4.1 INTRODUCTION

In the empirical literature on capital market efficiency, the hypothesis that futures price is an unbiased predictor of the future spot price has been one of the most controversial topics among the researchers, analysts and academicians. The study of the efficiency of the futures market is significant in an emerging market like India as futures market serves the most important functions of competitive price discovery, management of risk, facilitating financing, and promotion of efficient resource allocation. Thus, this chapter is an attempt to test the long-term efficiency of futures market in India. The application of unit root and Cointegration tests provide the evidence of the futures market efficiency in India. Efficient price discovery in the futures market implies that traders can take significant hedging positions to minimize the risk exposure in the spot market.

The study of efficiency of emerging capital markets is becoming more important as a consequence of integration of these markets with more developed markets and free movements of investments across geopolitical boundaries. The term market efficiency is used to explain the relationship between information and share prices in the capital market literature. Efficient capital markets are commonly thought of as markets in which security prices fully reflect all relevant information that is available about the fundamental value of the securities.

In an efficient market, the prices of stocks incorporate all relevant information and hence, stock returns display unpredictable (or random walk) behaviour typical of the stock market. A market following a random walk is consistent with equity being appropriately priced at an equilibrium level, whereas the absence of a random walk infers distortions in the pricing of capital and risk. This has important implications for the allocation of capital within an economy, and hence, for overall financial development. In this perspective, tests of market efficiency and more particularly, random walks, provide an important means by which financial development can be appraised.
The important functions carried out by a futures market in all economies are the price discovery and Hedging. Futures are the standardized exchange traded contracts. The price of the futures contract is determined by following the cost of carry model, 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 co-movement of price series in two markets. Co-movement 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 (Figure 4.1), 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).
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.

The objective of this part of the thesis is to build a theory for testing of market efficiency by undertaking econometric models and to try to establish a conclusion about EMH in emerging financial markets. If the National Stock Exchange of India (NSE) was efficient, the stock prices would correctly and fully reflect all relevant information and hence, no arbitrage opportunities would exist. Thus, in broader sense the implication of efficiency, is that stock prices always reflect their intrinsic worth and can be taken at their face value.
4.2 EFFICIENT MARKET HYPOTHESIS

The study of capital market efficiency examines how much, how fast, and how accurately available information is incorporated into security prices. Efficient Markets Hypothesis has been a widely accepted theory which claims that the prices are defined in a random walk procedure, making price behaviour completely unpredictable. Reilly and Brown, (1997) define an efficient market as one in which stock prices adjust rapidly when new information arrives and, therefore, the current prices of stocks have already reflected all information about the stock. For a market to be efficient, three assumptions must hold: (i) Large numbers of competing profit-maximizing participants analyze and value stocks independently of each other, (ii) New information regarding stocks comes to the market in a random fashion and the announcements are independent of each other, and (iii) Competing investors attempt to adjust stock prices rapidly to reflect the effect of new information.

Fama (1970) defines an efficient market as a market in which prices always reflect the recent available information and states that three different levels of efficiency exist based on what is meant as ‘available information’ – the weak, semi-strong, and strong forms.

*Weak form efficiency* exists when security prices reflect all the information contained in the history of past prices and returns. If capital markets are weak-form efficient, then investors can not earn super-normal profits (excess profits) from trading strategies based on past prices or returns. Therefore, stock returns are not predictable, and hence follow a random walk.

Under *semi-strong form efficiency*, security prices reflect all publicly available information. The semi-strong form also encompasses the weak-form hypothesis, since all the information of the market information of the past returns, prices and trading volumes of the stock is public. Additionally to the market information, the public information includes all non-market information such as earnings, dividend announcements, other ratios and news about the overall economy. Investors, who base all their decisions on the information that becomes public, cannot gain above-average returns. The reason is that in such a market, all the prices of stocks have already reflected this information. Thus, only traders with access to non-public information,
such as some corporate insiders, can earn excess profits. In this case, the market reacts so quickly to the release of new information that there are no profitable trading opportunities based on public information.

Under *strong form efficiency*, all information - even apparent company secrets – is incorporated in security prices and thus, no investor can earn excess profit by trading on public or non-public information. Strong form presumes that the stock prices fully reflect all the available information, both from public and private sources. This means that no group of investors has monopolistic access to some information relevant to the stock, so no group of investors should be able to consistently make above-average returns. In this context, the strong form encompasses both the weak form and the semi-strong form, and assumes that prices adjust rapidly to the release of any new public information where all of this information is cost-free and available to everyone at the same time.

