Presence of Rational Speculative Bubbles In The Indian Stock Market

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India ranks as one of the largest emerging markets in terms of economic size and market capitalization. It has attracted direct foreign investments as well as portfolio investments in the stock market. The net foreign institutional investment flows touched a record $10.57 billion in 2005 against $8.52 billion in 2004, and this is a 24.06% jump in a 5-year duration. The portfolio investments of the foreign institutional investors certainly contributed to the market boom in which the role of IT sector needs a special mention. The Indian domestic IT segment recorded a significant growth of nearly 22 percent during 2005-06, touching US$ 12.4 billion in revenues[1]. Though the stock market growth is justifiable through the optimistic economic growth as reflected by the GDP rates, there is skepticism as to the high expectations of potential returns. It is pertinent to examine at this stage whether the expectations in the stock market are justified by the fundamentals.

Theoretical arguments for the efficiency of financial markets rely crucially on the stabilizing powers of rational speculation. These arguments, dating back to as early as Friedman (1953), say essentially that rational speculators "buck the trend" and by doing so, bring prices closer to fundamental values (De Long, Shliefer, Summers and Waldmann, 1990).Though there had been a crash in the IT sector during 2001 in the Indian stock market aftermath of the dotcom bubble everywhere, not much research evidence is apparent of the presence or bursting of a bubble in the Indian scenario.

Speculative bubble theory attempts to explain the 'excessive' financial spot market price volatility often observed in the real world within the context of a predetermined external reality that imparts intrinsic or fundamental values to all real economic assets (Davidson, 2002). If the bubble is rational, decision makers believe that there is a probability *'p'* of a positive deviation from the intrinsic value in the next period's financial stock price.

There are various ways of classifying bubbles that include the one depending on its own observation of the previous period called a Markovian bubble (Ikeda, 1992). A bubble depending on the exogenous stochastic process (fundamentals) is called an intrinsic bubble (Froot, Obstfeld, 1991). A bubble depending on an arbitrary exogenous, possibly stochastic process or any other event occurring outside the model is called an extrinsic bubble (Camerer, 1989).

Brooks, Katsaris (2003) test for the presence or otherwise of speculative bubbles in the London stock exchange and classify the tests into three main categories: tests for bubble premiums, tests for excess volatility and tests for the cointegration of dividends and prices.

Juha Junttila (2003) uses a battery of unit root test procedures and co-integration analysis with alternative null hypotheses and found some evidence of speculative bubbles in the Finnish stock market for monthly data on industry portfolio stock prices and returns from the 1990s. When analyzing the time series behavior of stock market prices and returns against the development of certain macroeconomic fundamentals, the bubbles seem to exist, especially in the information technology (IT) prices.

Sarno and Taylor (2003) test for asset price bubbles in stock markets of six Latin American countries using data from 1980 to 1990. They employ estimation techniques designed to exploit the skewness and leptokurtosis that bubbles may engender in the data. Massive deviations from normality in both stock prices and dividend series were detected and the test results provide strong evidence for the existence of stock price bubbles in each of the markets examined.

West (1987) proposed a test on speculative bubbles in a constant discount rate model based on the comparison of two sets of estimates of the parameters needed to calculate the expected present discounted value (PDV) of a given stock's dividend stream, with expectations conditional on current and all past dividends. The author finds evidence in favor of the presence of speculative bubble in the U.S. stock market. The same conclusion is suggested in Blanchard and Watson (1982), observing violations of volatility bound tests.

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West uses the constant expected return model in testing the null hypothesis of no bubbles. He first conducts a battery of tests to check that the return equation is consistent with the data and concludes that the evidence is not greatly at variance from the assumption. He next estimates a dividend forecasting equation in which future dividends depend upon the past history of dividends, and he checks its consistency with the data. The West specification test then compares the parameters in the projection of stock prices onto the information set of dividend forecasting equation to the parameter estimates constructed to satisfy the Hansen-Sargent (1981) formula, which uses the estimated 1/(1+r) and the parameters of the dividend forecasting equation. Since there is a substantive difference in the two sets of estimates, West concludes that the data rejects the null hypothesis of no bubbles. The rejection appears to result at least in part because the coefficients in the regression of price on dividends are biased upwards.

McQueen and Thorley (1994) examine monthly returns to the NYSE portfolio for evidence of speculative bubbles. They argue that negative duration dependence in runs of positive abnormal returns is indicative of rational speculative bubbles. But Harman and Zuehlke (2004) explore whether duration dependence tests for speculative bubbles are sensitive to specification decisions. Their results question the efficacy of using measures of duration dependence to test for speculative bubbles and find that evidence of duration dependence is sensitive to the method of correcting for discrete observation of continuous duration, the use of value-weighted versus equal-weighted portfolios, and the use of monthly versus weekly runs of abnormal returns. Chan, McQueen and Thorley (1998) evaluate six Asian stock markets viz. Hong Kong, Japan, Korea, Malaysia, Thailand and Taiwan and the U.S. market for evidence of rational speculative bubbles using duration dependence following McQueen and Thorley (1994) and conditional skewness tests. They find that none of the seven markets have return characteristics that completely conform to the predictions of the rational speculative bubbles model.

Besides these specification tests, direct tests consider explicitly a specific bubble process and test directly for the significance of the bubble solution. The three bubble specifications that are economically reasonable and econometrically tractable are: deterministic bubble analysed by Flood, Garber (1980) and an intrinsic bubble as investigated by Froot and Obstfeld (1991), and a geometric intrinsic bubble (Salge, 1997).

Ma and Angelos (2000) focus on the intrinsic bubble model of stock prices where they find a non-linear relationship between stock prices and dividends for the U.S. stock markets. A finding of a long run nonlinear stock price-dividend relationship is interpreted as evidence that intrinsic bubbles are relevant in the long run. Driffill and Sola (1998) show that a Markov-switching model is a more appropriate representation of dividends and generalize the formulation of stock prices including the intrinsic bubble to allow for this, and show that regime-switching provides a better explanation for stock prices than the bubble. Chiarella and Gao (2002) formulate a model that is able to generate the trend of stock price index, S&P 500 from earnings and interest rates implying that those are fundamental factors underlying stock price index and show that noise in the stock price index is a mean reverting process, causing the stock price index to mean-revert to the trend. The model fits the data well and the 1987 stock price bubble shows up clearly as a gap between price and value.

Ahmed and Uppal (1999) study the behavior of daily stock returns from ten pacific-rim countries by using regime switching models and non- linearity tests by studying the ARCH effects to detect trends and find that far -east and world stock indices point to the existence of bubbles.

In the context of the Indian stock market, two major stock exchanges dominate the equity market viz, the Bombay Stock Exchange and the National Stock Exchange. Both the markets have moved in tandem and several studies have been carried out to test the efficiency of the markets. In this paper, we study the presence of rational speculative bubbles in the Indian market with respect to the National Stock Exchange and the rest of the paper is organized as follows. Section 1 describes the testing methodology; section 2 presents the data structure, section 3 reports the empirical results and section 4 summarizes the results and conclusions.

SECTION : 1 SPECIFICATION TESTS

Two types of tests can be applied to empirically examine the presence or absence of bubbles in the stock market namely indirect and direct tests. Indirect tests do not specify the bubble process explicitly whereas direct tests assume a well- defined bubble process. These tests have been carried out in the present study which are substantiated below.

1.1 VARIANCE BOUNDS TESTS

Variance Bounds tests, developed by Le Roy, Porter (1981), Shiller (1981) consider a rational expectation of a variable formed by an individual at time t is the mathematical expectation conditional on the information set I_t. Here, the subjective expectation can be equated to the rational expectation.

$$P_{t=} \alpha E[(p_t+_1, d_t+_1) / I_t] \quad \text{.....(1)}$$

where $\alpha (0 < \alpha < 1) = 1/(1+r)$ is the constant ex ante real discount rate.

