the Indian equity futures market. Price discovery efficiency has been considered as the predominant feature of the efficient futures market (Telser (1981), Garbade and Sibler (1983)). The current study observed significant bilateral causality between the S&P CNX NIFTY and S&P CNX NIFTY Futures during June, 2000 and December, 2005. By applying Vector Autoregression (VAR) methodology, it has been observed that futures market is relatively more efficient as compared to the cash market. In addition, this papers reports the efficient price discovery through futures market during the high volatile periods, viz; one year around 11th Sept. 2001 (Terrorist Attack on America) and 17th May, 2004 (Biggest ever stock market crash in India due to unexpected Parliament election results). Efficient price discovery in the futures market implies that traders can take significant hedging positions to minimize the risk exposure in the cash market.

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Price discovery and risk transfer (i.e. Hedging) have been considered as the pivot functions of the futures market in all the economies (Telser (1981)). As we know, futures are the standardized forward contracts which are traded on stock exchanges. Cost-of-Carry model is followed to determine the price of the futures contract, which implies that futures represent the prospective price of the underlying asset in the cash market (Garbade and Sibler (1983)). For example; if the futures is traded at 2500 and the cash market at 2450, (if cost-of-carry model holds good) it implies that the futures will direct the next price move in the cash market, thus the next price of the underlying asset will be approximately 2500.

Price discovery is a function of the cost-of-carry model, which implies that price discovery will be true only if cost-of-carry model holds good (Turkington and Walsh (1999)). In other words, if at any time the futures are mispriced then lead-lag relationship between futures and cash market may be disturbed, which will result into wrong decision for the traders to take position in the cash market on the basis of the price movement in the futures market. In addition, if the futures are mispriced then hedging through arbitrage positions in the cash and the futures market will not work in the interest of the traders.

In addition, an efficient cost-of-carry relationship between the futures and cash market results in the comovement of price series in two markets. Comovement of price series of both markets is an evidence that price movement in both markets is cointegrated, but evidence of cointegration does not tell anything regarding the speed of price discovery in the market; rather it conveys very significant information regarding the strength of the basis (i.e. Futures Price – Cash Price) (Booth et al., (1999)). If on the date of the maturity of the contract, price series in

two markets converges (see figure I), it implies that cost-of-carry model holds good and both the series have long run relationship. If reverse holds, then it implies that the futures are mispriced and may not be an efficient price discovery vehicle (Garbade and Sibler (1983)). For an efficient convergence on the maturity date the basis is required to be predictable, but predictable basis does not necessarily imply that speedier price discovery takes place in the futures market (Fortenbery and Zapata (1997)).

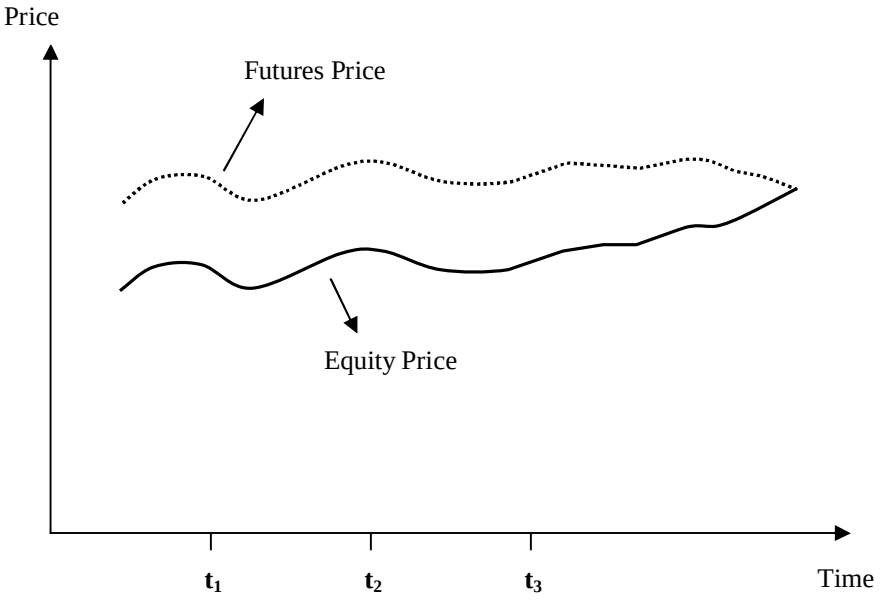


Figure I

Price discovery mechanism refers to absorbing the new information, and reflecting it into the market prices. Price discovery in the cash market has been a serious issue for debate for the traders, professionals, regulatory bodies and the academicians. Three different schools (i.e. Fundamental Analysis, Technical Analysis and Efficient Market Hypothesis) have emerged to analyze the reaction of the prices to new information. Fama made significant efforts in this regard and in 1970, he came out with formal definitions of the market efficiency. He classified the market efficiency into three categories i.e. Weak Form Efficiency, Semi-Strong Form Efficiency and Strong Form Efficiency.

A market is said to be weak form efficient if the current market price and past price are uncorrelated (i.e. the asset price movements are random). A market is known as semi-strong efficient, if it absorbs and reflects the market information as well as the public information (viz; corporate actions, political announcement etc.). Strong form efficient market is one which neglects the chances of even insiders to make abnormal profits on the basis of first hand information.

In the developed economies viz; U.S.A. and U.K., markets are found to be efficient but reverse holds in case of the emerging markets like India, Taiwan, Bangladesh etc. (Mobarek and Keasey (2000)). Thus in the emerging markets, relative pricing efficiency of the futures market may work like a lantern in the dark coal mine. If in emerging markets, futures market is able to react to the market information immediately, when these becomes available then, it will certainly help the regulators to control the volatility in the cash market and the confidence of the traders can be restored in a market like India, where people burnt their hands in early and mid 90's due to the overwhelming participation in the market by one trader (i.e. Harshad Mehta). If in India, futures market acts as an efficient price discovery vehicle, traders will be getting more confidence to trade in the cash market because they will know that futures market is their to guide their prospective actions in the market and they can protect themselves from the possible loss by taking (Beta weighted) reverse positions in the futures market (Brannen and Ulveling (1984)).

Efficient price discovery in the futures market has many advantages for the traders as well as for the regulators. Traders can manage their risk exposure in the cash market by taking reverse positions in the futures market. In many stock markets it has been observed that the volatility in the cash market has reduced in the post futures trading era as compared to the volatility in the pre futures trading era (Gulen and Mayhew (2000)). Reduction in the

magnitude of volatility will certainly work for the benefit of all traders (both retail as well as big traders). Reduction in volatility ensures relatively stable price movements in the market, which will help the traders to take their decision in the market (subject to the experience and exposure of the trader in the market) (Jong and Donders (1998)). The regulatory bodies can also be benefited through efficient price discovery in the futures market (Raju and Karande (2003)). They can simulate the reforms through futures market and then directly implement the same in the cash market. The reaction of the futures market to such reforms will certainly help the regulatory bodies to evaluate the probability of success/failure of the reform in the cash market, thus they can make appropriate modifications, if necessary.

In India, equity futures are of relatively recent origin and were introduced in the phased manner. In the first phase index futures trading was introduced on 12th June, 2000 and in the second phase, stock futures trading was permitted on 9th Nov., 2001. The trade volume in both the markets has been increasing by leaps and bounds. These days significant efforts are being made to investigate the efficiency of Indian equity futures market. Raju and Karande (2003) investigated the price discovery efficiency of the Indian equity futures market but they could not conclude anything on the basis of short time dimension. Gupta and Singh (2006) also made an attempt to investigate the price discovery efficiency of the Nifty futures by considering lengthy time frame and their results showed lead-lag relationship between the two markets.

The current study is an attempt to investigate whether Indian equity futures market is efficient and to study whether it provides any significant information during the high volatility period. For this purpose the current study has been divided into four sections. First section reviews the literature, second section discusses the data base and research methodology, section three discusses the results and section four deals with the summary and policy implications.