Before the examination of the efficiency issues of NSE, it is necessary to revisit the definition of EMH. The EMH is a statement about: (1) the theory that stock prices reflect the true value of stocks; (2) the absence of arbitrage opportunities in an economy populated by rational, profit-maximizing agents; and (3) the hypothesis that market prices always fully reflect available information (Fama 1970). According to Jensen (1978), an efficient market is defined with respect to information set $\Omega_t$ if it is impossible to earn economic profits by trading on the basis of $\Omega_t$. Fama (1970) presented a general notation describing how investors generate price expectations for stocks. This could be explained as (Cuthbertson, 1996):

The general approach underlying these tests is based on the notion that under rational expectations, with agent risk neutrality and the absence of profitable arbitrage opportunities, the expected spot price at time $t + n$ for a given set of information is the future price quoted at time $t$ for delivery at time $t + n$. It is expressed in the following equation:

$$E(S_{t+n} \mid \Omega_t) = F_{t,t+n} \quad (4.1)$$

where $S_{t+n}$ is the spot price at time $t+n$, $F_{t,t+n}$ is the forward/futures price quoted at time at time $t$ for delivery at time $t + n$, $\Omega_t$ is the information set as of time $t$ and $E(.)$
is the rational expectations operator. The rational expectations can be further expressed as follows.

\[ S_{t+n} = E(S_{t+n} | \Omega_t) + \varepsilon_{t+n}, \quad \text{where} \quad E(\varepsilon_{t+n} | \Omega_t) = 0 \]  

(4.2)

Where \( \varepsilon_{t+n} \) is a zero mean, MA (n-1) error which is independent of the information set, by Substituting (3.1) into (3.2) we have that

\[ S_{t+n} = F_{t,t+n} + \varepsilon_{t+n} \]  

(4.3)

Equation (3.3) states that the forward/Futures price quoted at time \( t \) for delivery at \( t + n \) is an unbiased predictor of the spot price at time \( t + n \). \( \varepsilon_{t+n} \) will be interpreted as forecast error. In testable form equation (4.3) is:

\[ S_{t+n} = \beta F_{t,t+n} + \varepsilon_{t+n} \]  

(4.4)

Where efficiency will achieved when \( \beta = 1 \)

Tests of efficiency based on the forward/futures price being an optimal predictor of the future spot price have yielded mixed results. Tests based on equation (4.4) tend to accept the restriction and conclude that the forward/futures price is indeed an unbiased predictor of the future spot price. Other studies have formulated the model to be tested as:

\[ \Delta S_{t+n} = \alpha + \beta (f - s)_t + \varepsilon_{t+n} \]  

(4.5)

And have rejected the restrictions \( \alpha = 0, \beta = 1 \) such that the forward rate is a biased predictor and there is a risk premium \( (\alpha \neq 0) \). The problem with this conflicting evidence is the approach adopted. Tests based on (4.4) will find it hard to reject \( \beta = 1 \) first because the two prices will track each other closely and second, the model is capturing not the true relationship between the two prices but the fact that they both follow very similar trends. This second point is very damaging to tests based on (4.4) because the data are non-stationary and it is well known that in this situation (non-stationarity), standard inference procedures are invalid. Rejections based on (4.5) have been attributed by some authors (Hakkio, 1981) to misspecification of the model. Hakkio and Rush (1989) propose a framework within which this dilemma can be resolved.

First, given the well-documented evidence that spot and forward/futures prices are stochastic non-stationary (Baillie and Bollerslev, 1989; Antoniou and Foster, 1991)
equation (4.4) can be viewed as a cointegrating regression. Thus, a first step is to test for cointegration, or equivalently test for a unit root in \( S_{t+n} - F_{t,t+n} \). In this instance, cointegration (with \( \beta = 1 \)) is necessary for efficiency. As Dwyer and Wallace (1990) point out, studies that find that \( S_{t+n} - F_{t,t+n} \) is the cointegrating vector (Baillie and Bollerslev (1989) are wrong to conclude that cointegration is the evidence of inefficiency). Non-cointegration is evidence of inefficiency.