The rational expected value of the endogenous variable *'p'* one period ahead is the mathematical expectation conditional on past and current realizations of both the exogenous variable *d* and endogenous variable *p* contained in information set I_t.

$$E[p_t+_1/I_t] = E[p_{t+1}/ p_t, p_{t-1}, \ldots p_0; d_t, d_{t-1}, \ldots . d_0]$$

Variance bounds tests are based on the rejection of the null hypothesis of market efficiency, i.e. asset prices do not reflect their fundamental values. Alternatively, they conclude that a component, in addition to the present value of future fundamentals, is likely to be present in the data set.

Indirect specification tests are based on the standard efficient markets model and stock price is determined by the following arbitrage relationship (Brealy and Myers, 1981).

Here the current realization of the endogenous variable $\{p_t\}$ equals the current realization of ex-post rational endogenous variable $\{p^*\}$ minus a sequence of rational prediction errors.

$$p_t = p_t^* - c_t$$

c_t is by definition a speculative bubble, a rational expectation that affects asset prices since the market expects it.

c_t is described as

$$c_t = (c_t-_1 - \overline{c}) / \pi_t b \text{ with probability } \pi_t$$

$$(\overline{c} / (1 - \pi_t) b \text{ with probability } 1 - \pi_t$$

$$0 < \pi_t < 1, \overline{c} > 0$$

The probability that a bubble grows is π_t and that it collapses is $1 - \pi_t$

1.2 SPECIFICATION TEST

Specification tests focus more directly on the possible existence of rational bubbles. The inequality of the variance bounds tests states that the variance of the ex-ante rational endogenous variable has to be smaller or equal to the variance of the ex-post rational endogenous variable. The hypothesis is stated as

$$H0: Var(p_t) <= Var(p_t^*)$$

As in West (1987), two sets of consistent parameter estimates are taken into account and then Hausman specification test was conducted in order to estimate whether both the estimates differ or not. A rejection of the null hypothesis that there is no difference between both the sets may be interpreted as a possibility for existence of rational bubbles.

The first set of estimates are derived using the exogenous variable by applying an OLS estimation technique. This is in other words the fundamental explanation to asset prices. The second set of estimates are obtained by estimating the linear stochastic difference equation; taking into account the fundamental process simultaneously. If both models describe asset price movements, some restrictions concerning the estimated parameters of these model specifications must be true. These restrictions under the null hypothesis of no rational bubbles can be stated as :

$$R(\hat{\theta}) = 0$$

Where $\hat{\theta}$ denotes the set of estimates of both models.

The test statistic proposed by Hausman (1978) is

$$W(\hat{\theta}) = R(\theta)' [(\delta R \, \delta \theta) V (\delta R / \delta \theta)']^{-1} \quad \text{.....(2)}$$

V denotes the asymptotic variance covatiance matrix.The statistic $W(\hat{\theta})$ is asymptotically distributed as a chi-square random variable with q+1 degrees of freedom, where q is the number of restrictions to be tested. Undifferenced and differenced specifications were carried out with the following estimations (3) and (4) respectively

$$d_{t+1} = \mu + \varphi_1 d_t + \ldots\ldots + \varphi_q d_{t-q+1} + v_{t+1} \quad \text{.....(3)}$$

$$\Delta d_{t+1} = \mu + \varphi_1 \Delta d_t + \ldots\ldots + \varphi_q \Delta d_{t-q+1} + v_{t+1} \quad \text{.....(4)}$$

1.3 DIRECT TESTS

The endogenous variable exclusively described by the fundamental solutions to the indirect rests may be insufficient in describing reality. The desirability of bubble solutions through the direct tests have given a better explanation of economic phenomena by incorporating an additional component that enables the endogenous variable to deviate temporarily or permanently from its fundamentals. The bubble specifications viz. a Markovian bubble, in the sense of a deterministic bubble, an intrinsic bubble for fundamentals following a random walk, and

the geometric intrinsic bubble are empirically tested in this paper.

1.31 TEMPORARY MARKOVIAN BUBBLE

A Markovian bubble can be characterized as depending on its own preceding period value. The deterministic Markovian bubble (Flood and Garber, 1980) can be derived by applying the relation

$$\mathbf{Mbu_t = 1/\alpha^t b\ ;\ b > 0, \alpha = [1/(1+r)]}$$

for $|\alpha| < 1$, the bubble process grows monotonically and is therefore usually termed as 'ever expanding bubble'. A deterministic bubble is applicable if ever expanding phenomena are observable in the data set. This bubble specification, however, may have explanatory power in case of a temporary presence of rational bubbles in a time series.

This is given by the equation:

$$\mathbf{P_t = a + b_t + C_0 x_t + C_1 Mbu + e_t} \quad \text{.....(5)}$$

Where P_t is the price, b_t is the trend component, $C_0 x_t$ is the fundamental intrinsic component, C_1Mbu is the bubble solution containing time dependent markovian process. The constant *'a'* is included for adjusting the scaling effects between endogenous and exogenous process. The trend component b_t moderates the problem of non-stationary regressors. Here, theoretically, $C_0 > 0$ and $C_1 > 1$ and significant values of these parameters can be interpreted as a possible presence of Markovian bubbles on the data.

1.32 TEMPORARY INTRINSIC BUBBLE

Intrinsic bubbles relate to both the bubble and the fundamental variables by assuming that the bubble process itself depends exclusively on fundamental process. The bubble process is supposed to react positively to changes in the fundamental process and this substantiates the notion of overreaction to changes in fundamentals. Assuming fundamentals follow a random walk, the intrinsic bubble specification can be described as

$$\mathbf{Tbu = 1/\alpha^t x_t, , \alpha^t = 1/(1+r)^t}$$

Any fundamental process xt following a random walk with drift and satisfying the bubble description can be regarded as an intrinsic bubble. Based on this intrinsic bubble specification, the regression equation to capture temporary intrinsic bubble is

$$\mathbf{P_t = a + b_t + C_0 x_t + C_1{}^t Tbu + e_t} \quad \text{..... (6)}$$

$$\mathbf{P_t/x_t = a/x_t + b_t/x_t + c_0 + c_1 + u_t} \quad \text{.....(7)}$$

$$\mathbf{u_t = e_t/x_t}$$

In addition to the constant a, trend b_t and the fundamental process $c0x_t$ is additionally introduced in computing the temporary intrinsic bubble component including the time driven coefficient. Further, besides this, the price to dividend ratio is also tested for the presence of temporary intrinsic bubbles in order to avoid the problem of multicollinearity. Again, the testing of the assumption is that $C_0 > 1$, $C_1 > 1$ indicates the presence of temporary intrinsic bubbles in the data set.

1.33 PERMANENT INTRINSIC BUBBLE

The next direct specification test is derived from the geometric random walk which captures a permanent intrinsic bubble. Application of the random walk model to the logged series implies that the forecast for the next day's value of the original series will equal the previous day's value plus a constant percentage increase. This suggests that random growth is taking place in percentage terms, rather than absolute terms. Flood and Hodrick (1990) emphasize that dividends are better explained by being stationary in log-differences than in levels of pure differences. The permanent intrinsic bubble specification can be described as

$$\mathbf{Pbu = 1/x_t^{\lambda}} \quad \text{.....(8)}$$

Theoretically, $c_0 = [\exp(r) = \exp(\mu + \sigma^2/2)]$ and λ relates to the positive root of the equation $\lambda\mu + \frac{1}{2}\lambda^2\sigma^2 - r = 0$.