Section I: Review of Literature: Investigation of causal relationship between futures and cash prices is not a new phenomenon. At the international as well as at national level, significant efforts have been made to evaluate the price discovery efficiency of different futures markets (viz; commodity futures, currency futures, equity futures, etc.). Stensis (1983), Garbade and Sibler (1983), Protopapadakis and Stoll (1983), French (1986), Kawaller (1987), Mohd. Fatimah (1994), Cheung and Fung (1997), Hall (2001), Yang Jian (2001), Singh (2001), Thomas and Karande (2001), Sahadevan (2002), Campbell and Diebold (2002), Zhong (2004), and Isabel and Gilbert (2004) investigated the price discovery efficiency of commodity futures market in different countries viz; America, United Kingdom, Malaysia, India, Mexico etc. respectively. All researchers (except for Sahadevan (2002)) found strong lead-lag relationship between the futures and spot prices.

Granger et al., (1998), Covrig and Melvin (2001), Anderson et al., (2002) and Yan and Zivot (2004) examined the price discovery efficiency of currency futures market in various economies like; Hong Kong, Indonesia, Japan, South Korea, Malaysia, Philippines, Singapore, Thailand, Taiwan, America respectively and they observed strong bilateral causality between both markets. Moreover, they found that futures market is efficient for underlying currencies, in the sense that it leads the cash market.

Chan (1992), Hasbrouck (1995), Jong and Donders (1998), Booth (1999), Turkington and Walsh (1999), Menkveld (2003), Chuang (2003), Raju and Karande (2003), Barclay and Hendershott (2004), Sharma and Gupta (2005), So and Tse (2005) and Gupta and Singh (2006) evaluated the prices discovery efficiency of equity futures in different countries namely; America, Netherlands, Germany, Australia, Taiwan, India, Hong Kong respectively. Except for Barclay and Hendershott (2004), all researchers observed significant evidence of efficient price discovery through equity futures market. They all found that equity and futures prices were

cointegrated and the causality from the futures to cash market was significant as compared to the causality from reverse side.

Citing the above studies makes one thing very clear that investigating the causal relationship between futures and cash market is not a new phenomenon. For many markets in different economies at different time frames, price discovery efficiency of the futures market has been investigated and the review of literature provides strong evidence favoring the argument that futures market is an efficient price discovery vehicle.

In America, price discovery efficiency of futures market has been far investigated for all types of futures viz; commodity futures, equity futures and currency futures etc. Stensis (1983), Garbade and Sibler (1983), French (1986), Chan (1992), Cheung and Fung (1997), Hall et al., (2001), Yang Jian et al., (2001), Campbell and Diebold (2002) and Isabel and Gilbert (2004) examined the causal relationship between the spot and futures price on Chicago Board of Trade (CBOT) and they observed that spot market significantly followed the futures market and the futures market price movements provides a basis for predicting the prospective spot market price changes.

In addition to commodity futures, Hasbrouck (1995), Menkveld (2003) and Barclay and Hendershott (2004) investigated the price discovery efficiency of the equity futures market on NYSE and NASDAQ during 1993, 1997-98 and 1993-99 and except for Barclay and Hendershott (2004), all found significant causal relationship between the cash and futures prices, which is an essential condition for price discovery efficiency of futures market. Although Barclay and Hendershott (2004) found weak lead-lag relationship between cash and futures prices but their study does not completely reject the hypothesis rather their results are statistically significant and have little economic use. Moreover, first order cointegration is one

of the essential features of the cash and futures prices, which reflects that both futures as well as cash prices are non-stationary as found by different scholars in various speculative markets.

In addition to America, significant efforts have been made to investigate the price discovery efficiency of the equity futures market in different economies viz, India, Taiwan, Mexico and Hong Kong. Raju and Karande (2003) investigated the causality relationship between equity futures and cash market on NSE, but found mixed results regarding the causality relationship between two markets. The reason for the confusing results may be the short time period (i.e. Three Years) considered for the study but when the same market was examined by considering lengthy time frame (i.e. Five Years) by Gupta and Singh (2006), they found strong bilateral causality between cash and futures market. Moreover by applying Impulse Response Analysis, they found that the causality from the futures to cash market was stronger as compared to the causality from cash market to futures market.

Chuang (2003) examined the price discovery efficiency of TAISEX (Taiwan Stock Exchange Capitalisation Weighted Index Futures) and MSCI (Morgan Stanley Capital International Taiwan Index Futures) during 1998-99 and found strong statistical evidence of bilateral causality and inferred that basis movement was an efficient predictor of the prospective cash market price movements. So & Tse (2005) made an attempt to examine the causality relationship between cash and futures market on Hang Seng Index Market, and by considering the time frame of three years (i.e. 1999-2002), they found significant bilateral causality between these two markets.

Booth et al., (1999) and Upper & Werner (2002) conducted studies on German stock markets and found strong evidence of information traveling from the futures market to the spot market and they evidently highlighted and supported the price discovery role of the futures

market. Gulen and Mayhew (2000) conducted a wonderful study considering the behaviour of cash market prices during the post futures trading era for 25 countries. They observed that except for America and Japan, in all countries, the magnitude of volatility during post futures trading era has gone down. Gupta (2001), Shenbagaraman (2003) and Raju and Karnade (2003) observed the same in Indian capital market. Kiran and Nagaraj (2003) observed that futures market could do better during the market crash due to terrorist attack on America on 11th Sept.,2001 and concluded that futures market provides better information during the high volatility period and the basis looks very strong during the high volatility period, which means that both markets moves into same direction.

Thus, the review of literature provides sufficient evidences that equity futures market has been an efficient price discovery vehicle. Even in India, the studies conducted by Raju and Karande (2003) and Gupta and Singh (2006) found significant causal relationship between these two markets. The current study examines specifically the price discovery efficiency of Indian equity futures market during high volatility periods i.e. period around 11th Sept., 2001 (Terrorist attack on America) and 17th May, 2004 (Ever highest Indian stock market crash) and to the best of author's knowledge, there is no study available which examined the same hypothesis. Thus, the current study will be of great benefit for the traders and will help to fill the gap in the literature.

Section II Data Base and Methodology: Index futures on S&P CNX Nifty were permitted for trading on National Stock Exchange (NSE) on 12th June, 2000. For the purpose of the current study on price discovery, Index futures on S&P CNX Nifty. Daily closing values of Index futures and S&P CNX Nifty have been taken from June, 2000 till 31st Dec., 2005 (i.e. 1397 observations), Returns (R_t) have been calculated as log of ratio of present day's price to

previous day's price **(i.e. $R_t = \ln (P_t / P_{t-1})$)**. Data relating to the price series have been obtained from website of NSE (www.nseindia.com).

Methodology: A nonstationary time series is said to be integrated in order one, often denoted by I(1), if the series is stationary after the first-order differencing. An (n x 1) vector time series Y_t is said to be cointegrated if each of the series taken individually is I(1) while some linear combination of the series $A` Y_t$ is stationary for some nonzero vector A (Hamilton, 1994). The theory of cointegration relates to the study of the efficiency of a futures market in the following way. Let S_t be the cash price at time t and F_{t-i} be futures price taken at i periods before the contract matures at time t, where i is the number of periods ahead, then some linear combination of S_t and F_{t-i} is expected to be stationary- that is there exist a and b such that Z_t is stationary with mean 0:

$$\mathbf{Z_t = S_t - a - bF_{t-i}} \qquad \mathbf{(1)}$$

If both S_t and F_{t-i} are I (1), a condition that usually holds for prices, the vector process (S_t, F_{t-i}) is cointegrated. This cointegration between S_t and F_{t-i} is a necessary condition for market efficiency (Lai and Lai (1991)). Cointegration ensures that there exists a long-run equilibrium relationship between the two series. If S_t and F_{t-i} are not cointegrated, they will drift apart without bound, so that the futures price provides little information about the movement of the cash price.

