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Examining Non-Economic Factors in Indian Stock Markets: A Study of Threshold Impacts and Strategic Caution

[1]Neeraj Nautiyal
Faculty of Busines,
Sohar University, Oman

[2]Ahmed Abubakar
Faculty of Busines,
Sohar University, Oman

Abstract:- It's not uncommon for financial market reforms to be met with some level of reaction, as they can impact various stakeholders. Recent financial market reforms in the Indian economic ecosystem and overall investment patterns have sparked an overwhelming response. Considering that multiple factors contribute to the sharp increase (decrease) of stock prices that may not align with economic reasoning, we intend to examine the anticipated threshold impacts spanning from 2010 to 2020 using deflated and logarithmic weekly observations for Indian stock prices. The study analyzes potential herding behavior and bubbles in the market. Our research supports the validity of the present valuation model for predicting long-term returns with time-varying expected returns. Since the result identifies small bubble footprints and alarms investors to exercise caution in the Indian market, the findings also imply crucial implications for market practitioners to remain aware of the potential for the emergence of a future bubble.

Keywords:- *Bubble, Thresholding, Indian Capital Market, Herd Behavior, Non-Economic Factors.*

I. INTRODUCTION

Maintaining a constant balance between risk & return is a complex issue to understand and navigate. This enigma probably arises from the conflict between fundamental, rational, and irrational behavior. The rational theme explains that stock markets are too volatile for market fundamentals alone to explain the changes, so exogenous forces also need to be explored (33, 7, 6, 29, 26). Efficient market hypotheses (EMH) also lay the groundwork for research on external factors. However, numerous anomalies have been reported in efficient market hypothesis (EMH) that were dominant in explaining stock prices. These phenomena, such as speculative bubbles and extreme volatility, seem incompatible and contribute to financial strain on individuals. It is important to provide a satisfactory explanation for these observations that aligns with the underlying premise. For instance, from mainstream economic reasoning, bubble formation is largely based on the presumption that the stock price does not follow its fundamental levels and is expected to continue rising further. These situations are often the result of contagious expectations of excessive growth in stock prices fueled by excess liquidity in the economy.

Bubbles in the market often occur when there is irrational behavior and a disconnect between the market price of an asset and its intrinsic value. This can be caused by an over reactive market, leading to unsustainable price increases that are not supported by the asset's underlying value (34). These overreactions and under reactions are based on investors' cognizance; a major barrier to market efficiency that lays the groundwork for behavioral finance. However, it is important to note that the potentially disastrous consequences of a stage transition or bubble burst result in a significant drop in the investment portfolio and could potentially lead to a financial crisis (2). Even if the bubble does not burst, a rational bubble can have serious repercussions for the real economy.

Research on rational bubbles in the Indian market is limited compared to global studies. However, the role of herding by foreign players in contributing to the volatile capital flows in emerging financial markets has received significant attention. The study of nonstationary and cointegrated systems has led to new insights and advances. In most cases, the cointegration test determines the relationship between stock prices and dividends. In one of the initial studies (4) highlight a negative relationship with the economic growth post-liberalization period (1991–2001), indicating that there is a possibility of irrational investment trigging a bubble in Indian stock markets. According to (29), there is evidence of rational bubbles in the Indian stock market (BSE), which suggests the presence of herd behavior among market participants. (1) also observes bubble presence in the Indian market in their study made for Asian, African, South American, and Eastern European emerging markets for a database from the 1990s to 2006. (14) investigates the period from 1990 to 2013 for multiple stock market bubbles in BRICS countries. With the help of the generalized sup ADF (GSADF) recursive test (30), they conclude evidence of a short bubble at the end of 1999 for India. Highlighting the recent trends, (36) found evidence of irrationality in Indian stock prices when using symmetric adjustment approaches, suggesting the presence of "rational bubbles." However, the asymmetrical adjustment approach yielded the opposite result. (20) examine herd behavior in their study and reveal no evidence of herding in any format (daily, weekly, and monthly).

Hence, the absence of herd behavior does not impact stock returns; consequently, no bubble has formed in the Indian equity market.

