Chapter – III

Asset Market Behaviour:
A Theoretical Approach

3.1. Introduction

Theorizing expectation or belief formation is the central part in any economic approach trying to model for capital market upheavals. Since its introduction in the sixties by Muth (1961) and its popularization in macroeconomics by Lucas (1971), the Rational Expectation Hypothesis has become the dominating expectation formation paradigm in economic theories. Although many economists nowadays views the ongoing paradigm as something inadequate in explaining the market upheavals, but a generally accepted alternative paradigm is yet to be developed. Theories from other social sciences like sociology, anthropology, psychology etc. have motivated much empirical works in recent past in analyzing less than perfect behaviour in making investment decisions. But studies of human psychologies in analyzing decision making under risk and uncertainty is a multifaceted issue. Wide ranges of literature are available claiming the influence of an array of complex set of psychological antecedents in decision making. It is perhaps the most formidable task to quantify the relevance of one particular psychological issue playing its role in course of a decision. Basically the anomalies to the existing paradigm are observed in complex real world settings, where many possible factors may be at work, not in the experimental psychologist's laboratory. However, to overcome such difficulties, a rapidly increasing number of structural heterogeneous agent models have been introduced in the financial literature recently. These multi agent heterogeneous framework offers a more coherent approach particularly, towards analyzing psychological underpinnings of expectation or belief formation in capital market decisions. This approach draws heavily from a new school of thought widely emphasized in literature by the Santa Fe Institute of New Mexico (see Hommes and Gounresdorfer ,2007, Gounresdorfer 2000,2001, Simon 1955 , Johansen and Sornette 1999,2000,2010,Aurther et.al 1997,Le Baron et al 1999,Lux and Marchesi 1999 Broke and Hommes 1998 etc.).The major emphasis of the model is on explaining psychological implications of human interactions that generate epidemics in opinion and bubble grows. Basically, it allows employing the bottom up approach, focusing on micro level of the agents' interaction but aiming at studying the behavioural macro effects on asset price dynamics. Market is viewed as a "soup' of diverse agents who interact with each other making it resemble a constantly boiling mixture.Going by this

emerging direction, our humble approach, in this present chapter, is to study Indian equity market in multi agent framework.

Unlike the conventional framework, the heterogeneous market model does not make any stereotypical assumptions about investor's behavior. Rather it questions some fundamental epistemological issues that are not fully addressed in the rationality driven market theory (Fiedman, 1953 and Fama, 1970). In the conventional wisdom, distinctions are often made between rational and non rational agents and it has been found useful in mathematical modeling approach. Why is it that some agents are rational and others are not? Although the difference between rational and non rational behaviour is quite fundamental, are there are two fundamentally different types of human being in societies? And if these types exist, how are they selected? To avoid these basic debates, the present framework has been developed under the condition of bounded rationality with evolutionary belief (see Simon 1955, Kahneman, 2003, Johansen and Sornette (1999, 2000). In this present framework all market participants are similar victim of cognitive limitations in their decision making. All of them have similar information complexity and use the best possible strategies within the confines of their limited ability. Forecast about the future asset prices are made by applying simple but different trading rules. They are thought to check the relative fitness of the comparative trading rule , update their belief and switch over to more profitable ones to maximize own utility function(See Brock and Hommers 1997, 1998 Lux 1998, Gaunersdorfer and Hommes, 2007). Here the model introduces concepts borrowed from evolutionary economics school of thought under adaptive belief mechanism. This concept has also been influenced highly by the literatures of behavioral finance (see Tversky and Khneman 1981, Thaler 1994, Shleifer 2000, Barberis and Thaler 2003).