In addition to cointegration, market efficiency also requires an unbiased forecast of futures price on cash price i.e. a = 0 and b =1 in equation (1). Therefore, the market efficiency should be tested in two steps: first to examine the cointegration relationship between the two price series S_t and F_{t-i}, if cointegration exists then parameters restriction a = 0 and b = 1 is tested. The second step may consist of multiple tests: a = 0 and b = 1 jointly or each individually. The constraint b = 1 is a more important indicator of market efficiency, because A

is non-zero under the existence of risk premium and/or transportation costs even when the market is efficient. That is why we also test them separately through a = 0 and b = 1 are often tested jointly. The cointegration relationship and the parameter restrictions can be tested using Johansen's approach as outlined below.

Cointegration Tests: Before testing for cointegration, each individual price series should be examined for I (1) first. Phillips-Perron unit root test is the common method (Booth et. al., (1999)). If both the futures and cash price series are I (1), Johansen's cointegration tests can be conducted. Consider a general k^{th} order VAR model:

$$\mathbf{\Delta Y_t = D + \Pi Y_{t-1} + \sum_{i=1}^{K-1} \Gamma_i \Delta Y_{t-i} + \varepsilon_t} \qquad \mathbf{(2)}$$

Where Y_t is an (n x 1) vector to be tested for cointegration, and $\Delta Y_t = Y_t - Y_{t-1}$; D is the deterministic term which may take different forms such as a vector of zeros or non-zero constants depending on properties of the data to be tested; Π and Γ are matrices of coefficients; and k is chosen so that ε_t is a multivariate normal white noise process with mean 0 and finite covariance matrix.

The cointegration relationship can be detected by examining the rank of the coefficient matrix Π, because the number of cointegration vectors equals the rank of Π. In particular, the 0 rank i.e. $\Pi = 0$ implies no cointegration. In a bivariable case, i.e. n = 2, the two variables are cointegrated only if the rank of Π equals 1 (Johansen and Juselius (1990)).

Johansen (1998) suggested two test statistics to test the null hypothesis that there are at most r cointegration vectors. The null hypothesis can be equivalently stated as the rank of Π is at most r, for r = 0, 1, ….., n-1. The two test statistics are based on trace and maximum eignvalues, respectively,

$$\lambda_{Trace} = -T \sum_{i=r+1} \ln(1- \lambda_i) \quad (3)$$

$$\lambda_{Max} = -T \ln(1- \lambda_{r+1}) \quad (4)$$

Where λ_1 …. λ_r are the r largest squared canonical correlations between the residuals obtained by regressing ΔY_t and Y_{t-1} on ΔY_{t-1} , ΔY_{t-2} , ….., ΔY_{t-k-1} and 1 respectively. The critical values have been taken from Johansen and Juselius (1990).

In our test for efficiency of futures market, $Y_t = (S_t, F_{t-i})$, n = 2, and the null hypothesis should be tested for r = 0 and r = 1. If r = 0 cannot be rejected, we will conclude that there is no cointegration vector, and therefore, no cointegration. On the other hand, if r = 0 is rejected, and r = 1 cannot be rejected, we will conclude that there is a cointegration relationship.

Section III: Results and Discussion: Prior to discussing the lead-lag relationship between the futures and cash markets, table 1 discusses the descriptive statistics of the Indian cash as well as the futures market and the spread between futures and the cash prices (i.e. Basis). The results of table 1 clearly show that the futures and cash market returns are asymmetric and highly volatile. Asymmetry in the cash market and futures market returns is not a new phenomenon. Risk averse nature of the traders in the market may be the prominent cause for the asymmetric returns (Moolman (2004)). Asymmetric behavior has been observed in basis as well, which implies that the comovement of both series does not have constant variance. Significance of the Jarque-Bera (JB) test statistics does not only imply that the returns are asymmetric, but it also means that the returns are not normally distributed, which is the precondition for any market to be efficient in the weak form (Fama (1965), Stevenson and Bear (1970), Reddy (1997) and Kamath (1998).

Coefficient of Box-Ljung (LB) statistic provides very interesting and useful information. Basis is predictable for full period as well as for all sub periods. Basis are serially correlated at 1 % significance level, which means for full period as well as for all sub periods

there is strong comovement between futures market and the cash market. Figure II provides same information through the plot of futures and cash prices and the spread between these two. Both futures and cash market shows upward comovement trend and more or less basis seems to be stationary during the whole period (see table 2). In figure II comovement between cash and the futures market is so strong that it is very difficult to see the curve of cash and futures market separately.

Table I Descriptive Statistics

[*] Significant at 1% level of significance, [**] Significant at 5% level of significance and [***] Significant at 10% level of significance.

VARIABLE		N	MEAN	VARIANCE	SKEWNESS	KURTOSIS	J-B	LB(1)
FULL PERIOD	FUTURES	1397	4.753E-04	2.152E-04	-1.350	14.262	7807.06[*]	4.615[**]
	CASH	1397	4.854E-04	1.987E-04	-0.976	7.774	1548.42[*]	19.106[*]
	BASIS	1397	-1.9116	58.808	-1.219	2.735	350.07[*]	842.110[*]
00-01	FUTURES	202	-1.17E-03	3.007E-04	-0.901	3.826	32.91[*]	0.501
	CASH	202	-1.13E-03	2.998E-04	-0.444	1.440	26.99[*]	1.469
	BASIS	202	2.1787	47.137	-2.327	9.536	539.17[*]	76.606[*]
01-02	FUTURES	247	3.464E-05	1.971E-04	-0.597	3.081	14.68[*]	2.640
	CASH	247	-3.07E-05	1.979E-04	-0.576	2.428	16.96[*]	7.175[*]
	BASIS	247	-3.8506	57.211	-0.922	0.899	80.10[*]	159.699[*]
02-03	FUTURES	253	-6.04E-04	8.339E-05	0.149	0.230	80.85[*]	0.392
	CASH	253	-6.09E-04	9.852E-05	0.101	0.757	52.83[*]	0.310
	BASIS	253	1.0859	13.368	-0.263	1.282	33.63[*]	109.726[*]
03-04	FUTURES	252	2.318E-03	2.166E-04	-0.215	-0.244	112.88[*]	1.477
	CASH	252	2.324E-03	2.061E-04	-0.347	0.135	91.61[*]	5.177[**]
	BASIS	252	0.7010	31.484	0.159	0.348	75.21[*]	121.703[*]
04-05	FUTURES	253	4.590E-04	3.427E-04	-2.693	27.306	6507.80[*]	0.004
	CASH	253	4.451E-04	2.679E-04	-2.290	20.022	3262.61[*]	17.465[*]
	BASIS	253	-4.1866	66.822	-1.627	4.781	144.49[*]	148.207[*]
05-06	FUTURES	190	1.661E-03	1.434E-04	-0.562	0.731	50.49[*]	0.057
	CASH	190	1.673E-03	1.165E-04	-0.696	0.866	51.12[*]	2.337
	BASIS	190	-8.1629	70.736	-3.22	-0.463	421.04[*]	92.343[*]
One Year Pre 11th Sept., 2001	FUTURES	250	-1.09E-03	2.370E-04	-0.836	4.470	51.63[*]	2.637
	CASH	250	-1.09E-03	2.469E-04	-0.398	1.830	20.86[*]	5.404[**]
	BASIS	250	-0.1248	66.732	-1.624	3.593	113.55[*]	179.981[*]
One Year Post 11th Sept., 2001	FUTURES	255	1.279E-03	2.526E-04	-0.769	2.865	25.33[*]	0.094
	CASH	255	1.260E-03	2.276E-04	-0.832	2.825	29.74[*]	0.763
	BASIS	255	-3.9508	39.033	-0.373	-0.759	156.05[*]	63.967[*]
One Year Pre 17th May, 2004	FUTURES	253	1.910E-03	2.572E-04	-0.659	1.550	40.48[*]	1.145
	CASH	253	1.922E-03	2.445E-04	-0.863	2.748	32.07[*]	3.275[***]
	BASIS	253	-5.83E-02	42.150	-0.353	0.858	53.62[*]	145.059[*]
One Year Post 17th May, 2004	FUTURES	252	2.640E-03	2.673E-04	0.848	10.158	568.19[*]	0.178
	CASH	252	2.337E-03	2.036E-04	0.837	7.198	214.47[*]	1.108
	BASIS	252	-6.7853	81.425	-1.651	4.185	129.23[*]	68.195[*]

Comovement of two series is one of the pre-condition for the relatively speedier price discovery in one market. Comovement of futures and cash market price series implies that long run relationship exists between both the markets. Johansens cointegration has been applied and table no. 2 discusses the cointegration results.