This specification explains the observed excessive deviation from the endogenous and exogenous process. Here if $\lambda > 1$, it indicates overreaction of the fundamentals. In order to derive this bubble type, the trend component is dropped from the earlier regression model. The model

$$\mathbf{P_{t=} c_0 x_t + c_1 x_t^{\lambda} + e_t} \quad \text{.....(9)}$$

The permanent intrinsic bubble component is x_t^{λ}. The testing of $\lambda > 1$ indicates the geometric growth of fundamentals and the significance of $c_1 > 0$ allows for the belief of permanent intrinsic bubbles in the time series. Additionally, in order to account for the correlation between the bubble parameter λ and c1, a restricted regression by using the theoretically derived value of λ is used in estimating equation 9.

SECTION : 2 THE DATA SET

The data is obtained from the National Stock exchange (NSE), which was incorporated in November 1992 and is arguably the most rigorously constructed stock market index in India. The data set S&P CNX NIFTY INDEX reflects the price movement of 50 stocks selected on the basis of NSE market capitalization and liquidity and CNX IT INDEX has whose turnover is more than 50% from IT related activities like software development, hardware manufacture, vending, support and maintenance. Hence, the closing prices, dividend, earnings per share and book value of the index from January 1, 1999 to June 30,2006 are used for analysis. The data set on fundamentals pertaining to the chosen index are available from January 1999.

The fundamentals representing the data set could be dividend, earnings or book value. Dividend has been represented as a fundamental performance indicator in literature capturing market bubbles since it satisfies the assumption of actual return flow from the index. Besides dividend, earnings per share has been argued to represent the fundamental performance since it represents total return flow for the stock. The book value indicates the actual worth of the stock and hence can also be considered as a fundamental performance indicator, the assumption being value maximization is used as a performance target.

The average dividend, EPS as well as book value are higher for CNX IT when compared to NIFTY indicating the high valuation of technology stocks in the Indian market. The growth rates in the fundamentals seem to justify the growth rate in stock movements. However, the justification of corroborated growth rate needs testing.

Both the indices are positively skewed indicating a bullish run in the market. Similarly, when tested for kurtosis, there is an indication that the distribution is leptokurtic. The peakedness could indicate an overvaluation in the market. Between the two indices, CNX IT is much more volatile since its coefficient of variation is 82% compared to the coefficient of variation in NIFTY, which is 38%. There could be a market growth which from time to time tends to correct itself to the fundamentals through rational speculative deals in the market. This raises a suspicion of presence of speculative bubbles in the market. The next section considers the various tests conducted to identify the presence of speculative bubbles and consolidates the empirical results.

SECTION : 3 EMPIRICAL RESULTS

Testing for bubble presence has been done using indirect and direct procedures and the specification tests examine market efficiency and indirectly identify the presence or absence of bubbles.

3.1 VARIANCE BOUNDS TEST

Variance bounds tests check if the present value relation provides a correct description of the actual market. If this is so, then the prices forecast using future expected values of fundamentals should vary less than prices related to the actual stochastic processes of the fundamentals. Empirically, the stock prices appears to be more too much justified by subsequent changes in fundamentals. Since rational bubbles tend to increase the variance of prices, variance bounds test serves as a tool for examining the existence of rational bubbles.

For both NIFTY and IT indices, the results of the Variance bounds tests suggest the variance of expected stock price is significantly lesser than the variance of actual data sets. This indirectly suggests that there is a positive term ct that could indicate the presence of rational speculative bubble.

As can be seen from Table 1, the C_t values are positive and are quite high for the technology index. The probability values (π) of the bubble growing for both the indices are 0.99, indicating the presence of rational speculative bubbles in the Indian Stock market. The probability of the bubble bursting is hence very less (0.01). The technology index had reached a peak during March 2000 and thereafter following an immediate reversal in prices till October 2001, afterwhich the prices have rebound steadily.

Since the database for the analysis includes the entire period, the variance bounds test has not distinguished the turbulent time separately. The rebound data points have influenced the entire data set and shows the possible bubble growth as 0.996, slightly lower than that of the NIFTY index bubble growth. The expected duration of the bubble can be worked as $(1-\pi)^{-1}$, 333 days for NIFTY and 250 days for the IT index.

The positive constant and slope of the fundamental estimation equation iterates the significance of the efficient market hypothesis. This test has examined the efficiency of the market in reflecting fundamentals and the positive gap (C_t) indicates the actual rise in the market beyond fundamental explanation and could hence indicate the presence of rational bubbles.

TABLE 1 : Variance Bounds Test

INDEX	CONSTANT	π	C_t	F (Significance)	slope
NIFTY	182.1187	0.997	25.8400	1.25338 *	
CNX IT	2469.084	0.996	134.5231	2.648691*	

*Significant at 5% level

3.2 SPECIFICATION TEST

Two forms of specification tests were examined - differenced and undifferenced. The Hausman specification tests rejected the null hypothesis of equality of $p_t = p_t^*$, iterating the possible existence of specification bubbles. The models, though statistically significant, did not give a statistically significant coefficients of θ_2, except for IT index differenced data set, thus proving little serial correlation in fundamentals.

The coefficients of the fundamentals are positive and can be construed to imply that market prices are positively influenced by growth in fundamentals. The lagged fundamental coefficient is negative for NIFTY differenced series and positive for IT index differenced series. However, none of the coefficients are statistically significant.

The stability of models are confirmed but for NIFTY differenced series. The examination of the serial correlation in the data set confirms that fundamentals (dividend) represents index movement. The rejection of equality tests further signifies that besides fundamentals, other factors could indicate the market movement.

The specification tests also have identified the efficiency of markets through the NIFTY and IT index series. The central idea of the specification tests developed by West (1987) is to consider two sets of consistent parameter estimates whereas only one set admits the existenc of rational bubbles and then to conduct a Hausman specification test in order to examine if the estimates of both sets differ significantly or not. A rejection of the null hypothesis that there is no difference between both sets may be interpreted as a possible proof for the existence of rational bubbles. Specification tests hence also capture the fundamental ability to explain movements.

TABLE 2 : Indirect Specification Tests

INDEX	WHETHER DIFFERENCED	Q	θ_1	θ_2	F	HAUSMAN'S SPECIFICATION TEST
NIFTY	NO	2	20.256 (0.124)	20.914 (0.113)	1430.28 (0.000)	102.759566 *
	YES	2	-0.535 (0.628)	0.391 (0.732)	0.193 (0.825)	1.486*
CNX IT	NO	2	-0.284 (0.994)	28.305 (0.429)	141.172 (0.000)	3576.905*
	YES	2	1.628 (0.583)	25.316 (0.000)	38.288 (0.000)	74.00947*

*Significant at 5% level

3.3 MARKOVIAN BUBBLES

Markovian bubbles consider explicitly a specific bubble process and then tests the significance of the bubble solution. Insignificant parameters of the bubble solution would imply the absence of specific bubble process in the data set whereas significant parameters would lead to the conclusion that the inclusion of the markovian bubble process is likely to explain a greater part of the index movement than the ability of the fundamentals alone in explaining the bubble movement.

The Markovian bubble equation (5) estimates a trend stationary model where the estimated coefficients represent deviations from the trend.The expected results are $C_0 > 0$ and $C_1 > 1$. The results of all the fundamentals are significant and contribute positively to the index movements. The temporary markovian bubbles are significant at 5% level for all the fundamentals. This indicates the high probability of the existence of markovian bubbles in the time paths of NIFTY when dividend, EPS and book value are used as fundamnetals. The highest explanatory power is linked to the earnings as the fundamental (Adjusted $R^2 = 0.150$). However, the bubble coefficients are lesser than 1 indicating that the rational bubbles may be periodically bursting or shrinking without violating the non-negativity property of prices.