3.2. The model[5]:

We assume that , there are different type of agents in the market denoted by 'i' depending on their beliefs about the future asset price. Each agent can invest in two assets; a risk free asset with same pay off and risky asset. The agent's utility function according to Grauwe and Grimaldi (2004) can be defined as follows:

$$u(W_{t+1}) = E_t(W_{t+1}) - \frac{1}{2}\mu V(W_{t+1}) \text{----------Eq. No. (1)}$$

where w_{t+1} is the wealth of the agent of type 'i' at the time (t + 1), E_t is the expectation operator , μ is the coefficient of risk aversion and $V^i(W^i_{t+1})$ represents the conditional variance of wealth of agent 'i', while 'μ' does not include any specific shape considered in some of the earlier studies, The wealth is specified as follows:

$$W^i_{t+1} = (S_{t+1} + Y_{t+1})d^i_t + (1 + r)(W^i_t - S_t d^i_t) \text{--------- Eq. No. (2)}$$

S_{t+1} is the price per share at the time t+1, d^i_t represents the unit of risky assets holding at time 't',the term Y_{t+1} is the amount of dividend received,'r' being the risk free rate of interest known with certainty. The first term of the right hand side of the above equation represents the value of the risky asset at t+1 and the second term represents the value of risk less asset at t+1.

Substituting equation (2) in equation (1) and maximizing utility with respect to $d_{i,t}$ allows us to derive the standard optimal holding of risky assets by agents' type 'i':

$$d_{i,t} = \frac{E^i_t(s_{t+1} + y_{t+1}) - (1 + r)s_t}{\mu\sigma^2_{i,t}} \text{,.....Eq. No. (3)}$$

[5] The mathematical expressions used in the models have been grossly adopted from Grauwe.P and Grimaldi.M.(2004); "Bubbles and Crashes in a Behavioural Finance Model",(Center for Economic Studies & Ifo Institute for Economic Research ,CESifo ,Working Paper No. 1194) due to its simplicity and clarity.

Thus optimal holding of risky asset depends on expected excess return (corrected for risk) of the equity. The market demand for risky asset at time t is the sum of individual demands,

$$\text{i.e.:} \quad \sum_{i=1}^{N} n_{i,t} d_{i,t} = D_t, \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{Eq. No. (4)}$$

where $n_{i,t}$ the number of agents of type 'i' at time 't'.

Market equilibrium implies that market demand is equal to the market supply Z_t which we assume to be exogenous. Thus,

$$Z_t = D_t, \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{Eq.No.(5)}$$

Grauwe and Grimaldi (2004) finally substituted the optimal holdings into the market demand and then into the market equilibrium equation and solving for S_t yields the market clearing price:

$$S_t = \left(\frac{1}{1+r}\right) \frac{1}{\sum_{i=1}^{N} \frac{w_{i,t}}{\sigma_{i,t}^2}} \left[\sum_{i=1}^{N} w_{i,t} \frac{E_t^i(s_{t+1})}{\sigma_{i,t}^2} - \Omega_t Z_t \right] \ldots\ldots\ldots \text{Eq.No. (6)}$$

where $w_{i,t} = \dfrac{n_{i,t}}{\sum_{i=1}^{N} n_{i,t}}$ is the weight (share) of agent i, and

$$\Omega_t = \frac{\mu}{\sum_{i=1}^{N} n_{i,t}}$$

Thus, share price is determined by expectations of diverse agents, E_t^i, about the future return. These forecasts are weighted by their respective variances $\sigma_{i,t}^2$. when agent's i forecast have a high variance the weight of this agent in the determination of market price is reduced.

We will now attempt to specify how the agents in the market formulate their expectations about future prices and how they evaluate portfolio risk. We start with an analysis of the rules that agents use in forecasting speculative prices.

(a) Expectation formation and selection of rules:

We assume that two types of forecasting rules are used, one is called a "fundamentalist strategy", and the other is "technical trading" rule. The idea of distinguishing between fundamentalists and technical traders rules was first introduced by Frankel and Froot (1986). Agents using the fundamentalists rule, base their forecast on a comparison between the market and the fundamental value. They forecast the market rate of return to the fundamental rate in future. In this sense they use a negative feedback rule that introduces a mean reverting dynamics into stock price movements. The speed with which the market price returns to the fundamental is assumed to be determined by the speed of adjustment in the goods market which is assumed to be in the information source of fundamentalists. Thus, the forecasting rule for the fundamentalist can be formulated as:

$$E_t^f(\Delta s_{t+1}) = -\psi(s_{t-1} - s_{t-1}^*) \quad \text{.....Eq.No.(7)}$$

where S_t^* is the fundamental share price at time t, which is assumed to follow a random walk and $0 < \psi < 1$.Moreover, fundamental value is exogenous and in forecasting future value, fundamentalists use information up to period t-1.This agents do not know the full model structure and as a result, they cannot compute the equilibrium price of time t which will be the result of their decisions made in period t.