Figure II

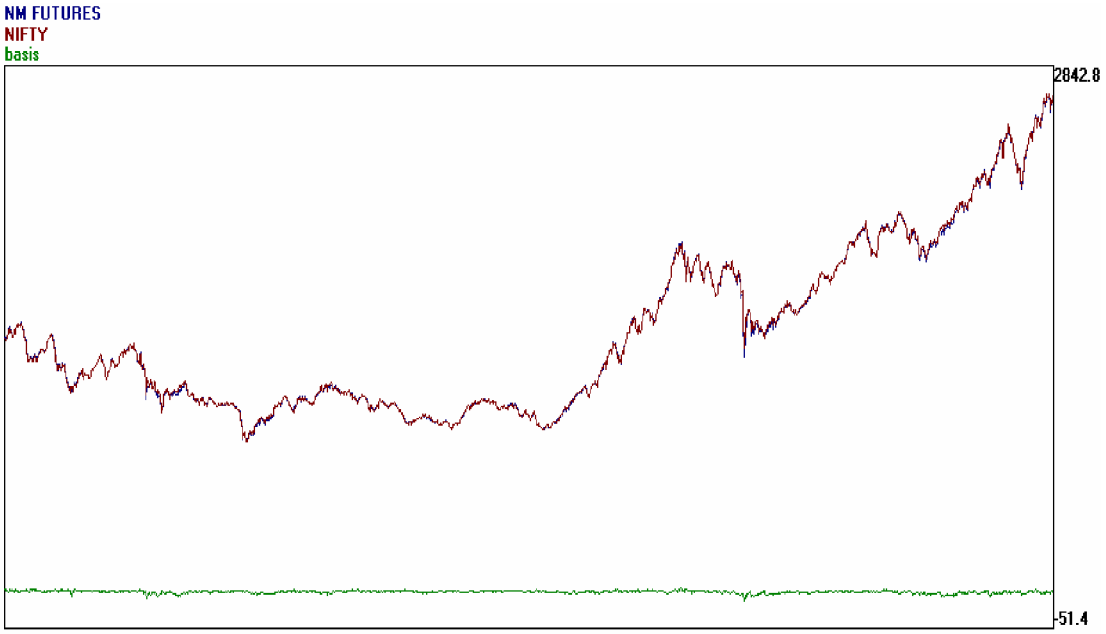


Table 2 Unit Root Test Results

Variables	Philips Perron Test Results			
	At Levels		First Difference	
	With Drift	With Drift and Trend	With Drift	With Drift and Trend
Full Period (Close to Close)				
Futures	2.40	-3.27	-1370.28*	-1307.36*
Nifty	2.52	-2.98	-1241.67*	-1182.50*
Basis	-570.68*	-610.13*		
2000-01				
Futures	-6.03	-9.87	-75.02*	-75.14*
Nifty	-6.18	-9.94	-83.97*	-84.21*
Basis	-98.41*	-92.06*		
2001-02				
Futures	-6.31	-6.05	-220.03*	-215.84*
Nifty	-6.65	-6.31	-192.37*	-88.19*
Basis	-54.34*	-59.97*		
2002-03				
Futures	-6.24	-6.31	-266.80*	-264.19*
Nifty	-6.74	-6.88	-251.08*	-248.85*
Basis	-119.10*	-119.63*		
2003-04				
Futures	-0.99	-8.08	-228.91*	-224.51*
Nifty	-0.94	-8.31	-200.82*	-197.04*

Basis	-116.34*	-120.11*		
2004-05				
Futures	-1.82	-7.77	-216.59*	-207.72*
Nifty	-1.70	-7.42	-199.57*	-190.08*
Basis	-92.80*	-116.22*		
2005-06				
Futures	0.12	-19.53**	-178.56*	-176.77*
Nifty	0.25	-17.85	-160.62*	-158.85*
Basis	-82.15*	-85.53*		
One Year Pre 11th Sept., 2001				
Futures	-3.70	-15.35	-268.72*	-269.02*
Nifty	-3.67	-15.77	-241.91*	-242.24*
Basis	-108.59*	-119.95*		
One Year Post 11th Sept., 2001				
Futures	-1.39	-27.24*	-230.24*	-212.37*
Nifty	-1.60	-23.75*	-223.04*	-206.20*
Basis	-95.98*	-108.71*		
One Year Pre 17th May, 2004				
Futures	-2.69	1.46	-250.05*	-213.80*
Nifty	-2.65	1.41	-227.05*	-193.79*
Basis	-83.27*	-83.32*		
One Year Post 17th May, 2004				
Futures	-4.06	-35.65*	-199.11*	-195.71*
Nifty	-2.83	-23.99*	-94.03*	-100.65*
Basis	-199.11*	-195.71*		

* Significant at 5 % Significance level. ** Significant at 10 % Significance level.

From table no. 3 it is clear that both markets have stable long run relationship, though in the short run they may be in the disequilibrium. Presence of the cointegration between two price series implies that both the series are integrated of order 1, which has already been shown with the help of unit root testing in table no. 2.

Presence of long run relationship implies that if both the price series contribute to same nature of information the there may exist causality relationship between these two. For this purpose Grange Causality test has been applied. Table no. 4 discusses the results of Granger causality. The results of Granger causality as presented in table no. 4 are very interesting. Bi-

Table 3 Johansens Cointegration Test Results[c]

Vector (r)	λ_{max}	λ_{Trace}
Full Period (Close to Close)		
0	71.30*	76.10*
1	4.90	4.90
2000-01		
0	49.70*	52.40*
1	2.70	2.70
2001-02		
0	29.70*	33.00*
1	3.30	3.30
2002-03		
0	44.00*	48.50*
1	4.50	4.50
2003-04		
0	42.90*	46.60*
1	3.70	3.70
2004-05		
0	22.20*	22.90*
1	0.70	0.70
2005-06		
0	40.60*	46.00*
1	5.40	5.40
One Year Pre 11th Sept., 2001		
1	23.50*	26.60*
0	3.10	3.10
One Year Post 11th Sept., 2001		
1	24.30*	31.20*
0	6.90	6.90
One Year Pre 17th May, 2004		
1	22.00*	27.70*
0	5.70	5.70
One Year Post 17th May, 2004		
1	20.80*	24.20*
0	3.50	3.50

* Significant at 5% level of significance.

directional causality has been observed, which implies that both futures and cash market contributes to the price movement in other series. In order to study the extent of causality between both the markets VAR methodology has been applied, the results of which have been attached in the appendix.

[c] Critical values for the Johansens cointegration test have been taken from Johansen S. and K. Juselius (1990).

Table 4 Granger Causality Results

Independent / Dependent	Futures	Cash
Full Period (Close to Close)		
Futures	----	16.06*
Cash	17.04*	----
2000-01		
Futures	----	13.80*
Cash	13.38*	----
2001-02		
Futures	----	11.06*
Cash	10.56*	----
2002-03		
Futures	----	13.28*
Cash	13.90*	----
2003-04		
Futures	----	25.50*
Cash	24.90*	----
2004-05		
Futures	----	37.78*
Cash	34.96*	----
2005-06		
Futures	----	20.72*
Cash	18.18*	----
One Year Pre 11th Sept., 2001		
Futures	----	11.23*
Cash	11.08*	----
One Year Post 11th Sept., 2001		
Futures	----	14.05*
Cash	13.84*	----
One Year Pre 17th May, 2004		
Futures	----	29.45*
Cash	29.73*	----
One Year Post 17th May, 2004		
Futures	----	26.42*
Cash	25.41*	----

* Significant at 1% level of significance.