Cointegration, with the forecast error being the cointegrating vector, however, is not sufficient to ensure efficiency. A second step must be used and this is to test for efficiency in the reduced form error correction model that follows given cointegration. Specifically, setting \( n = 1 \) for ease of exposition and estimate:

\[
\Delta S_{t+1} = \alpha \Delta f_{t,t+1} + \rho \left( s_t - \beta f_{t-1,t+1} \right) + \varepsilon_{t+1}
\]

(4.6)

The joint hypothesis is being tested at \( \rho = \beta = \alpha = 1 \). If this is valid then Equation (4.6) will collapse to Equation (4.4) and we have market efficiency.

This principle is equally applicable to the stock and stock index futures markets, although it does need modification. In fact, with the modification the conditions for efficiency are in some senses less stringent. The theory states that the stock index futures market will efficiently price contracts if the actual stock index futures price is equal to:

\[
f_{t,T}^* = s_t + (r - d)(T - t)
\]

(4.7)

The long-run equilibrium from this is simply \( f^* = s \), implying the restriction \( \beta = 1 \) in \( f_t = \beta s_t + \varepsilon_t \). This can be tested by checking for the presence of a unit root in

---

1The temptation to conclude that Cointegration implies inefficiency, as Baillie and Bollerslev (1989) do, stems from the apparently contradictory observation by Granger (1986) that first, there should be no Cointegration between two speculative markets if they are efficient and second, markets in which prices move closely together, such as spot and futures markets, should cointegrate. Baillie and Bollerslev (1989) appear to be treating spot and forward foreign exchange markets as separate speculative markets since they argue that prices can be predicted from the error correction term. This is incorrect. For example, we have already seen that if spot and futures markets are functioning effectively, they are indistinguishable, that is, they function as one market. If they are functioning as one market, then cointegration must imply efficiency. The way to think of this is that if the forward or futures price is an optimal predictor of the spot price, then the forward market now reflects the spot market in n period’s time. Therefore, they are essentially the same market and in essence one is testing the efficiency of one market at two different points in time. Thus, Granger’s (1986) observation is not contradictory.
\((f_t - s_t)\), the null hypothesis of a unit root being rejected if the restriction is valid. The system reduced to error correction model that follows on naturally and is represented by:

\[
\begin{bmatrix}
\Delta f_t \\
\Delta s_t
\end{bmatrix} = \begin{bmatrix}
-\alpha_{11} \\
\alpha_{21}
\end{bmatrix} \begin{bmatrix}
f_{t-1} \\
s_t-1
\end{bmatrix} + \begin{bmatrix}
u_{1t} \\
u_{2t}
\end{bmatrix}
\]

(4.8)

In terms of the system (4.8) reducing to \(f = s (s = f)\), the very formulation of the error correction term ensures that this will happen.\(^1\) The advantage of addressing the efficiency question in these systems framework lies in the fact that, unlike the 'traditional' framework discussed above, it is concerned with efficiency in both markets.

In the context of the systems approach it requires slightly different condition than those required in using the approach discussed above. As it turns out these conditions are not at all dissimilar to those required to ensure strongly effectively functioning equity markets.\(^2\) The following is the discussion of the efficiency of the above model in the context of stock index and index futures market.

**Both Markets are Efficient:** For both markets to be classified as efficient the model requires the cointegrating vector as a basis and the system as a whole cannot be identified. These two conditions are exactly the same as the first two necessary conditions for markets to be strongly effectively functioning. If these conditions hold, then together they are necessary and sufficient to ensure market efficiency.

The difference between efficiency and strongly effectively functioning financial markets is that there is no a priori reason to require stability as a necessary condition. If the model is stable, so much the better since this implies that the market will be efficient all of the time. However, given that there is no a priori reason to suppose that markets are efficient all of the time (and the increasing body of literature on stock market inefficiency suggests that this is the case), stability is not necessary for efficiency. If the model is unstable, it simply means that efficiency will be specific to the sample period under consideration.