The agents using the technical analysis, the "technical traders", forecast future price by extrapolating from past price movements. Their forecasting rule can be specified as:

$$E_t^c(\Delta s_{t+1}) = \beta \sum_{i=1}^{T} \alpha_i \Delta s_{t-i} \quad \text{,.....Eq.No (8)}$$

The technical traders compute a moving average of the past stock price changes and they extrapolate this into the future stock price changes. The degree of extrapolation is given by the parameter β.Technical traders take into account information concerning the fundamental value indirectly, i.e. through the stock price movements itself. In addition, technical rule can be interpreted as an attempt to detect "market sentiments" which is prone to generate price to price feedback (Shiller 2003. Hirshleifer et al. 2006). Chartists virtually observe sequence of price changes before they chase the trend and they do not respond instantaneously to price movements. "Price to price channel" shape the expectation of future price movements for technical analysts.

(b) Modeling of risk perception:

In the evolutionary economics with adaptive belief, risks are measured by the variance terms which are defined as the weighted average of the squared (one period ahead) forecasting errors made by technical traders and fundamentalists, respectively. Thus,

$$\sigma_{i,t} = \sum_{k=1}^{\infty} \theta_k \left[E^{i}_{t-k-1}(s_{t-k}) - s_{t-k} \right]^2 \quad \text{.....Eq.No (9)}$$

where $\theta_k = \theta(1-\theta)^{k-1}$ are geometrically declining weights ($0<\theta<1$) and i = f,c.This approach of assessing risk is highly influenced by the concept of "Loss Aversion" in the literature of reference dependent decision making in behavioural finance (Kahneman and Tversky, 1979).

(c) Potential solutions to the model:

Assumption of bounded rationality offers the scope for explaining behavioural biases in decision making that can lead the market towards its potential solutions. Adaptive belief in the market is formed either in favour of technical or fundamental rule subject to its evolutionary fitness. More the actual prices converges to the predictions made using a particular rule, lesser its perceived risk (see equation 09) and higher its evolutionary fitness. Thus, it is immaterial whether a decision rule is ridiculous or rational. Rather, the model requires the use of a particular decision

rule that is context specific based on its suitability in expectation formation weighted in terms of deviation from actual. Accordingly, when adaptive belief is formed in favour of fundamentalists, they dominate the market; technical rules consistently make large forecasting error, thereby decreases evolutionary fitness. Prices systematically approach to informational efficiency, and in its extreme all arbitrage profits are eliminated. Alternatively when technical traders dominate, evolutionary update in belief is formed in favour technical rules, market continues to undervalue quality of information, asset price becomes noisy, and tend to deviate from its fair value. Thus, adaptive belief formation either in favour of fundamentalists or chartists tips balance in the market. Following the traditional dictum, if deviations are due to idiosyncratic demand from ill informed, rational arbitragers instantly indulge themselves to take appropriate position, snap up profit opportunities created by misalignment of prices (Friedman 1953). Then they virtually substitute the behavior of trend chasers and produce an outcome consistent with rational model. In such a way better informed rational traders are rewarded with more wealth and financial market is shielded from ill informed and optimal allocation of resources are ensured. In contrast, if fundamentalists continue to make large forecasting errors, risk perception of using their own strategy increases and then evolutionary belief tends to form in favour of technical rules. Under such conditions, fundamentalists virtually complement the behavior of trend chasers, arbitrage operation gets limited and bubble grows(Andrei Shleifer; Robert W. Vishny1997). Thus the presence of strategic substitutability or complementarity *seems* to be the key condition in determining when a population, that is a priori heterogeneous with regard to their expectation or belief, make the market to reach either "fundamental or bubble solution" (Fehr and Tyran 2005).

Behavioural finance theories under the cover of "strategic complimentary and substitutability" (Fehr and Tyran 2005), nicely describes how and when agents revise their forecasting rules and how it affects aggregate market behavior. In the next section we will be interested specifically to study underlying socio – psychological and cultural underpinnings of investor's mind that put strategic complementarily into action and bubble grows.