VAR results for the aggregate period (i.e. 2000-2005) clearly shows that both markets affect each other upto 4 lags (see figure 2(a) and 2(b)), which implies that there is no preferable market for the traders and they can not rely upon the price movement of the futures

Figure 3 (a)

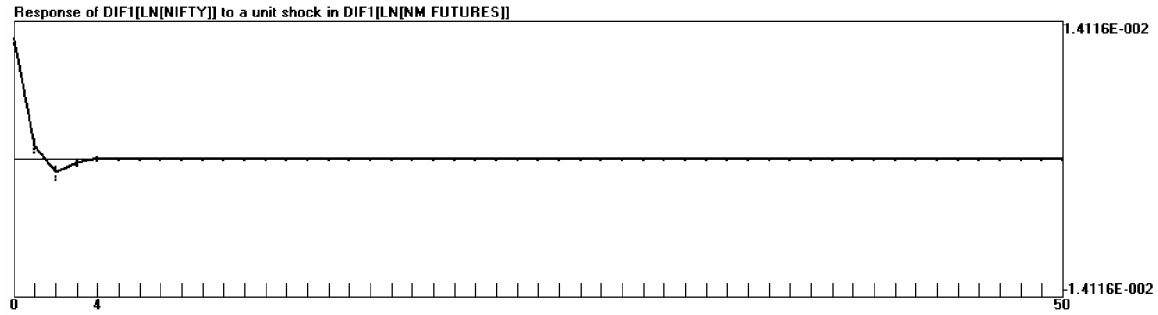
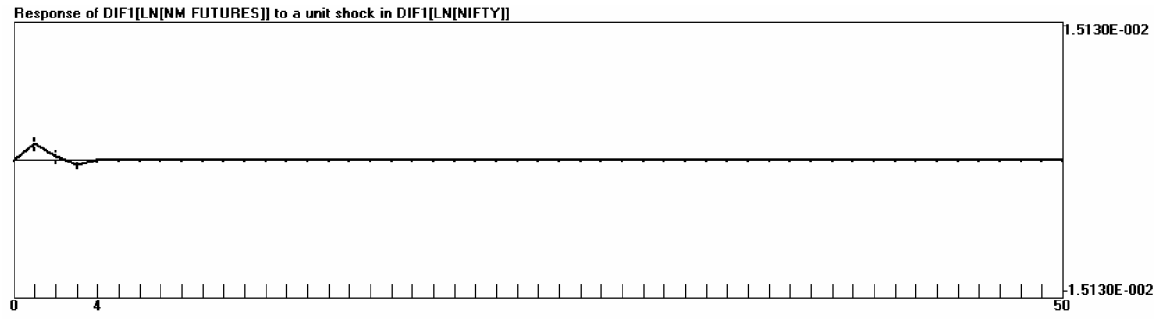


Figure 3 (b)

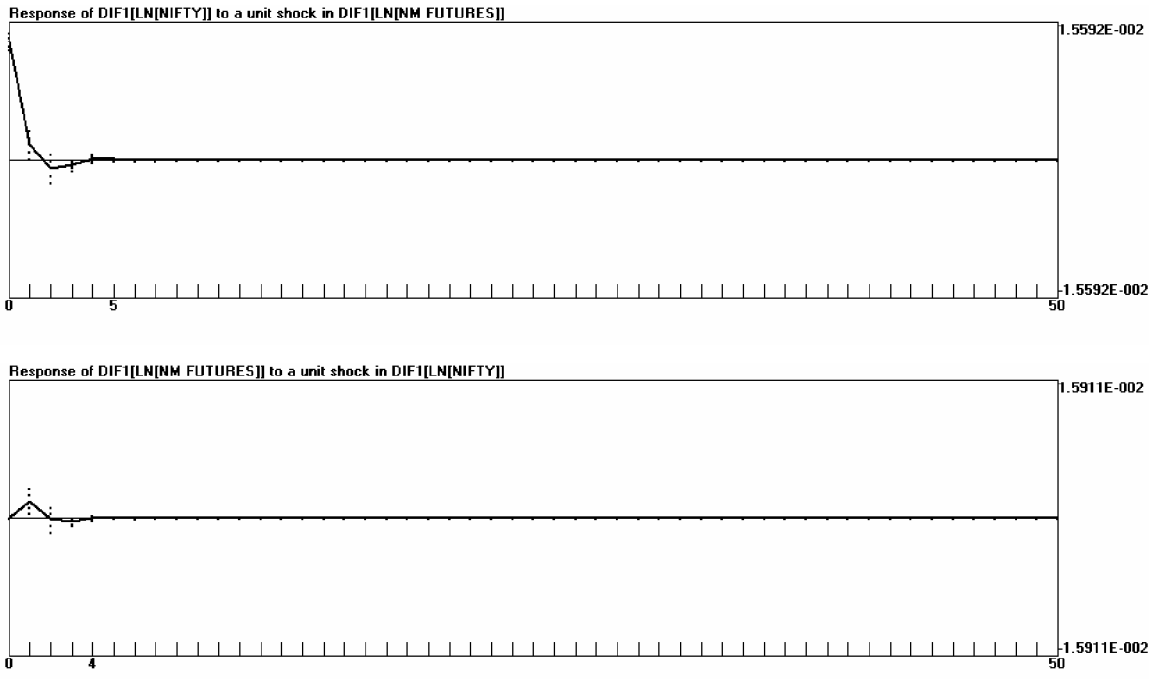


market. In figure 3(a) shows that a unit shock in futures market destabilized the cash market upto 4 lags and thereafter the cash market price curve established. Similar observation can be made from a unit shock to price series in the cash market and its effect to the futures market, as shown through figure 3(b). The notable consideration is that cash market reacted instantaneously from very upward point to a unit shock in the futures market whereas, reverse seems to be the case of shock to the cash market and its reaction to the futures market.

However, when disaggregate price series were evaluated then significant price discovery behaviour has been found in few sub periods viz; in 2000-01 futures market lead the cash market by 4 days (see figure 4(a) and 4 (b)), in 2001-02 by 6 days (see figure 5(a) and 5 (b)), in 2002-03 by 2 day (see figure 6(a) and 6(b)), in 2003-04 by 1 day (see figure 7(a) and 7(b)) and in 2004-05 by 11 days (see figure 8(a) and 8(b)), whereas in 2005-06 (see figure 9(a) and 9(b)) there is no preferable market available to the traders. These results are very significant from the traders view point because 2001-02 and 2004-05 witnessed highest

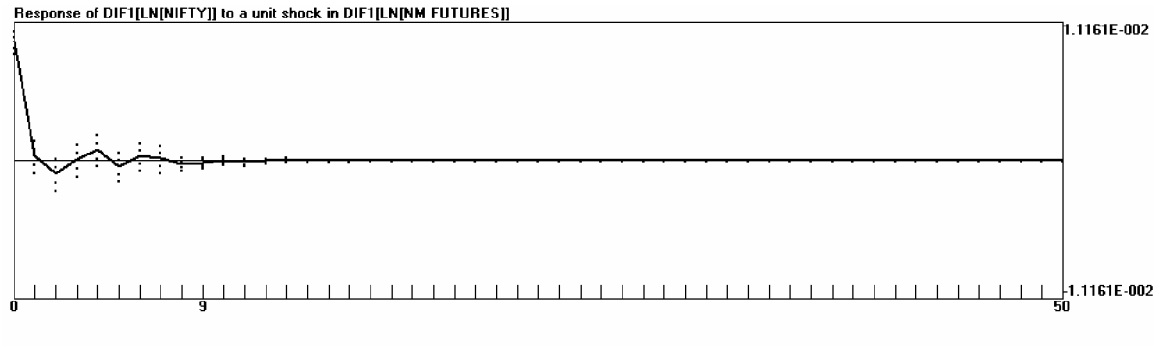
volatility in the capital market. In 2001-02 stock markets crashed due to the terrorist attack in America on 11th Sept, 2001 and in 2004-05 Indian economy observed Black Monday on 17th May, 2004 when Indian markets had to be closed due to the ever highest selling pressure because of unexpected election results.