For the IT index, the highest explanatory power (Adj $R^2 = 0.092$) is achieved when dividend is considered as the fundamental. Earnings per share and book values, when used as fundamentals, give a negative coefficient in the regression. One reason that can be attributed to this could be due to the fact that the geometric growth rate of the fundamental are higher than the real interest rate, that is expected to represent the markovian bubble. Another reason for a significant negative coefficient may be due to the presence of certain effects specific to the IT industry, which is not reflected in the fundamentals such as a bubble burst during May 2000 - April 2001, that has resulted in the fundamentals not conforming to the market movement. Further there could also be some extrinsic process as well as the possibility of irrationality in price behavior in the IT sector where there have been abnormal peaks during february 2000, which then eventually burst by June 2000.

TABLE 3 : Markovian bubble

Index	Fundamental	C_0	C_1	a	Adj R^2	F
S&P CNX NIFTY	Dividend	7.365 (0.000)	0.834 (0.019)	-193.767 (0.000)	0.043	43.679 (0.000)
	EPS	4.43 (0.000)	0.817 (0.015)	-413.080 (0.000)	0.150	166.503 (0.000)
	Book Value	0.857 (0.000)	0.867 (0.014)	-388.25 (0.000)	0.049	49.173 (0.000)
CNX IT	Dividend	22.294 (0.000)	0.932 (0.001)	-3085.030 (0.000)	0.092	96.415 (0.001)
	EPS	-5.992 (0.000)	0.995 (0.001)	3492.876 (0.000)	0.021	21.191 (0.000)
	Book value	-2.002 (0.000)	0.982 (0.001)	4771.165 (0.000)	0.040	39.495 (0.007)

The plot of the markovian bubbles for NIFTY (Fig 2.1,2.2 and 2.3) indicate the bubble presence during the two bubble periods of January 1999 to March 2001 and March 2005 to June 2006. There had been an adjustment period in between from March 2001 and January 2004 where indices were way below the fundamental and rational expectations. The presence of the temporary markovian bubbles are prominent during January 2004 to April 2004 and from May 2005 wherein the bubbles are able to provide an explanatory power beyond fundamentals.

The graphs for the IT index (Fig.3.1, 3.2 and 3.3) also indicate a bubble period in the beginning from December 1999 to February 2001 and again towards the end of the data sereis from August 2004 till June 2006. The first bubble period from December 1999 to February 2001 is marked by a wide fluctuation in the temporary markovian rational bubbles. Though these bubbles were not able to explain the realistic price rise, the capture of Markovian bursting bubble could, to some extent, have explained the price movements during this bubble period. The second bubble duration that had been identified gives a correct fit for price when dividend is used as a proxy for the exogenous process.

3.4 TEMPORARY INTRINSIC BUBBLE

The fundamental assumption in Temporary Intrinsic bubble is that the bubble process depends exclusively on the fundamental process. Values of $C_0>1$ and $C_1>1$ indicate the presence of temporary intrinsic bubble in the data set. The NIFTY index satisfies the tests for Temporary intrinsic bubbles, the highest explanatory power, though, is obtained when book value is used as the fundamental (Adj $R^2 = 0.164$). However, they don't seem to completely explain the undervaluation and overvaluation phenomena in the market as indicated in the graphs (Fig. 4.1, 4.2 and 4.3). Nevertheless, the presence of bubble is confirmed by the postive coeficients of fundamentals and the bubble solutions.

The equations capturing Temporary intrinsic bubble in the IT index yield negative coefficients for all the fundamentals namely dividend, earnings per share and book value, and the bubble coefficient for earnings per share and book value are also negative. The negative coefficients seem to be a consistent feature in the temporary intrinsic bubbles test also owing to the reasons already indicated involving the geometric growth of fundamentals being greater than the real interest, presence of a bubble bursting phenomenon etc. The high growth in the fundamentals could be compensated by the low movement of bubbles and hence could have given the uncharacteristic solution of negative bubble coefficient for earnings per share and book value. Further, for the IT index, when dividends represent the fundamental process, the bubble is almost 0, thus trying to indicate a bursting tendency in the data series. Here, the bubble becomes observationaly indistinguishable from completely bursting bubble.

The graph (Fig 4.1, 4.2 and 4.3) identifies the capturing of temporary intrinsic bubbles in the NIFTY series. The bubble presence during the two bubble periods of January 1999 to March 2001 and March 2005 to June 2006 is obvious here also. The market has faced sequential overvaluations and undervaluations and it may be noticed that the temporary intrinsic bubble fit is not in tune with the price and fundamentals. Consideration of dividend, earnings per share and book value as the fundamental tend to give similar results in NIFTY.

As far as the technology stocks are concerned, temporary intrinsic bubbles are not captured except during September 2004 - June 2005 when dividend is used as the fundamental indicator (Fig. 5.1). When earnings per share is used as the fundamental, there is an indication of negative bubble process(Fig 5.2), where the probable

reasons are indicated already.

TABLE 4 : Temporary Intrinsic bubble

Index	Fundamental	C_0	C_1	a	Adj R^2	F
S&P CNX NIFTY	Dividend	142.636 (0.000)	4.557 (0.000)	-115.574 (0.000)	0.011	11.359 (0.000)
	EPS	10712.668 (0.000)	0.568 (0.000)	-42.890 (0.000)	0.143	156.687 (0.000)
	Book Value	2146.879 (0.000)	0.120 (0.000)	-8.713 (0.000)	0.164	83.293 (0.000)
CNX IT	Dividend	-625.674 (0.420)	0.079 (0.915)	2.796 (0.889)	0.000	0.702 (0.496)
	EPS	-11433.5 (0.000)	-1.1 (0.000)	74.228 (0.000)	0.067	67.306 (0.000)
	Book value	-4599.706 (0.000)	-0.045 (0.000)	11.496 (0.000)	0.039	38.593 (0.000)

3.5 PERMANENT INTRINSIC BUBBLE

The bubble specification to be tested here is for is a permanent geometric intrinsic bubble process and the application of this bubble specification can economically be justified because of its potential for explaining the observed excessive deviation between the endogenous and exogenous process. When tested for Permanent intrinsic bubble in the NIFTY series, there are significant coefficients for C_0 and C_1 for all the fundamental indicators. Earnings per share has the highest explanatory power of 0.793 as the adjusted R^2. Both dividend and EPS as fundamental indicators give a λ of 0.99, which is close to 1. But book value as a fundamental gives a λ of 0.5, which hence may not be the right proxy for representing the fundamentals in capturing Permanent intrinsic bubble in the nifty Index.

For the IT index, dividend seems to be a better indicator of the fundamentals, having the highest explanatory power (Adj R^2 = 0.115) and with positive coefficients for fundamental and bubble solutions.Value of λ for dividend and EPS are 0.97 and 0.99 respectively, which is close to 1, but book value again fails to be a representator of fundamentals with a λ of 0.5 in the IT index. Negative coefficients for EPS, book value and their respective bubble solutions seem to persist for permanent intrinsic bubbles also.

TABLE 5 : Permanent Intrinsic Bubble

Index	Fundamental	C_0	C_1	F	Adj R^2	λ
S&P CNX NIFTY	Dividend	0.868 (0.000)	0.113 (0.000)	1605.398 (0.000)	0.683	0.990319
	EPS	0.938 (0.000)	0.083 (0.000)	3578.715 (0.000)	0.793	0.99477
	Book Value	0.783 (0.000)	0.004 (0.830)	1448.607 (0.000)	0.608	0.50244
CNX IT	Dividend	33.950 (0.000)	136012.1 (0.000)	172.369 (0.000)	0.155	0.977027
	EPS	-20.651 (0.000)	-3744662 (0.000)	69.434 (0.000)	0.068	0.999097
	Book value	-6.792 (0.000)	-2.0E+07 (0.000)	138.204 (0.000)	0.128	0.557198

Permanent Intrinsic bubble in the NIFTY index are captured during the phase -December 2001 and May 2002, when dividend and EPS are the representors of fundamentals. The specification has a low explanatory power for the rest of the time duration in the data set.When book value is used, it fails to capture the bubble process in the NIFTY index. In the IT index, permanent intrinsic bubbles are fully captured by the regression equation from November 2003 onwards when dividend is the fundamental (Fig. 7.1) signifying the presence of a rational speculative bubble. However, when EPS and book values are considered, they show a negative bubble phenomenon (Fig. 7.2 and 7.3), which is repeatedly observed in the IT index.