More recently, (5) employed asset centrality signals and crowded trading indicators to highlight the formation of a bubble in sectoral indices in the 2004–19 database. The authors find that sectors in an inflationary phase outperform the index, while those in a deflationary phase underperform it. The result offers promising investment opportunities to institutional investors and portfolio managers in India's market. (22) applies the recursive econometric approach to detect bubbles in Indian indices**.** The results suggest that the Indian stock market does not appear to be behaving explosively. The findings suggest that the market prices of assets are more closely aligned with their fundamental values and less subject to irrational exuberance or speculative bubbles. (24) investigate the Indian stock indices of CNX Nifty 50 and CNX Nifty 100 at a time of geopolitical tension to find evidence of herding and bubbles. Both indices indicate that geopolitical tensions with neighboring countries (China and Pakistan) led to herding and the bubble formatting environment.

With weak legal and information systems, developing economies are more likely to violate the efficiency hypothesis's assumptions. A new focus on bubbles has emerged in the context of developing economies because of this. It is noteworthy that the Indian stock market has experienced numerous scams and crises (such as the National Spot Exchange Limited commodities market scam, non-performing asset issues, demonetization, the rollout of the Goods and Services Tax, non-bank financial company and banking crises, the coronavirus pandemic, and border disputes with China), as well as other developments, over the last decade. This leads to erratic price behavior, providing us with a unique opportunity to detect the presence of rational speculative bubbles in the Indian stock exchange during that period. Coupled with some more interesting facts, the income loss due to the COVID-19 pandemic disruption and falling real interest rates on bank deposits have made the stock market a more popular investment option in India than ever. The massive inflow of foreign capital, inflated stock prices, and rapid development have raised concerns among investors and policymakers, particularly retail investors, about creating a favorable environment for bubble formation. What fuels the phenomenon is the participation of novice retail investors who trade on momentum. Investor herding in Indian stock markets has risen due to the increased equity portfolio flow into the country (32). Continuously increasing stock price levels have also become subject to heated debate; hence, Indian stock index performance remains a fertile ground for academic research. Even the recent Reserve Bank of India report has cautioned about the inflated asset prices in the face of an estimated 8% decline in GDP in 2020–21 and has voiced concern about the risk of a bubble in Indian stock markets. A large amount of liquidity (approximately Rs. 11.1 trillion in 2020, as of December 28, 2020) has been injected to support the recovery, along with capital flows from the foreign portfolio and domestic institutional investors. This may outweigh the fundamentals of the companies and lead to unintended consequences of inflated equity prices. Therefore, critical thinking and a desire to better understand the stock pricing anomalies in the presence of these events make it an interesting subject to study. The present study attempts to highlight recent changes in the Indian stock market and explore the possibility of bubble formation therein.

In light of recent data and developments, and considering the questions and suspicions surrounding the topic, we make a novel attempt to analyze the Indian stock market from April 2010 to March 2020 using non-linear threshold econometric methods. We contribute to the current body of empirical literature in the following *three* ways. *First*, our work involves deflated and logarithmic weekly observations that enable us to expand for more reliable observational findings. This method differentiates between the times of an overvalued market before a collapse and recognizes the asymmetric changes that occur during collapsing bubbles, either negative or positive. *Second,* we relate to the present value model, which involves the expected return changing over time and threshold tests to determine deviation from fundamental values. *Third*, the current research investigates the expected threshold effects using two asymmetrical cointegrated models: TAR and MTAR (17, 18). In this threshold approach, the TAR approach monitors the deep cycle of the time series asymmetrical movements to capture the complete bubble phase when the positive variations are greater than the negative movements. The M-TAR approach is noteworthy because it can capture sharp sequential movements in equilibrium errors when variables experience asymmetrical adjustments in one direction, showing more strength. The study discovers no rational bubbles in the Indian market during the sample period. At the same time, we confirm asymmetric development towards long-term equilibrium.

This paper is organized into four sections. The second section outlines the data, models, and methodology employed in the study. The third section presents the results and their interpretation using the statistical models outlined in the previous section. The final section provides a conclusion and discusses the implications for future policy development.