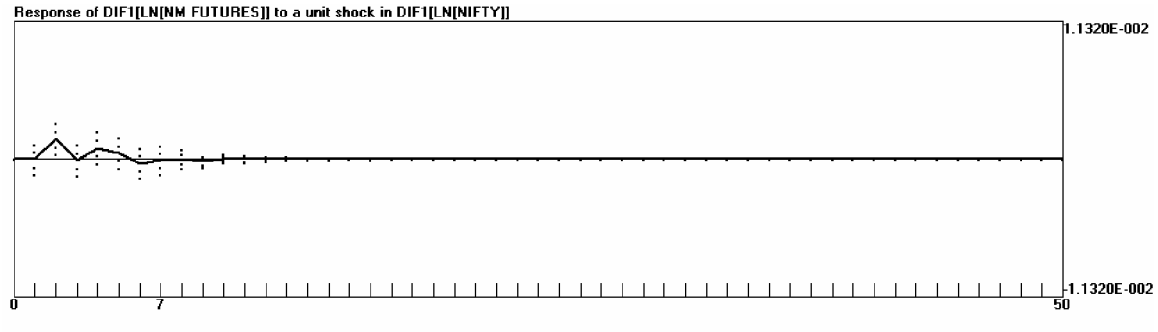
One Year Pre 11th September, 2001



In order to confirm the impact of these abnormalities in the market and to verify whether during this period futures market was actually able to provide significant information regarding the prospective price movements in the cash market, we studied the causality relationship between the futures and cash market by taking sub periods as one year pre abnormal event and one year post abnormal event.

One Year Post 11th September, 2001

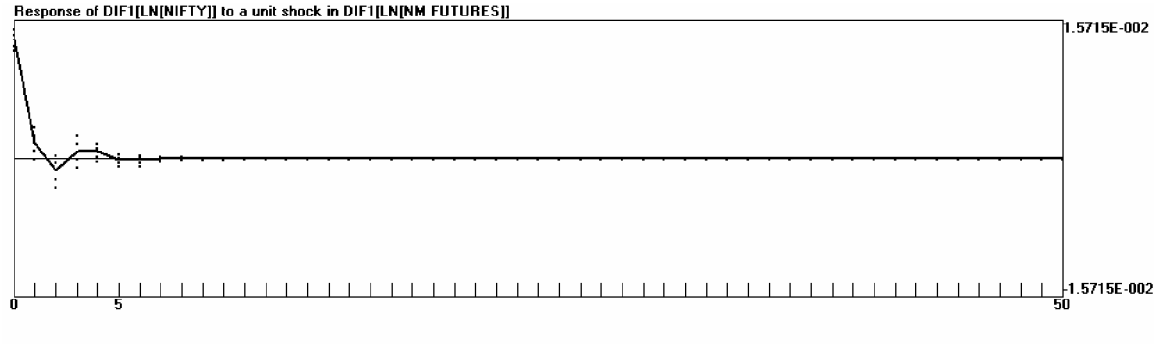


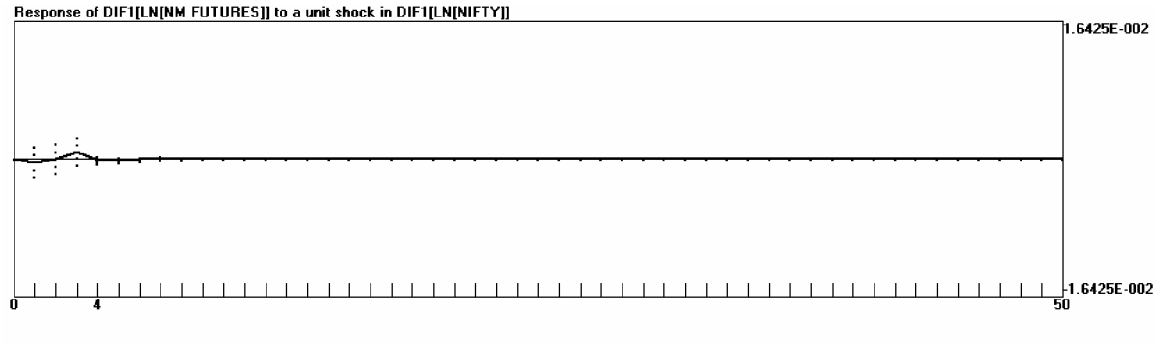


From above pictures it is clear that during one year prior to the 11 September attack on America, futures market could lead the cash market by 1 day but during one year after the attack Indian futures market was leading the cash market by 2 days. Similar evidence has been observed during 2004-05 when Indian capital market observed biggest ever market crash on 17th May, 2004.

One year prior to 17 May, 2004, futures market was leading the cash market by one day, whereas one year after the date of abnormality, futures market lead the cash market by 2 days, which supports the evidences available in the literate, that if efficient cost-of carry exists between futures and cash markets then futures market plays key role to stabilize the cash market and traders prefer to take hedging positions through futures market. Existence of cointegration relationship clearly indicates that cost-of-carry relationship between both markets is efficient and further evidences from the periods of abnormalities implies that when Indian

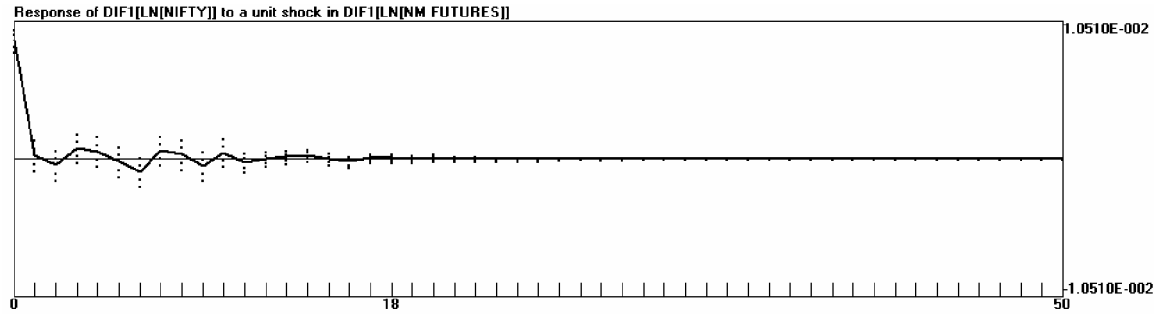
One Year Pre 17th May, 2004

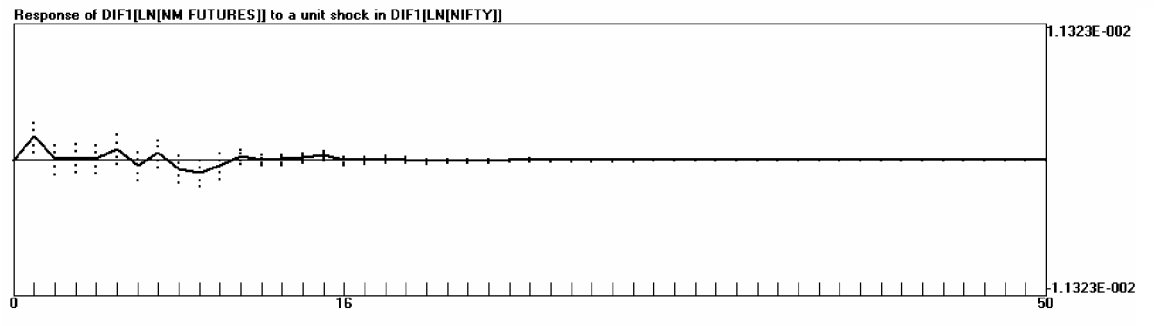




cash market is volatile then futures market is more preferable for the traders to take hedging and arbitrage positions.