---

\(^1\) As with the conditions for effectively functioning markets, the conditions for efficiency in the context of the stock and stock index futures markets has been discussed. They can obviously be generalized for systems containing more than two markets.
**One Market is Efficient:** The conditions for one of the market to be efficient correspond primarily to those for weak effective functioning of financial markets. This requires that the cointegrating vector be the basis and that one of the equations comprising the system to be identified. The equation which can be identified then corresponds to the market which is inefficient. Moreover, the inefficiency should be an exploitable one since identification will require the presence of lagged futures returns, lagged Index returns or both in the equation, which in turn implies forecastability of future returns in whichever market is inefficient. The stability condition is not required for the same reasons given in the discussion on efficiency in both markets.

Obviously, as with the discussion of the conditions for markets to function effectively, we can also identify situations when both markets will be inefficient. If there is no Cointegration, or the cointegrating vector is not the basis, then inefficiency in both markets is implied. Given that, by its designated role, the stock index futures price and the stock index price should track each other almost exactly the absence of Cointegration between the two implies that they will drift apart without bound. If this is the case, it should be possible to develop a trading strategy that exploits with the express purpose of earning abnormal returns.

In the case where there is Cointegration but the basis is not the cointegrating vector, predictability of prices is implied and again investors should be able to take advantage of this to earn abnormal returns. Finally, if both equations of the system can be identified, the implication is that future returns in both markets can be predicted and investors again should be able to formulate a trading strategy that exploits these inefficiencies.

At last the paradox here is with the Efficient Markets Hypothesis, which explains that investors who take advantage of the inefficiencies will ensure that the market is efficient. If investors believe that both markets are efficient and operate buy and-hold-type hedging strategies, the markets will remain inefficient since there will be nothing to correct prices so that they fully reflect information available.

As opposed to the above models the Random walk model (Bachelier, Pearson (1905)), explained a random walk with an analogy to a drunk who staggers in an
unpredictable and random fashion. The drunk is just as likely to end up where he began his stagger as at any other point. More formally, general random walks are stochastic processes satisfying the following equation:

\[ X_t = X_0 + \sum_{k=1}^{t} Z_k, \quad \text{where } t=1, 2, 3 \ldots \]  

(4.9)

With independent, identically distributed (i.i.d.) increments \( Z_k \). This means that at time \( t \), the increment \( Z_{t+1} \) is independent of the past values \( X_0, \ldots, X_t \) so that the best prediction of \( X_{t+1} \) is simply \( X_t + \mathbb{E}[Z_{t+1}] \), with an additional assumption that \( \mathbb{E}[Z_k] = 0 \) for all \( k \). So, Bachelier postulated “the best prediction for the value tomorrow is the value today”.

Thus the objective of this chapter is, to examine whether prices in emerging capital market of India follow a random walk process as required by market efficiency to facilitate greater degree of financial innovations for financial development and hence, for economic growth.

4.3 TESTING THE MARKET EFFICIENCY OF INDIAN SPOT MARKET

There are a number of different ways of testing for market efficiency, i.e., there are a number of techniques available to determine patterns in time series data. This study uses the Unit Root Test. In the literature, unit root test is widely used to test the efficient market hypothesis in its weak form. This study conducts a test of random walk for the NSE market in India, using its popular Index Nifty. It employs Augmented Dickey – Fuller (ADF) unit root test. We perform ADF test with intercept and no trend, and with an intercept and trend. We further test the series using the Phillip – Perron test for a confirmatory data analysis. The data used are daily stock price indices, and cover the period from June 2000 to May 2011. All data are obtained from NSE data base. The monthly values are transformed into natural logarithms of the monthly returns by using the following formula:

\[ R_t = \log \left( \frac{I_t}{I_{t-1}} \right) \]  

..................................... (4.10)

Where, \( I_t \) is the closing value of index on day \( t \), \( I_{t-1} \) is the closing value of index on previous day i.e. \( t-1 \), \( R_t \) is the daily compounded rate of return on index.
Dickey and Fuller have developed a test, known as Augmented Dickey – Fuller (ADF) test. The test consists of estimating the following regression:

\[ \Delta R_t = \beta_1 + \beta_2 t + \rho R_{t-1} + \sum_{i=1}^{m} \alpha_i \Delta R_{t-i} + \varepsilon_t \] ................................. (4.11)

Where, \( \Delta R_t \) is the first difference of the \( R_t \), \( \beta_1 \) is the intercept, \( \beta_2, \rho \) are the coefficients, \( t \) is the time or trend variable, \( m \) is the number of lagged terms chosen to ensure that \( \varepsilon_t \) is white noise, i.e. \( \varepsilon_t \) contains no autocorrelation; \( \varepsilon_t \) is the pure white noise error term, \( \sum_{i=1}^{m} \alpha_i \Delta R_{t-i} \) is the sum of the lagged values of the dependent variable \( \Delta R_t \).