(d) Social and Psycho-economic foundations of bubble solution:

At the outset, we must mention one pre requisite condition for bubble formation, widely recognized in the literature. Strong positive or negative shifts in economic fundamentals have been identified as a common denominator in all psychological manias in a wide range of literature around the globe. Bubbles have been found to generate in the backdrop of strong and burgeoning economic conditions (Kindelberger 1978, Groundersforder, 2000, 2001 etc.).Specifically, in growing economies positive shock in fundamentals occurs more frequently thus chances of getting positive bubbles are also higher. In this context, the heterogeneous market model predicts some common features of a typically endogenously generated bubbles and crashes. Once a bubble emerges, it sets into motion bandwagon effects. As the price moves steadily in one direction, evolutionary fitness of using technical trading rules increases initially. Technical traders, who tend to derive information about fundamental condition indirectly by looking at the price trend, psychologically tend to promote self confidence and generate excitement over their own ability. Their perceived riskiness in using their own rule thus diminishes by ongoing movements in price (see equation no.09) thereby, attract more and more technical traders in the market.But a sustained upward movements in prices cannot develop into full scale bubble if at some point market does not get sufficiently dominated by technical traders.Thus the basic essential condition for a bubble formation requires that, at some points most agents in the market are not willing to take contrarian fundamentalists view.However the theories of market efficiency demands, rational arbitragers being the guardians of market can take care of any possible misalignment in prices. Otherwise a sustained upward or downward movement in prices may get itself converted into a full scale bubble or crash. At this point, very naturally the question is raised : why arbitragers fails to take corrective actions and fundamentalists do not take opposite position thereby preventing bubble from growing. After all, larger the deviation of the price from fundamental, more the fundamentalists expect to make profits.But the empirical evidences of bubbles and crashes point towards that solution of the model where fundamentalists do not take the contrarian position , and massively leave the market place to the technical traders.Therefore a self-fulfilling force is to develop in the market in favour of profitability of technical traders and

losses for fundamentalists. Theories of behavioural finance offer explanations to this respect.

Once the speculative prices starts to deviate steadily in a direction,(may be due to an overreacting response to a strong shifts in underlying macroeconomic conditions)[6], evolutionary fitness of using technical trading rule increases dramatically. Technical traders tend to ascribe psychologically their "successes" in asset market as a result of "brilliant ability to recognize pattern", strong "wishful thinking" "superb caliber" to explain asset prices (Barberis and Thaler (2003), Daniel et al. (2002), De Bondt (2002, 2005, 2008a b), Shiller (2002). Ultimately chartists start to make better prediction and their dependency on this "naïve" but "rewarding" investment strategy increases. Evolutionary fitness of technical rule derives more utility to its users through its higher relative profitability and ultimately more and more traders are drawn into the market as technical traders which push prices further and make the technical trading more profitable (see equation no.01). On the other side of the story, fundamental traders having bounds on their cognitive resources to analyse the situation optimally, tend to perceive high relative riskiness[7] in using their own rule (see equation no.09). Moreover consecutive forecasting errors resulting out of adverse movements in prices to their prediction model, fundamentalists psychologically locate themselves in the losing quadrant of their value function. Reference dependency in decision making (exhibited through a kink in the value function) tends to play its role as a key determinant factor here in subsequent decisions. At this stage any potential threat of losing statuquo in terms of initial wealth (W) are valued psychologically more heavily and this often get strongly intensified with the presence of other related biases like myopic horizon, urge to avoid post decisional regret of not taking right decisions in time, pain of cognitive dissonance, career and reputational concerns etc. (see Andrea Devenow, Ivo Welch,1996, Welch 2000, Scharfstein and Stein 1990, Trueman 1994, Zweibel 1995, Prendergast and Stole 1996, Graham 1999, Brennan

[6] Overeaction has been widely studied in the literature in the context of Mean Reversion (see De Bondt and Thaler ,1985; Summers ,1986; Fama and French 1988; Poterba and Summers, 1988).