To sum up, markovian bubbles show ever expanding behavior, similar to not fundamentally justifiable expectations, resulting in an extreme increase in the endogenous process (prices). There is an evidence for existence of markovian bubbles in the NIFTY series and IT index series, when dividends are used as proxy for fundamental exogenous process. Temporary intrinsic bubbles are also confirmed of their existence in NIFTY

index and in IT index, a bursting tendency of the bubble is indicative with the negative coefficients of the fundamentals. Permanent Intrinsic bubbles have little explanatory power in the NIFTY series but effectively captured in the IT index when dividend is the proxy for fundamental.

SECTION 4

CONCLUSION AND DISCUSSION

The study confirms the presence of bubbles in the said Indian Indices which is the objective of the paper. It may be noted that both the direct and indirect specification tests confirm the existence of bubbles, where there is some unexplained component that does not justify the actual price movement. The paper uses linear rational expectations model in the behavior of the variables and one of the significant attributes of this bubble going up could be the expectation of investors which is very high and is much more than what the price movements can really be explained by the fundamentals thus hinting that irrationality could exist in the market. The limitations of the paper include the non -consideration of non- linear models for estimating price movement and a parsimonious approach of taking into account only the internal factors that affects investor expectations namely dividend, Earnings per share and book values. The study can be expanded by including all macro- economic variables and incorporating their impact on investor expectation and further on the justification of the price movements.

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APPENDIX

DESCRIPTIVES	S&P CNX NIFTY			CNX IT		
No. of data points	1883			1877		
Mean	1528.2891			17431.62		
Standard deviation	585.23994			14243.31		
Skewness (SE)	1.497(0.057)			1.854 (0.057)		
Kurtosis (SE)	1.990 (0.114)			5.201 (0.114)		
Average daily returns	1.182802			16.64576		
	Dividend	EPS	Book Value	Dividend	EPS	Book Value
Average	24.97	91.92672	449.4906	134.1578	573.786	2362.328
Average growth (%)	0.98	0.05	0.03	0.25	0.22	0.20

GRAPHS

Fig 1.1 - Price and Dividend movements in S&P CNX NIFTY in the sample period

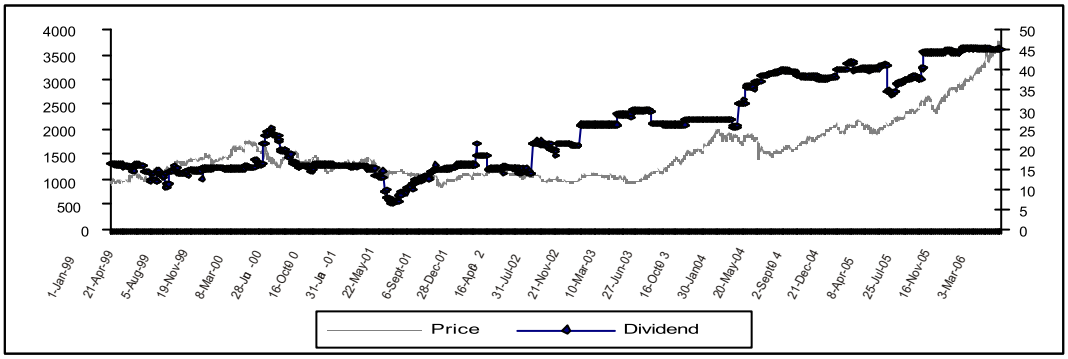

Fig. 1.2 - Price and Dividend movements in CNX IT index in the sample period

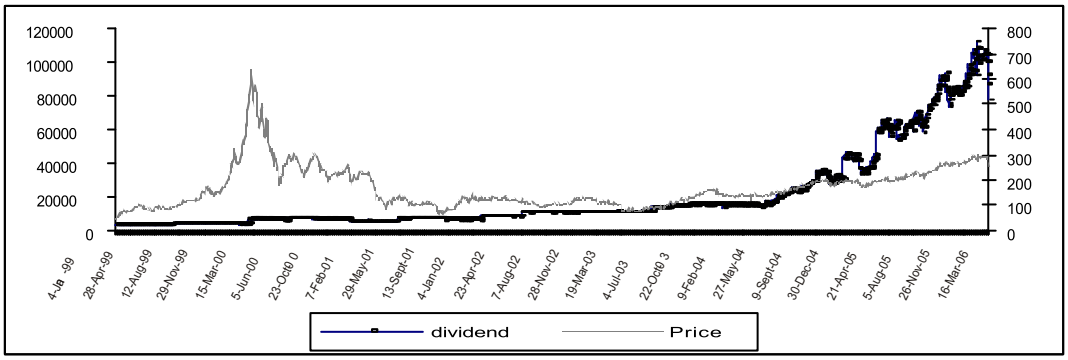

Fig. 2.1 Markovian Bubble in the NIFTY index with dividend as the fundamental indicator

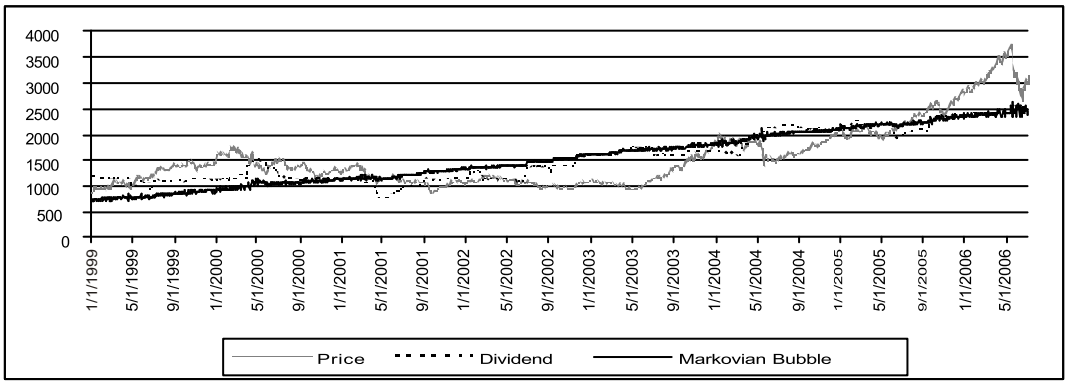

Fig. 2.2 Markovian Bubble in the NIFTY index with EPS as the fundamental indicator