Using the equation (4.11), the null hypothesis \( (H_0) \) of a unit root is \( \rho = 0 \) which is tested against the alternative hypothesis \( (H_1) \) that \( \rho < 0 \). The acceptance of null hypothesis implies the existence of a unit root, which means the time series under consideration, is non-stationary thereby indicating that the market shows characteristics of random walk and as such is efficient in the weak form. The rejection of null hypothesis implies the non-existence of a unit root which means the time series \( R_t \) is stationary and do not show characteristics of random walk. And, hence is not weak form efficient.

This research work also employs the Phillips-Perron unit root test as a confirmatory test of efficiency. Phillips and Perron suggested a non-parametric method of testing for a unit root. The PP method estimates the non-augmented DF test equation:

\[ \Delta R_t = \alpha R_{t-1} + x_i \delta + \varepsilon_t \] \& \[ \alpha = \rho - 1 \] .......................... (4.12)

Where, \( R_t \) is the monthly compounded rate of return calculated on the basis of NSE monthly stock price indices, \( x_i \) are optional exogenous regressors which may consist of constant, or a constant and trend, \( \rho and \delta \) are parameters to be estimated, and, \( \varepsilon_t \) are assumed to be white noise.

The null and alternative hypotheses of this test are

\[ H_0: \alpha = 0 \] and \( H_1: \alpha < 0 \)
The null hypothesis that the time series is non-stationary is rejected when test statistic is more negative than the critical value at a given level of significance.

It is clear that the null hypothesis of no unit roots for both the time series are rejected at their level form since the ADF test statistic values are less than the critical values at 10%, 5% and 1% levels of significances. Thus, the series are stationary. It suggests that these markets do not show characteristics of random walk and hence are not efficient in the weak form.

Table 4.1: Results of Augmented Dickey-Fuller Unit Root Test

<table>
<thead>
<tr>
<th>Series in their Level Form with Trend and Intercept</th>
<th>ADF Statistic</th>
<th>Critical Values</th>
<th>Decision</th>
</tr>
</thead>
<tbody>
<tr>
<td>NIFTY Based Return Series</td>
<td>-49.45</td>
<td>At 1% : -3.96</td>
<td>Reject Null hypothesis of no unit root</td>
</tr>
<tr>
<td></td>
<td></td>
<td>At 5% : -3.41</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>At 10% : -3.12</td>
<td></td>
</tr>
<tr>
<td>FUTIDX NIFTY based Return Series</td>
<td>-51.12</td>
<td>At 1% : -3.96</td>
<td>Reject Null hypothesis of no unit root</td>
</tr>
<tr>
<td></td>
<td></td>
<td>At 5% : -3.41</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>At 10% : -3.12</td>
<td></td>
</tr>
</tbody>
</table>

Table 4.2: Results of Phillips - Perron Unit Root Test

<table>
<thead>
<tr>
<th>Series in their Level Form with Trend and Intercept</th>
<th>PP Statistic</th>
<th>Critical Values</th>
<th>Decision</th>
</tr>
</thead>
<tbody>
<tr>
<td>NIFTY Based Return Series</td>
<td>-49.40</td>
<td>At 1% : -3.96</td>
<td>Reject Null hypothesis of no unit root</td>
</tr>
<tr>
<td></td>
<td></td>
<td>At 5% : -3.41</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>At 10% : -3.12</td>
<td></td>
</tr>
<tr>
<td>FUTIDX NIFTY based Return Series</td>
<td>-51.11</td>
<td>At 1% : -3.96</td>
<td>Reject Null hypothesis of no unit root</td>
</tr>
<tr>
<td></td>
<td></td>
<td>At 5% : -3.41</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>At 10% : -3.12</td>
<td></td>
</tr>
</tbody>
</table>

It is clear that the null hypothesis of no unit roots for both the time series are rejected at their level form since the PP test statistic values are less than the critical values at 10%, 5% and 1% levels of significances. Thus, the series are stationary. This means these markets do not exhibit characteristics of random walk and as such are not efficient in the weak form.