II. DATA

We obtain data on the weekly aggregate equity prices and dividend yields of NSE 500 companies from April 2010 to March 2020 (consists of 508 observations). To analyze the behavior of the original stock price indices in real terms, we deflate them using the consumer price index. This allows us to adjust for the effects of inflation and more accurately compare the values of the indices over time. Next, we transform the series into a normal logarithm using a steady and reliable method.

To examine the potential presence of bubbles and their implications, we used (18) periodically collapsing model. This model effectively captures bubble behaviour's dynamic and abrupt nature and demonstrates the transition from a relatively stable to a consistently cyclical phenomenon. This research focuses on the present value model and employs threshold approaches to identify deviations from fundamental values. In order to determine whether there are rational bubbles present in the Indian market, we utilize two non-conventional co-integration tests: the TAR (Threshold Autoregressive) and MTAR (Modified TAR) methods developed by (17 and 18).

III. METHODOLOGY

➢ *Present Value Method*

The present value method is used to identify stock market bubbles by comparing the current market price of an asset to its fundamental value. This model helps to understand the relationship between an asset's current price and the expected future returns from that asset. The model can be expressed as follows:

$$P_t = \beta E_t (P_{t+1} + D_{t+1}) \quad 0 < \beta < 1 \qquad (1)$$

In Eq. (1) P_t represent the current price of the stock, D_{t+1} denotes expected dividend in the next period, E_t is conditional anticipated details at time t, and assuming $\beta \varepsilon$ (0,1) represents the required rate of return on the stock. For a firm with abnormally high growth, Eq. (1) can be modified accordingly. In Eq. (1), we impose convergence conditions, which require that the dividend growth rate remain small and countable enough. This means that the rate at which dividends are expected to grow over time should not be too large or too difficult to accurately estimate. This is important because if the dividend growth rate is too high or uncertain, it may be difficult to accurately determine the intrinsic value of the stock that relies on forecasting future dividends. It is worth noting that asset pricing models are based on certain assumptions and can be subject to limitations and errors in forecasting. Alternately Eq. (1) can be rewritten as:

$$\lim_{k \to \infty} \beta^k E_t [p_{t+k} + d_{t+k}]$$

As proposed by (11 and 21), the net return model for asset valuation can be expressed by the following formula:

$$f^t = \sum_{i=1}^{i=\infty} \beta^i E_t[d_{i+1}] \qquad (2)$$

Eq. (2) is a summation expression that calculates a function f^t (Intrinsic worth) based on the expected dividends $E_t[d_{i+1}]$ at future period $i+1$ where i is the index of the summation and ranges from 1 to ∞. The price of a stock is determined by the present value of its expected future stream of dividends (real income), which are discounted to account for the time value of money. However, if the transversality assumption is not satisfied, equation (1) may have infinite solutions. Each of these solutions can be expressed as follows:

$$P_t = f^t + B_t \qquad (3)$$

The term β_t represents the "rational bubble process," which must satisfy certain conditions.

$$E_t [B_{t+1}] = \beta^{-1} B_t \qquad (4)$$

If the present value model fails, it may be considered a sign of a rational bubble, as it can result in a discrepancy between the stock market price and the stock's intrinsic value. The fundamental premise of the rational bubble literature is to examine the relationship between the dividend-price ratios as a measure of the market's health. Put differently; rational bubbles may arise when there is a disconnection between the prices of assets and their anticipated future income, resulting in an inconsistent co-integrating relationship. The rational bubble causes asset prices to diverge from fundamental values, leading to market-reinforcing irrational behaviour (16).

➢ *Modeling Threshold Effect in Price Transmission*

Literature shows that conventional linear family models may produce misleading results when analyzing periodically collapsing bubbles with a co-integrating relationship between share prices and dividends (19, 13). To address the limitations of conventional linear models, we apply the Threshold Autoregressive) and Modified TAR methods to NIFTY prices and dividends that are integrated at the first order (I (1)).