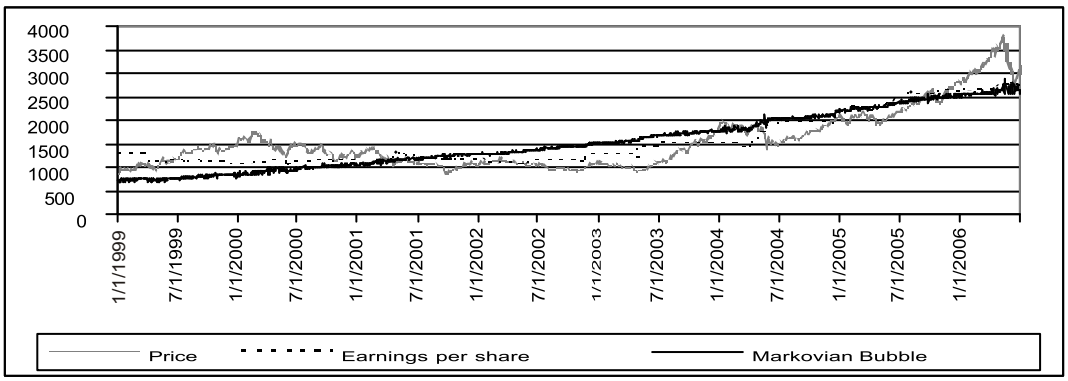

Fig. 2.3 Markovian Bubble in the NIFTY index with book value as the fundamental indicator

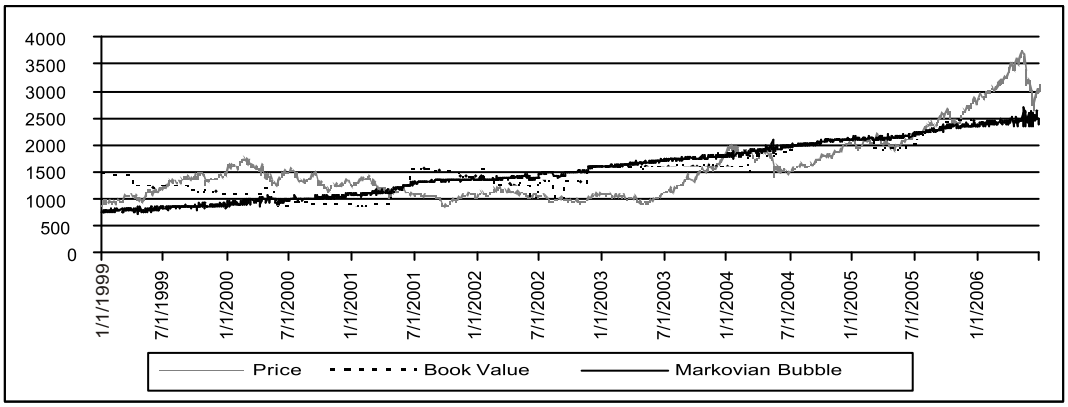

Fig. 3.1 Markovian Bubble in the CNX IT index with dividend as the fundamental indicator

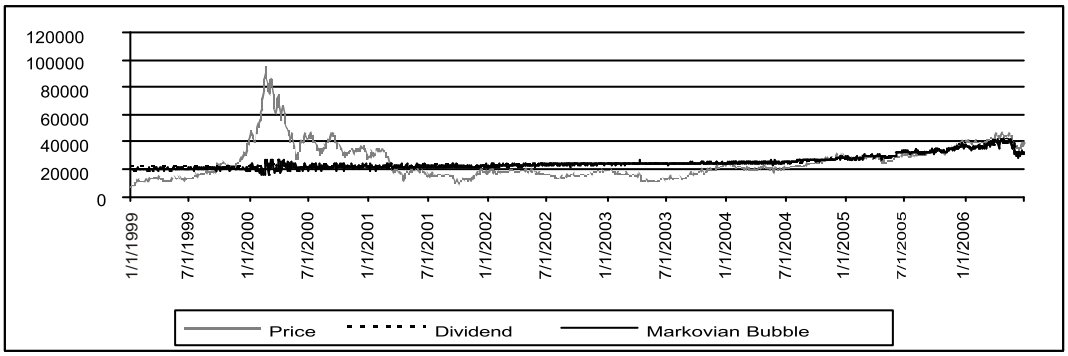

Fig. 3.2 Markovian Bubble in the CNX IT index with EPS as the fundamental indicator

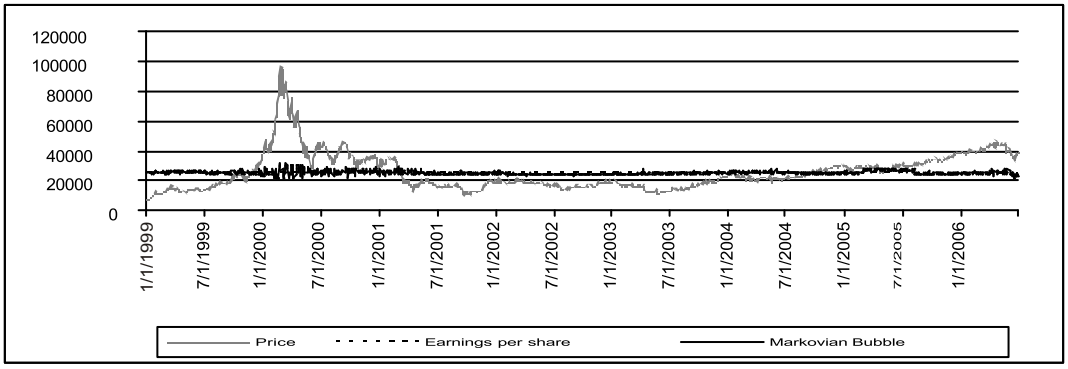

Fig. 3.3 Markovian Bubble in the CNX IT index with book value as the fundamental indicator

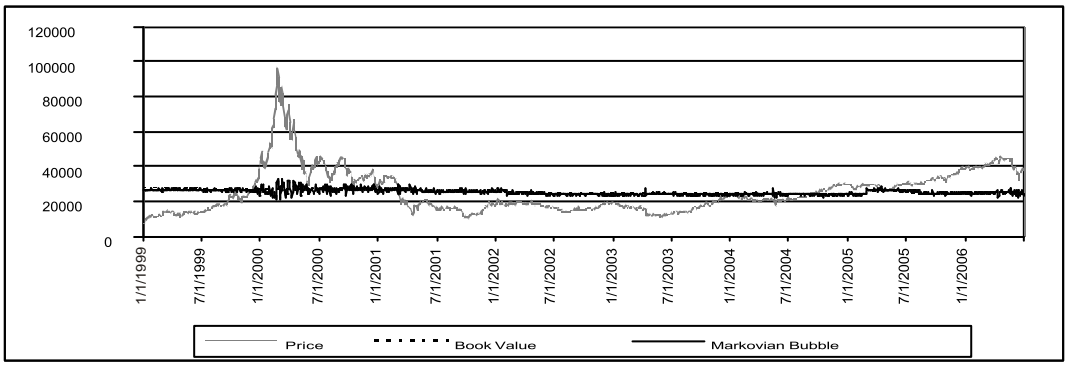

Fig. 4.1 Temporary Intrinsic Bubble in the NIFTY index with dividend as the fundamental indicator

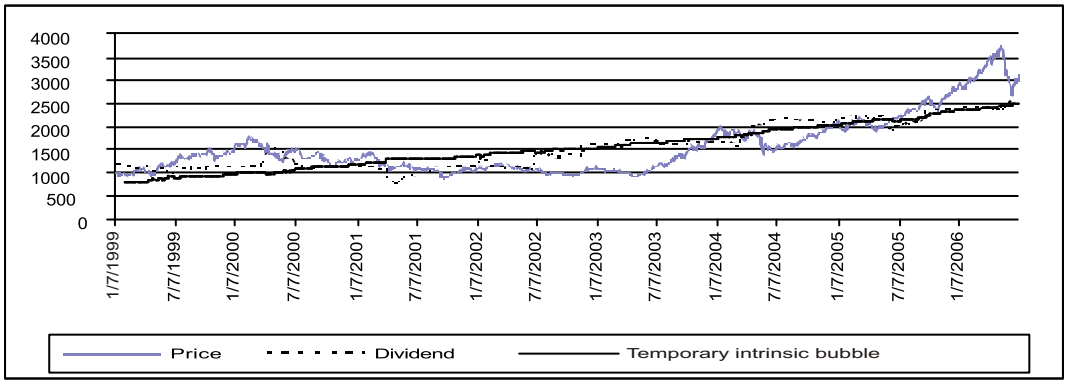

Fig. 4.2 Temporary Intrinsic Bubble in the NIFTY index with EPS as the fundamental indicator