The Efficient Market Hypothesis has been tested for the spot market in India by selecting NSE as representative market. The efficiency of spot market contributes to
the literature the evidence of its weak form inefficiency. The result supports the common notion that the capital markets in the emerging economies are not efficient and to some extent reveal the less optimal allocation of portfolios into these markets.

4.4 TESTING THE MARKET EFFICIENCY INDEX FUTURES MARKET

The efficiency of futures market in India is being tested over the period from June 2000 to May 2011. In order to analyze the efficiency of futures markets time series of the future spot price ‘$S_t$’ and futures prices ‘$F_{t-1}$’ that correspond to those spot prices are required. For this purpose, data on daily closing value of near-by month contract, i.e., FUTIDX NIFTY and closing price of S & P CNX NIFTY have been taken from the NSE India Ltd. The futures price and cash price values are then converted to their log values to avoid the natural problems of econometrics. Then market efficiency of index futures market is tested by examining cointegration relationship between the cash price (S & P CNX NIFTY) and the futures price (FUTIDX NIFTY). For the purpose, Johansen’s cointegration test has been applied. Cointegration of two price series is a necessary condition for market efficiency, since the market efficiency hypothesis implies that the future price is an unbiased predictor of the future spot price. If the two series are Co-integrated, $S_t$ and $F_{t-n}$ move together and will not tend to drift apart over time. If this is the case then the futures price is an unbiased predictor of the future spot price.

At the outset the spot and future prices are plotted to observe their co-movements over the sample period and the Fig.4.2 summarizes the findings. The Fig.4.2 provides the evidence that co-movement between cash and futures market is very strong. Co-movement of two series is one of the pre-condition for the relatively speedier price discovery in one market. Co-movement of futures and cash market price series implies that long run relationship exists between both the markets. This is the indication of futures market efficiency. And, this can be statistically captured by the Johansen’s cointegration test.
But before we proceed to the Cointegration test, it is required to determine the order of integration for each of the two variables used in the analysis. The Augmented Dickey-Fuller unit root test has been used for this purpose and the results of such test are reported in Table -4.3.

**Table 4.3: Results of Augmented Dickey-Fuller Unit Root Test**

<table>
<thead>
<tr>
<th>Variables in their First Differences with trend and intercept</th>
<th>ADF Statistic</th>
<th>Critical Values</th>
<th>Decision</th>
</tr>
</thead>
<tbody>
<tr>
<td>NIFTY</td>
<td>-49.33</td>
<td>At 1% : -3.96</td>
<td>Reject Null hypothesis of no unit root</td>
</tr>
<tr>
<td></td>
<td></td>
<td>At 5% : -3.41</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>At 10% : -3.12</td>
<td></td>
</tr>
<tr>
<td>FUTIDX</td>
<td>-51.12</td>
<td>At 1% : -3.96</td>
<td>Reject Null hypothesis of no unit root</td>
</tr>
<tr>
<td></td>
<td></td>
<td>At 5% : -3.41</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>At 10% : -3.12</td>
<td></td>
</tr>
</tbody>
</table>

It is clear from Table-4.3 that the null hypothesis of no unit roots for both the time series are rejected at their first differences since the ADF test statistic values are less than the critical values at 10%, 5% and 1% levels of significances. Thus, the variables are stationary and integrated of same order, i.e., I(1). Since the two series are integrated of same order, the Johansen’s Cointegration test is used to examine the long-run market efficiency and the results of Johansen’s Cointegration test are summarized in the Table-4.4.
Table 4.4: Results of Johansen’s Cointegration Test

<table>
<thead>
<tr>
<th>Hypothesized Number of Cointegrating Equations</th>
<th>Eigen Value</th>
<th>Trace Statistics</th>
<th>Critical Value at 5% (p-value)</th>
<th>Maximum Eigen statistics</th>
<th>Critical Value at 5% (p-value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>None*</td>
<td>0.038091</td>
<td>106.3986</td>
<td>15.49471(0.0001)</td>
<td>106.1764</td>
<td>14.26460(0.0001)</td>
</tr>
<tr>
<td>At Most 1</td>
<td>0.000081</td>
<td>0.222223</td>
<td>3.841466(0.6373)</td>
<td>0.222223</td>
<td>3.841466(0.6373)</td>
</tr>
</tbody>
</table>

*denotes rejection of the hypothesis at the 0.05 level

It is well known that Johansen’s cointegration test is very sensitive to the choice of lag length. So first a VAR model is fitted to the time series data in order to find an appropriate lag structure. The Akaie Information Criterion (AIC), Schwarz Criterion (SC) and the Likelihood Ratio (LR) test are used to select the number of lags required in the cointegration test.