The TAR model examines the persistence of deviations from long-term equilibrium, considering both positive and negative shocks of equal size. In contrast, the M-TAR model assesses the magnitude of positive and negative deviations from long-term equilibrium without regard to adjustments. Both models are used to identify trends or asset price patterns that may suggest bubbles or other abnormal market behavior (28). The TAR model utilizes a variable lag to analyze asset prices, while the M-TAR model incorporates adjustments from past periods as the threshold variable. The TAR approach is useful for detecting asymmetrical movements in time series data, mainly when positive variations are larger than negative ones. This can help identify the entire bubble phase. The M-TAR model is particularly effective for analyzing situations where upward or downward asymmetric adjustments in variables are stronger in a single direction and for capturing sharp sequential movements in equilibrium errors.

(18) propose a two-step technique for demonstrating the long-term dynamic relationship between the price-dividend ratio. The technique involves the following estimation:

$$P_t = \omega + \beta D_t + \acute{\upsilon}_t \qquad (5)$$

In eq. (5), $\acute{\upsilon}_t$ represents the sequential price increase followed by a sudden decline, indicative of a periodically collapsing bubble. The next step is to estimate the values of ρ_1 and ρ_2 using ordinary least squares (OLS) regression, as shown in the following equation:

$$\Delta\acute{\upsilon}_t = M_t \rho_1 \acute{\upsilon}_{t-1} + (1-M_t)\, \rho_2 \acute{\upsilon}_{t-1} + \sum_{i=1}^{i=k} \Upsilon_t\, \Delta\acute{\upsilon}_{t-1} + \mathcal{E}_t \qquad (6)$$

In Eq. (6), the convergence assumption is that ρ_1 and ρ_2 are both less than zero, and $\mathcal{E}_t$ is a white noise term.

The variable M is a Heaviside indicator variable that depends on the level of $\acute{\upsilon}_t$

$$M = \begin{cases} 1 \ if \ \acute{\upsilon}_{t-1} \geq \tau \\ 0 \ if \ \acute{\upsilon}_{t-1} < \tau \end{cases} \quad (7)$$

To determine a reliable estimate of τ, we employ (14) grid search method. Within the context of the M-TAR model, the null hypothesis of no transversality is represented as H_0: $\rho_1 = \rho_2 = 0$. The F-value for the null hypothesis of symmetry with the restriction $\rho_1 = \rho_2 = 0$ follows a nonstandard distribution, as demonstrated by (17 and 18). In this study, the F-statistic values were calculated based on the number of variables in the co-integrating vector, using the method proposed by (18). The analysis of asset prices (P) and dividends (D) was conducted using this method. If the null hypothesis is rejected, it suggests the presence of asymmetric adjustments in threshold co-integration. This approach is more effective at capturing the specific nature of periodically collapsing bubbles. The nonlinear time series model is considered more robust when there are asymmetric variations from equilibrium with a wide range of adjustment parameters.

In the M-TAR method, the threshold value is determined by the change in the error term from the previous period, $\Delta\acute{\upsilon}_{t-1}$

$$M_t = \begin{cases} 1 \ if \ \Delta\acute{\upsilon}_{t-1} \geq \tau \\ 0 \ if \ \Delta\acute{\upsilon}_{t-1} < \tau \end{cases} \quad (8)$$

The values of τ, ρ_1 and ρ_2 are estimated simultaneously in the final consistent M-TAR model using (14) method. This method involves minimizing the sum of squared residuals from each specified model.

IV. ANALYSIS AND DISCUSSION

The historical daily price and return series are shown in Figure 1 as they changed throughout the study period. A slight rise in market volatility has been observed following the onset of various crises. During the sample period, returns for Indian markets were stable, but some minor fluctuations were still visible. Indicating the impact of the 2008–09 global financial crisis, we can see that prices have fallen significantly since then. The substantial declines in 2012, 2014, and 2020 can be attributed to the Eurozone debt crisis (2010–2012) and the global oil crisis (2014), respectively. Soon after, the COVID-19 pandemic triggered a global equity market panic that led to a subsequent financial crisis.