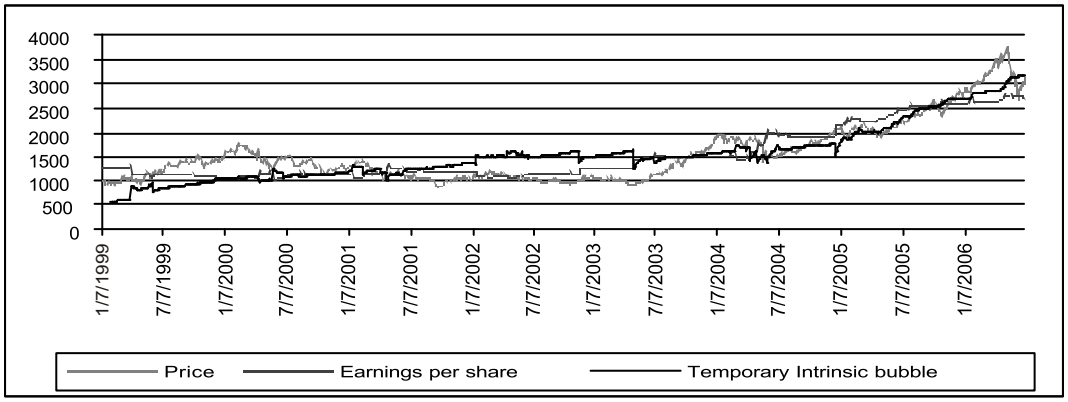

Fig. 4.3 Temporary Intrinsic Bubble in the NIFTY index with book value as the fundamental indicator

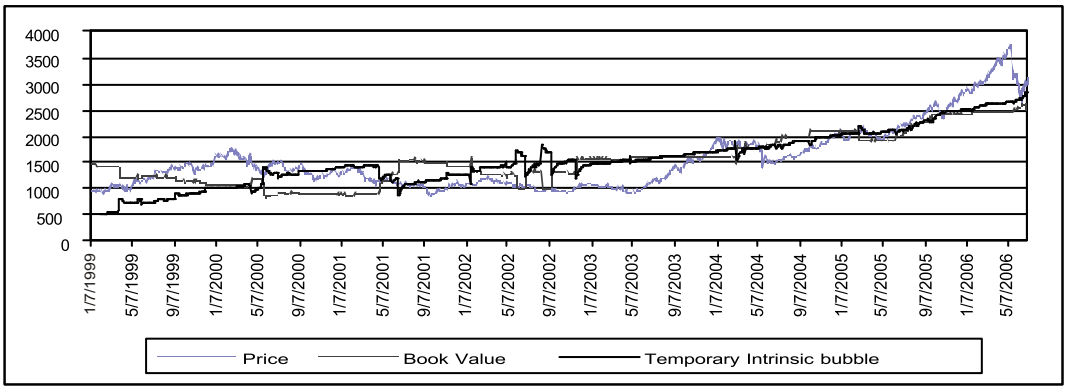

Fig. 5.1 Temporary Intrinsic Bubble in the CNX IT index with dividend as the fundamental indicator

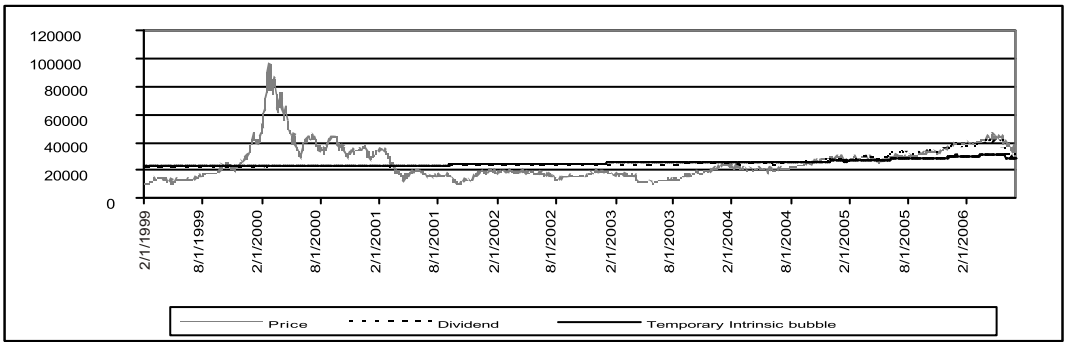

Fig. 5.2 Temporary Intrinsic Bubble in the CNX IT index with EPS as the fundamental indicator

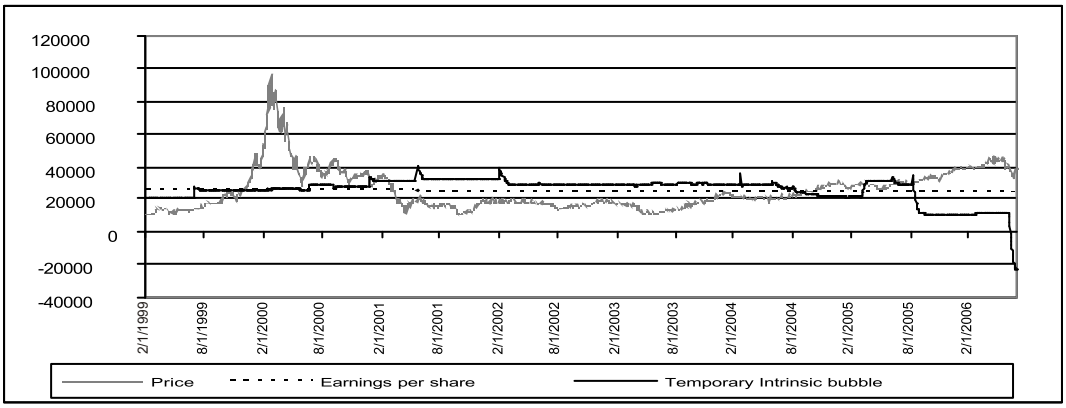

Fig. 5.3 Temporary Intrinsic Bubble in the CNX IT index with book value as the fundamental indicator

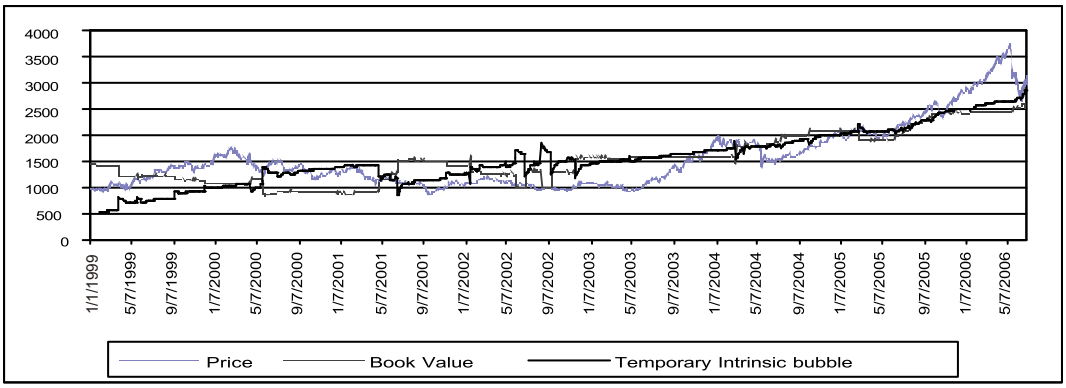

Fig. 6.1 Permanent Intrinsic Bubble in the NIFTY index with dividend as the fundamental indicator