The cointegration test indicates that there exists one cointegrating vector at the 5\% level of significance. This indicates that spot and future prices are cointegrated in the long-run which is the indicator of relative efficiency of futures market. Thus, on the basis of above observations, it can be concluded that Indian futures market is a relatively 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 spot market will provide significant information regarding the exact extent of price discovery of the India’s futures market.

The investigation of long run market efficiency over the sample period from June 2000 to March 2011 provides the evidence that the spot market is showing weak form of inefficiency. Thus next period price will not reflect the previous day’s information. As regards to the futures market, the time series of spot and future prices of S & P CNX NIFTY are integrated of order one and Cointegrated in the long-run. This is the indication of relative efficiency of India’s F & O market. Such 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 spot market. Thus, the retail as well as domestic institutional traders in India 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.

Finally, the evidence presented in this chapter implies that, despite the strong growth in Indian futures market’s short history since inception in 2000 and its development in accordance to other matured markets, more actions have to be taken in order to contribute to its efficiency. These actions concern the price transparency, the further decrease in margins and trading costs, the development of more effective trading systems and market monitoring and the market liquidity by increasing the participation from domestic and foreign institutional investors.

4.5 TO SUM UP

The continued worldwide expansion in the use of derivative instruments is attributable to the growing need of market participants to speculate and hedge against various financial risks. Derivatives offer a cheaper way of managing the risks than the corresponding cash markets. Globalization of investments and rapid advances in information and telecommunications technology also contributes to the strong growth of derivative trading.

For derivatives markets to perform a function being a price discovering market, the essential question is whether the new information is first reflected in futures prices. This means that there should be investors who regard derivatives as an investment vehicle superior to the underlying security and, therefore, futures prices determined by such traders will reveal ‘real’ stock prices. Some reasons for futures to be a superior vehicle are as follows. First, transaction costs are usually lower in derivatives markets than in the stock market. Second, the futures market may be more liquid than the stock market.
market and index transactions generally take a relatively long time, i.e. tracking a specific index is not a matter of seconds but it may take hours to buy or sell all stock series included in the NIFTY. Third, for a trader with bearish view it has been definitely easier to trade futures since there are no restrictions governing short sales.

Stock Market Efficiency is an important concept, in terms of an understanding of the working of the capital markets. The efficiency of the emerging markets like India assumes greater importance as the trend of investments is accelerating in these markets as a result of regulatory reforms and removal of other barriers for the international equity investments. The term market efficiency is used to explain the relationship between information and share prices in the capital market literature. Fama (1970 and 1991) classifies market efficiency into three categories namely, weak-form, semi strong-form and strong-form. In other words, a market is considered weak form efficient if current prices fully reflect all information contained in historical prices, which implies that no investor can devise a trading rule based solely on past price patterns to earn abnormal returns. A market is semi strong efficient if stock prices instantaneously reflect any new publicly available information and Strong form efficient if prices reflect all types of information whether available publicly or privately.

This study examines the long memory properties of Indian Capital Market with special reference to NSE using the weak-form version of the EMH as a criterion. This is important because the efficiency of a market in processing information affects its allocative capacity, and therefore its contribution to economic growth. Furthermore, our results show that the behaviour of equity market returns and the associated volatility are dissimilar. This may have implications for portfolio diversification and risk management strategies. In particular, these results may be useful to investors given that price volatility is an important driver of active investment returns; and, volatility is also a key determinant of risk premia in equity markets.

In terms of policy implications, the rejection of the market efficiency hypothesis implies that addressing trading frictions; promoting timely disclosure and dissemination of information to investors on the performance of listed companies; and strengthening regulatory oversight are key elements of a strategy aimed at improving the efficiency of the capital as well as the derivatives market.
REFERENCES