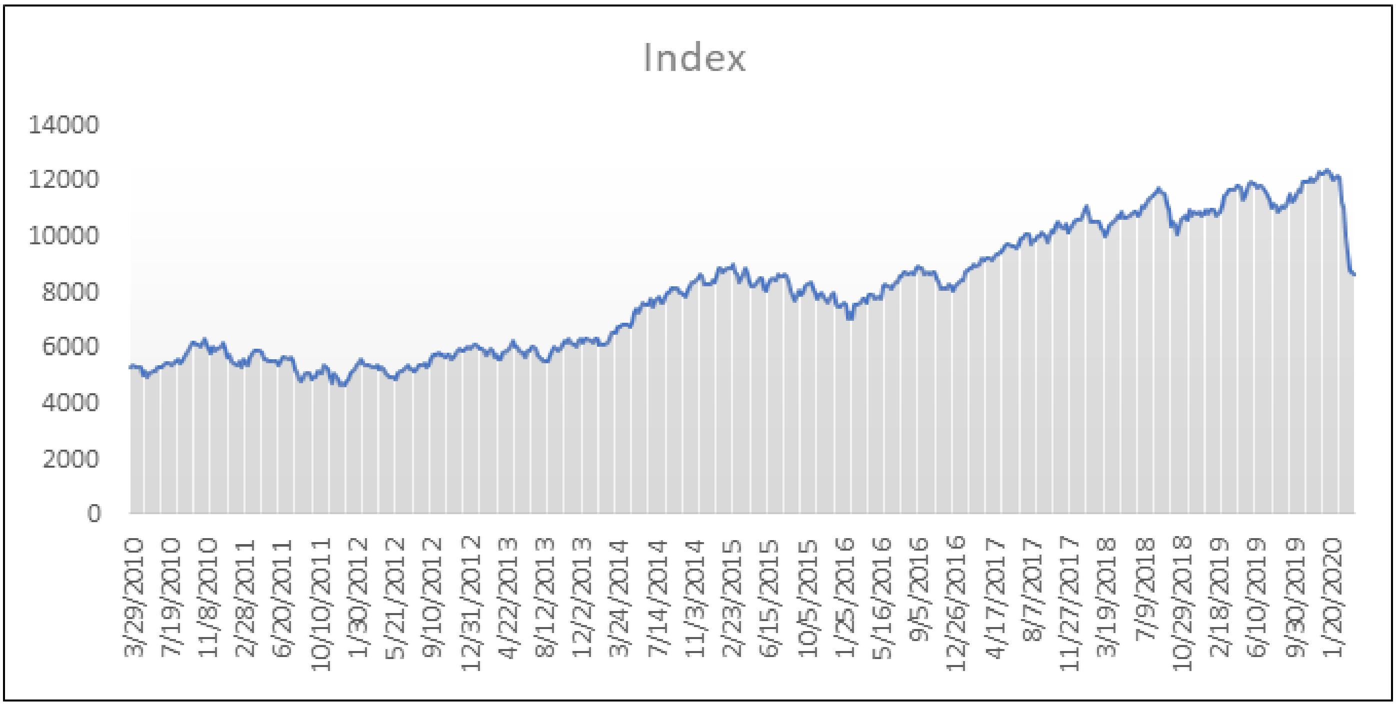

Fig 1 Statistical Properties
Source: Author's Calculations

Table 1 presents the statistical characteristics of Indian stock returns. The market's mean return is positive, exhibiting a maximum gain of 15 percent. A preliminary view of India's low and mean returns suggests an unfavorable investment market. The risk for the Indian equity market shows a reasonably low value, implying a promising bet for potential investors towards Indian equity market. The returns for Indian stock markets are skewed negatively, indicating that an uneven event will likely result in negative returns (3). The high positive kurtosis coefficient suggests non-normal data with a leptokurtic distribution, implying high chances of achieving positive returns. The Jarque-Bera result, which rejects the normal return distribution null hypothesis, further validates the non-normality proposition. The ADF tests rule out the return series having a unit root. The coefficient of the KPSS test also supports the idea that the return series is stationary. We use the Ljung-Box test on residuals and squared residuals at the 20th lag to look for serial dependence. Our findings show that return series have no autocorrelation, implying an independent return pattern. We also use the ARCH LM test to examine the ARCH properties, and the return series shows no homoscedasticity.