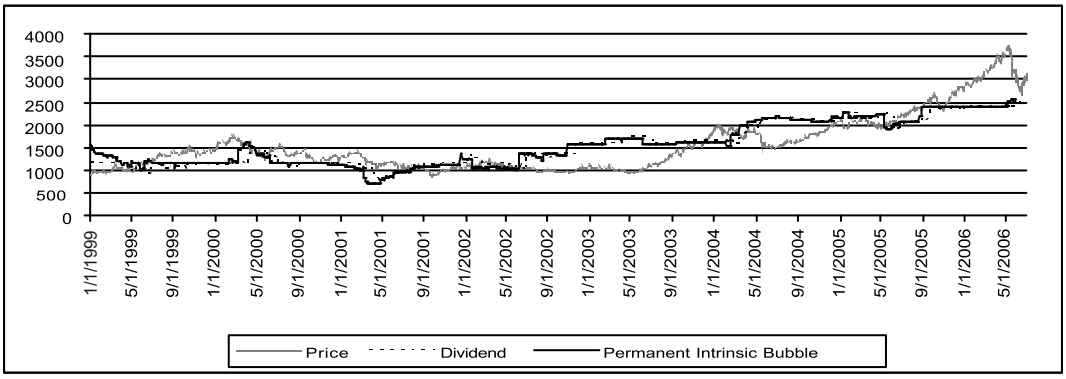

Fig. 6.2 Permanent Intrinsic Bubble in the NIFTY index with EPS as the fundamental indicator

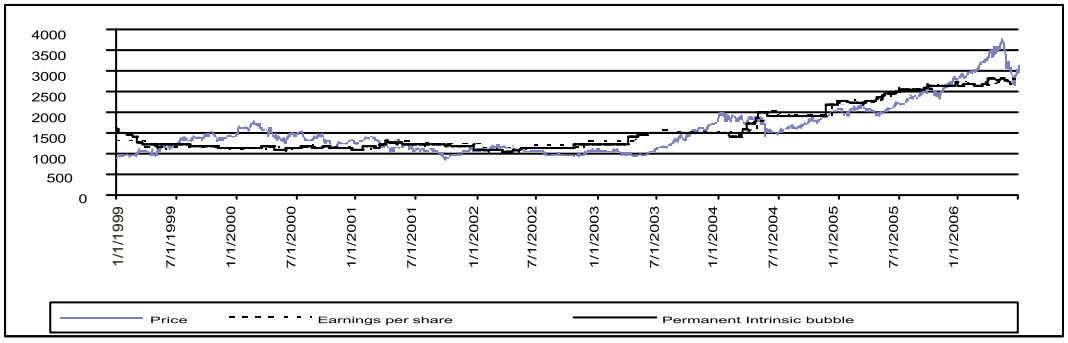

Fig. 6.3 Permanent Intrinsic Bubble in the NIFTY index with book value as the fundamental indicator

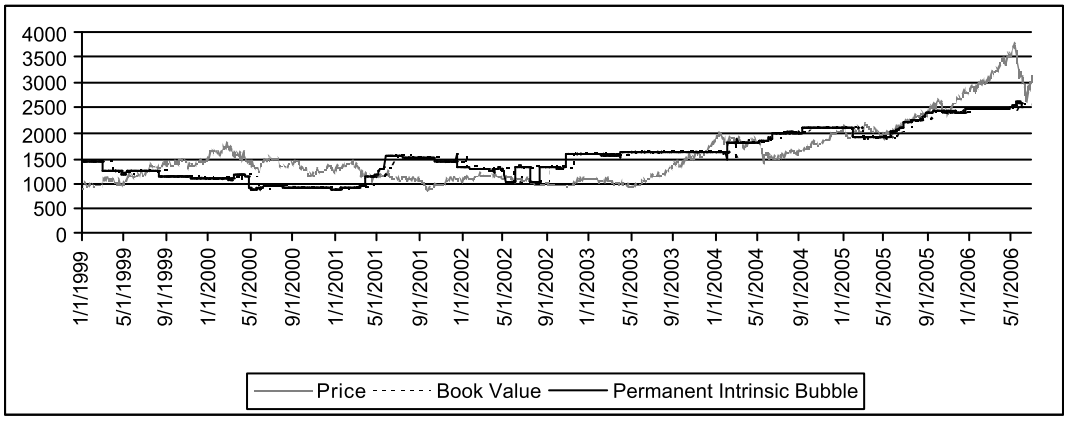

Fig. 7.1 Permanent Intrinsic Bubble in the CNX IT index with dividend as the fundamental indicator

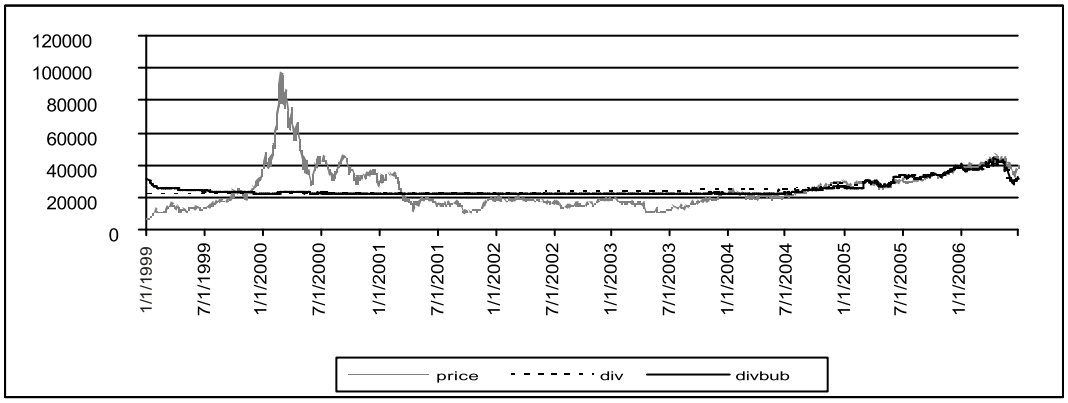

Fig. 7.2 Permanent Intrinsic Bubble in the CNX IT index with EPS as the fundamental indicator

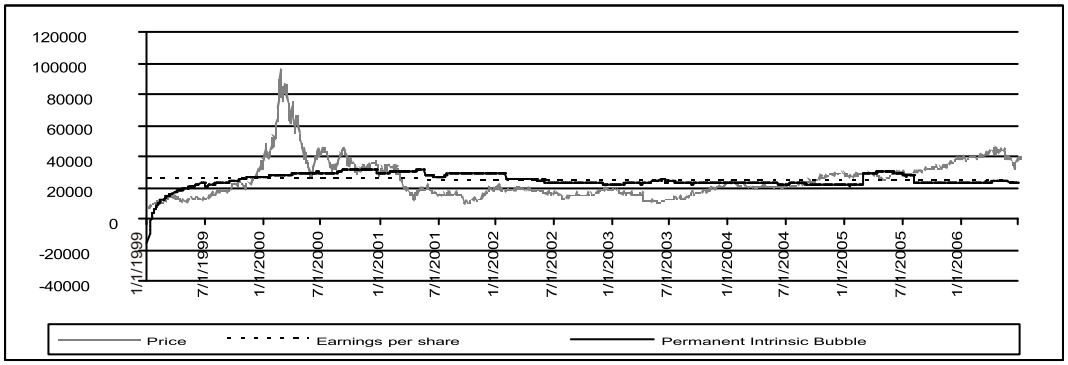

Fig. 7.3 Permanent Intrinsic Bubble in the CNX IT index with book value as the fundamental indicator