One Year Post 17th May, 2004





Section IV: Summary and Conclusion: Introduction of derivatives in the Indian capital market had been a very well planned decision. Prior to introducing derivatives in the Indian capital market, its prospective impacts on the market were thoroughly evaluated; L. C. Gupta Committee Report and J. R. Verma Committee Reports are one of the significant evidences in this regard. After thorough review and serious debate on the issue the derivatives were introduced in five phases viz, in the first phase index futures were introduced, followed by index options, stock options, stock futures respectively and in the last interest rate futures.

Shenbagaraman (2003), Raju and Karande (2003) and Bandivadekar and Ghosh (2005) observed significant decline in the spot market volatility during the post futures treading era. The current study provides significant support to the decline in volatility hypothesis by evaluating the price discovery performance of Indian equity futures market during the period of high volatility. The results of the study are beneficial for the traders as well as the regulators.

The above results assures the traders that in the event of high fluctuations in the market they can rely upon the direction of the futures market because it would provide them significant information regarding the prospective move in the cash market. Thus the retail as well as Indian institutional traders can design their portfolio and can take positions in the futures market to safeguard themselves from the fluctuations in the cash market. In addition, the regulators will in advance come to know regarding the prospective price movement in the cash market and when they feel market overreacting to the information, they can take appropriate action in the interest of the common investor. Moreover from the price movements in the futures market they can adjudge the expected volatility in the cash market.

Thus on the basis of above observations, it can be concluded that Indian futures market is an efficient price discovery vehicle and it will certainly help the traders to take hedging and arbitrage positions to secure maximum returns at minimum risk exposure. In addition, the

contribution of the futures market to minimize the volatility of the cash market is an important implication of the efficient price discovery. Though futures market has been found relatively efficient price discovery vehicle but investigation of the behaviour of spread between the futures and cash market (i.e. Basis) will provide significant information regarding the exact extent of price discovery of the Indian equity futures market.

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Appendix

Figure 4 (a)

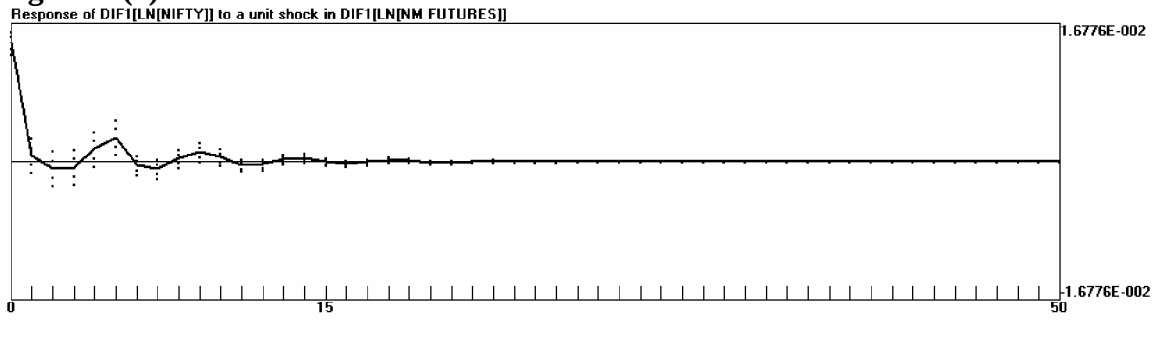


Figure 4 (b)

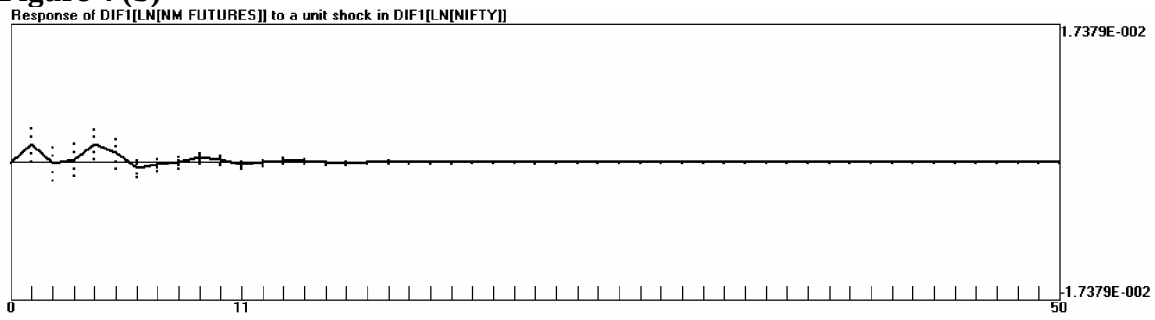
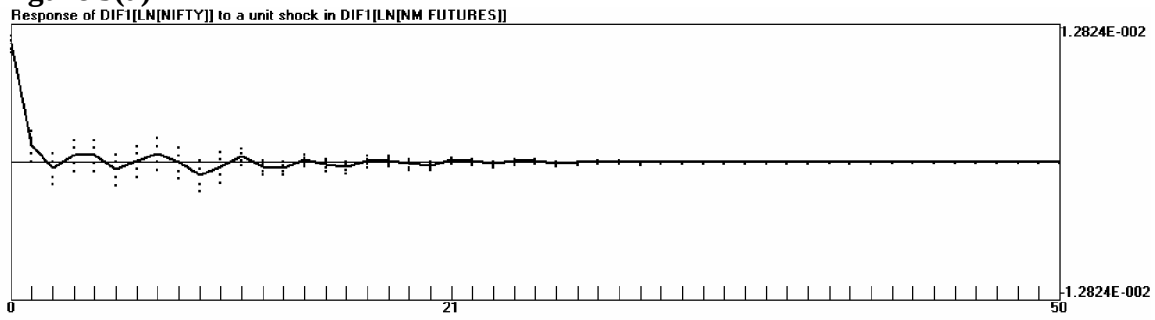


Figure 5(a)



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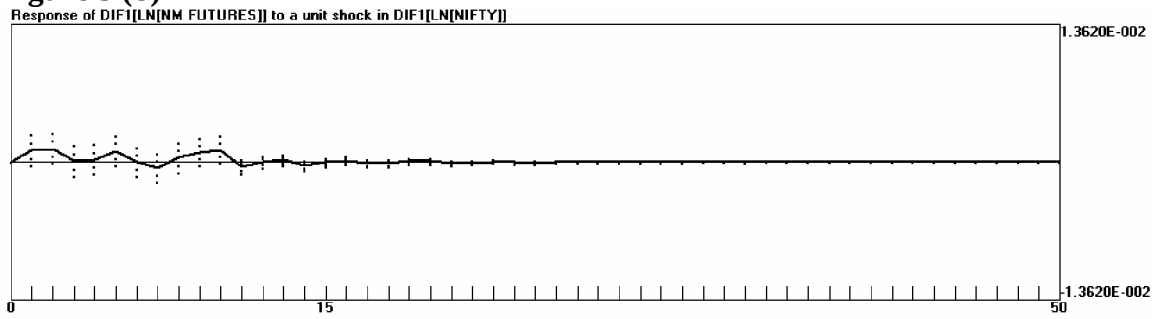

Figure 6 (a)

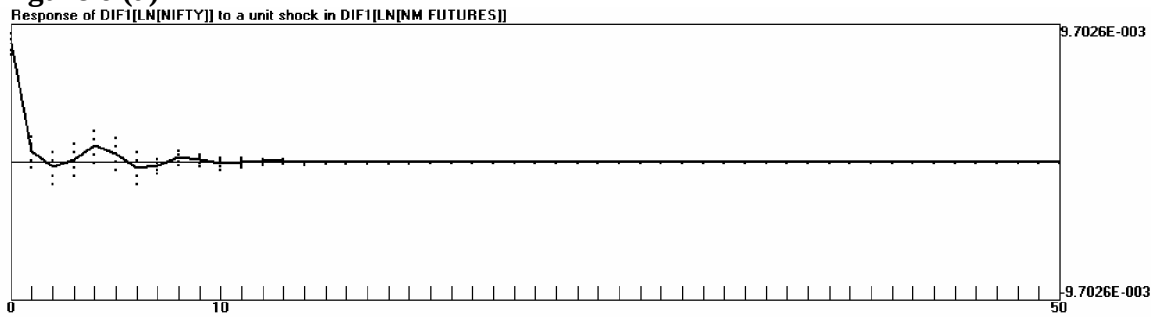

Figure 6 (b)