Table 1 Statistical Properties

Mean (%)	**0.0815**
Max	14.88
Min	-13.004
Std. Dev.	1.257
Skewness	-0.852
Kurtosis	17.50
Jarque-Bera	23530.01 ***
Q (20)	94.20***
ADF	-33.24***
KPSS	0.0638
ARCH	1356.74 ***

Source: Author's Calculations.

- *Note: *, **, *** Represent Significance Levels at 1,5,10 Percent Respectively*.

Table 2 shows the results of the cointegration tests for TAR and MTAR**.** The table displays the values of the adjustment coefficients ρ_1& ρ_2, as well as the Fc statistics that indicate the absence of cointegration using TAR approach. The statistics suggest the presence of cointegration with asymmetric adjustment. The threshold value parameter τ is calculated using (14) method. However, the F_a statistic rejects the null hypothesis and suggests the presence of symmetric adjustment. This leads to a mixed conclusion, so we apply the Modified TAR cointegration test to obtain a more unambiguous interpretation.

According to the M-TAR cointegration tests in *Table 2*, the Fc and Fa coefficients have statistically significant values of 11.725% and 1.710, respectively, at the 1% level. These estimates refute the null hypothesis of no cointegration and symmetric adjustment and suggest asymmetric development towards long-run equilibrium between the NIFTY price and dividends and suggests that prices and dividends are co-integrated, as indicated by the convergent specifications of $\rho_1 < 0$, $\rho_2 < 0$, and $(1 + \rho_1)$ (1 + $\rho_2 < 1$. These findings suggest that the current valuation model considers time-varying expected returns is effective in the long term. The M-TAR results suggest that prices and dividends are connected and tend to move together. The estimates of ρ1 and ρ2 indicate that they converge since they are negative and statistically significant. The estimated values of ρ1 and ρ2 also show faster convergence for $\acute{\upsilon}_{t-1} < \tau$ than for $\acute{\upsilon}_{t-1} \geq \tau$. The calculated values of ρ1 and ρ2 indicate that 1% of positive and 6% of negative divergence are lost within a week. This indicates that in the case of negative shocks for $\acute{\upsilon}_t$, stock prices tend to adjust more quickly towards their fundamental values, τ. The AIC value suggests that the M-TAR model is more suitable for data with consistent threshold estimates than the TAR model, indicating that the TAR model is less effective. Therefore, only the M-TAR specification will be used for the rest of the paper.

Table 2 Cointegration Test (TAR & MTAR)

NIFTY 50	**TAR**	**M-TAR**
ρ_1	-0.035 (0.762)	0.014 (0.896)[a]
ρ_2	-0.0132 (3.210)	-0.058 (6.861)[a]
F_C $\Phi(\rho_1 = \rho_2 = 0)$	2.261	11.725[a]
F_A F ($\rho_1 = \rho_2$) i.e., symmetry	0.231	1.710[a]
τ	0.163	0.027
AIC	-5.132	-5.451

Source: Author's Calculations.

- *Notes*: ρ_1 and ρ_2 correspond to the adjustment coefficients for the two regimes, with ρ_1 applying to values above the threshold and ρ_2 applying to values below the threshold. Under the null cointegration hypothesis, Fc represents the assumption that ρ_1 and ρ_2 are both equal to 0. The value of Fa represents the null hypothesis, in which ρ_1 and $\rho_2$are equal and imply symmetric adjustment. τ is used to estimate the threshold value. ** corresponds to 5% significance level.

Co-integration threshold models study the potential for asymmetric relationships between variables depending on their distance from long-term equilibrium. The TAR test does not reveal any evidence of an asymmetrical relationship between stock index and dividends. However, the M-TAR test reject the hypothesis that there is no symmetrical co-integration at a 5% level, which suggests the presence of asymmetrical co-integration. Considering asymmetries in the analysis, we uses asymmetric error correction modeling to analyse the movement based on M-TAR's consistent threshold values. The resulting calculation can be expresed as follows:

$$\left.\begin{aligned} P_t &= \eta_1 + \sum_{i=1}^{n} \delta_{1i} \Delta P_{t-i} + \sum_{i=1}^{n} \alpha_{1i} \Delta D_{t-i} + \rho_{1P} I_t \acute{\upsilon}_{t-1} + \rho_{2P}(1 - I_t)\acute{\upsilon}_{t-1} + \varepsilon_{1t} \\ \Delta D_t &= \eta_2 + \textstyle\sum_{i=1}^{n} \delta_{2i} \Delta P_{t-i} + \sum_{i=1}^{n} \alpha_{2i} \Delta D_{t-i} + \rho_{1D} I_t \acute{\upsilon}_{t-1} + \rho_{2D}(1 - I_t)\acute{\upsilon}_{t-1} + \varepsilon_{2t} \end{aligned}\right\} \quad (9)$$

We use the asymmetric error correction model (AECP) to further study the short-term movements of the dividend-price ratio. *Table 3* highlights the result of asymmetrical error correction approach with consistent threshold values. The selection of the appropriate time lag was based on the Akaike Information Criterion (AIC). Our findings show that deviations from equilibrium correct faster for negative deviations than positive ones, and most of these corrections are due to changes in prices rather than dividends. The results also generally support the pricing function. However, we also observe that the dividend convergence speed is relatively slow, despite being statistically significant. In particular, price point estimates indicate that the adjustment speed is faster for negative deviations from fundamental values, i.e., prices adjust so that 26 percent of the negative deviations are eliminated, while dividends contribute only 13 percent of the positive deviations. Conversely, dividends eliminate about 9% of negative and 5% of positive deviations in stock prices from equilibrium.

Table 3 Asymmetrical Error Correction Estimates

Dependent Variable	$\mathbf{I_t \acute{\upsilon}_{t-1}}$ **(Positive)**	$\mathbf{(1 - I_t)\acute{\upsilon}_{t-1}}$**(Negative)**
ΔP_t	-0.128 (-2.619)**	-0.258 (-3.152)**
ΔD_t	-0.051 (-1.943)**	-0.094 (-2.615)**
Lag	8	12
Q(8)	0.572	0.809

Source: Author's Calculations.

- *Note:* T values are given in parentheses. The values vary considerably from zero at **5%. Q (8) presents p –values for Box-Pierce Q-statistic.

V. CONCLUSION

The study aims to develop a model that represents the fundamental value of the Indian equity market based on future income streams. The fundamental value of the market represents rational bubbles as self-confirmed deviations in response to external forces. Rational bubbles, or deviations from this fundamental value, can be identified in response to external factors. Our findings from the M-TAR model did not find any evidence of rational bubbles in the Indian equity market for the sample period but did confirm the presence of asymmetric development towards long-term equilibrium. The TAR model showed that the index may not be integrated in the long term, suggesting the presence of a negative periodic collapsing bubble. The findings indicate no existence of bubbles at various levels of confidence. Indeed, the long-term behavior of the Indian stock market appears to be grounded in fundamentals, possibly due to the dominance of institutional investors in the major sectors of the NSE 500 Index (26), who tend to make investment decisions based on fundamental and technical analysis rather than on peer pressure. One possible interpretation could be that the market's fundamental variables, such as investors' dividends, reflect the impact of the economic environment.

Overall, our study finds that the present value model of valuing equity in logarithmic form effectively establishes a long-term link between equity prices and their fundamentals. Our results support the findings of (16, 20, and 22) for the Indian market but differ from the conclusions of (29, 1, and 5). However, the small bubble footprints that we identify should still be a concern for investors in the Indian market, as the existence of bubbles cannot be definitively ruled out. This interpretation also supports the recent Reserve Bank of India warning (2021) of bubble formation in Indian financial market potentially resulting in significant losses. However, several factors contributing to the growth of Indian market, such as moderate inflation, disinterest in Chinese markets, government stimulus, price caps etc. Several developing and emerging countries exposed to the speculative bubble may also find the findings of the article to be useful in formulating policy. The article proposes the use of an early warning system to identify and address bubbles in the market to correct any ongoing abnormalities. It is also important for Indian regulators and policymakers to consider this when expanding market operations. Studying the economic factors that cause rational bubbles in stock markets and how these bubbles grow, and collapse would be interesting.

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