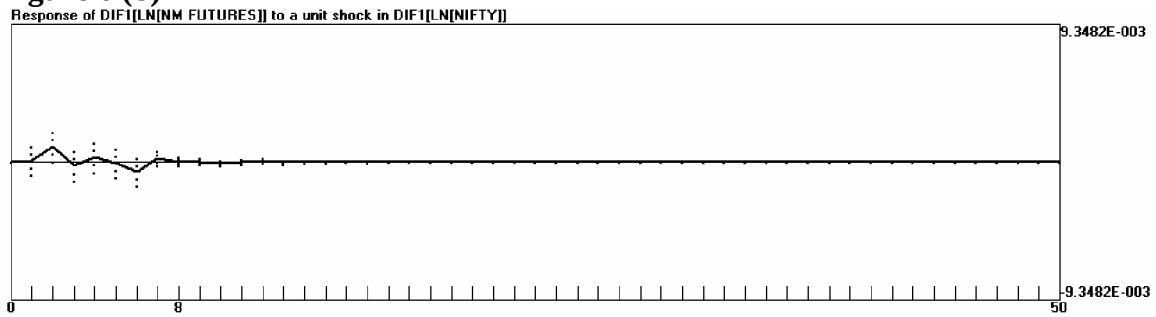

Figure 7 (a)

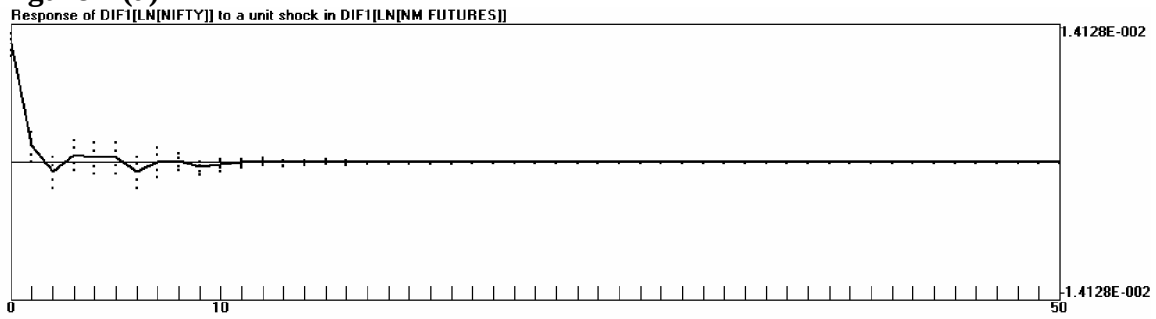

Figure 7 (b)

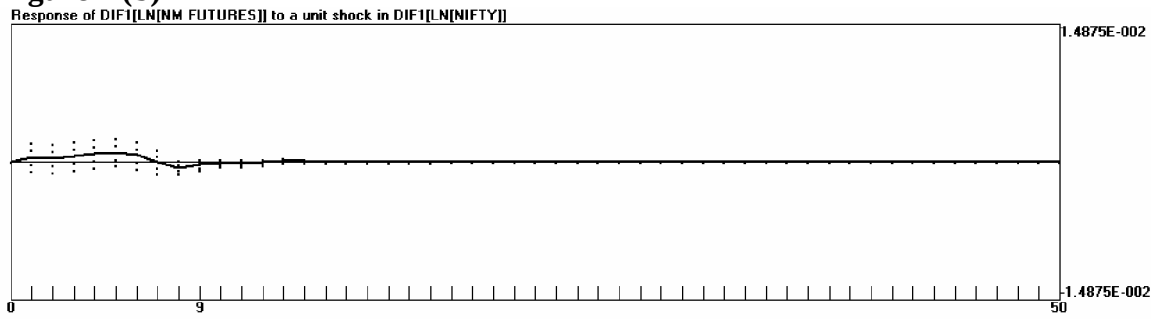

Figure 8 (a)

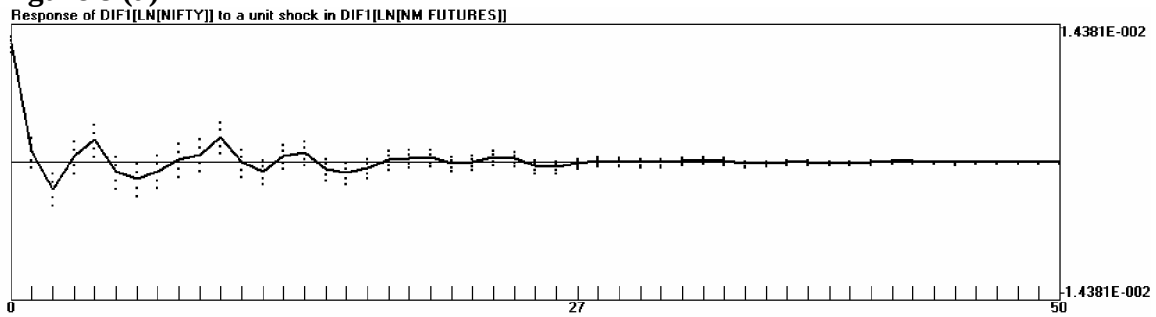

Figure 8 (b)

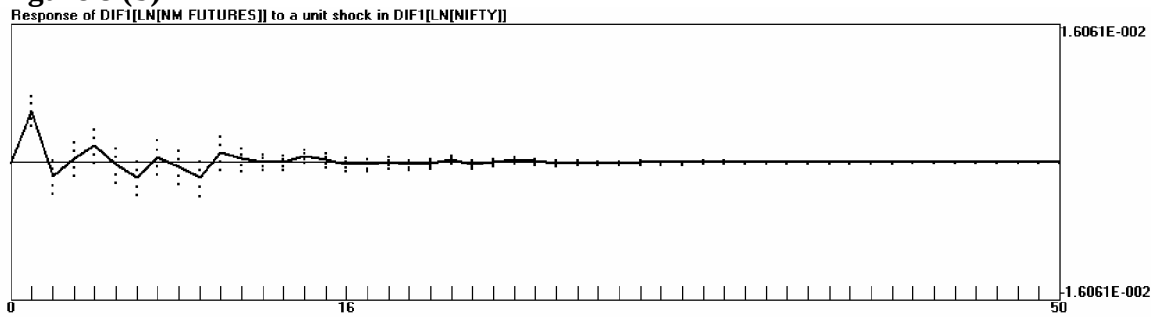

Figure 9 (a)

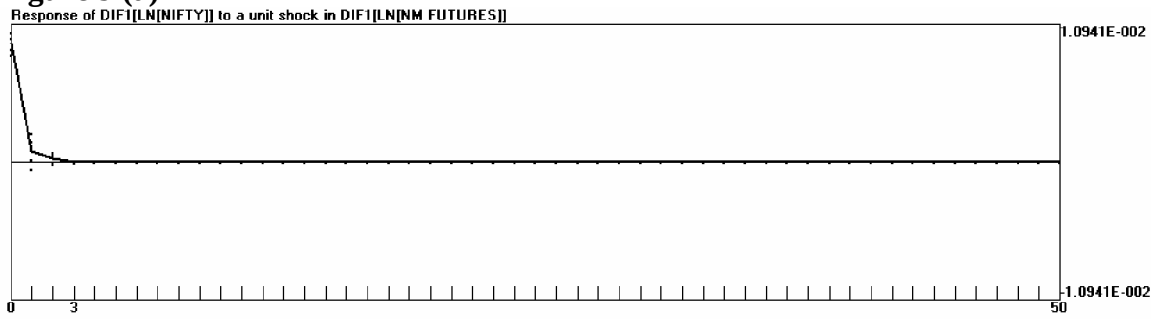

Figure 9 (b)