[7] Risk is being measured in terms of deviation from actuals, (equation no. o9)

1993, Roll 1992, Maug and Naik 1996, Brennan 1993, and Roll 1992). Thus aversion of losses but not the risk tends to be the prominent consideration here in subsequent decision by the fundamentalists (Kahneman and Tversky 1979). Added to this, fundamentalists on experiencing repeated failures, tend to be dragged socially in favour of technical traders gradually for clarification and affiliation. Information conveyed through competitive winning strategies of others seems to be here as an important source of reassurance and clarification for fundamentalists. Need for affiliation both within the organization and with the ongoing wisdom in the outside tend to become particularly stronger and this seem to override well established previous standards in determining optimum behavior towards risk and expectation. It ultimately tends to result in strengthening the commonality in thinking and increases group cohesiveness.In such a societal state of assuring and reassuring credentialties in favour of technical rules, it is likely to be more difficult for an individual to take an unpopular independent course of action than to be influenced heavily by whims of the moment.Both fundamental and technical traders, thereby tend to develop a representative mind whereby salient images of past price trend is programmed automatically to follow its trend in future. Thus sentiment and ideas of all the type of traders in the market gradually tend to take one and the same direction and their conscious personality tend to vanish. Whoever be the individuals that compose it, however like or unlike their mode of life, their occupations, their characters or intelligence the fact that they are all transformed into a crowd puts them in possession of a sort of collective mind which makes them think, feel and act in a manner different from one in isolation.

Thus to reach a bubble solution, it becomes essential that adaptive belief among majority of market traders has been formed in favour of technical traders and fundamentalists cannot exert any more influence to bring the mean reversion dynamics at work. The latter is necessary; otherwise fundamentalists are still expected to use their own rule and their forecast of a revision to the fundamental would move stock prices.

The above stated switching mechanism can be incorporated in the heterogeneous pricing model as (Broke and Hommes 1998):

$$w_{c,t} = \frac{\exp\left[\gamma\pi'_{c,t-1}\right]}{\exp\left[\gamma\pi'_{c,t-1}\right] + \exp\left[\gamma\pi'_{f,t-1}\right]} \text{ ..... Eq.No (10)}$$

$$w_{f,t} = \frac{\exp\left[\gamma\pi'_{f,t-1}\right]}{\exp\left[\gamma\pi'_{c,t-1}\right] + \exp\left[\gamma\pi'_{f,t-1}\right]} \text{ ..... Eq.No (11)}$$

Weights of forecasting rule are function of relative profitability. $\pi'_{c,t-1}$ and $\pi'_{f,t-1}$ are the risk adjusted net profits made by technical traders' and fundamentalists' forecasting the price in the period t-1, i.e. $\pi'_{c,t-1} = \pi_{c,t-1} - \mu\sigma^2_{c,t-1}$ and $\pi'_{f,t-1} = \pi_{f,t-1} - \mu\sigma^2_{f,t-1}$. This depicts exactly the switching rules where participants follow an adaptive behaviour. When the risk adjusted profit by trend chasers exceed the risk adjusted net profit of fundamentalists rules, then the share of the total agents who switches to technical rule in period t increases and vice versa. The parameter 'γ' is the measure of inertia that reflects the intensity with which trend chasers and fundamentalists revise their forecasting rules. With an increasing 'γ' agents react strongly to the relative profitability of the rules. In the limit when γ tends nearer to infinity all agents choose the forecasting rule which appear more profitable and changes camp from chartist's(c) to fundamentalist's (f) or vice versa .Trading will be impossible if either 'c' or 'f' becomes exactly equal to zero. This parameter is of great importance in generating bubbles. Degree of extrapolation is denoted by the parameter β (see equation No.08) whereas fundamentalists have some rational valuation of the 'risky asset', the technical analysts use a simple extrapolation rule to forecast asset prices. Technically speaking, during a bubble phase, larger the deviation of prices from fundamentals, higher the relative profitability of using technical trading rule and greater the influence of associated socio economic and psychological constraints in optimum decision making. Bounded rational traders having not very perfect information about the optimum course of action, tend to be a very natural candidate of wild eyed speculations. Gradually, they become prone to follow emerging price movements to derive private information of others on the mistaken

belief that, most of the others cannot be wrong (that is the case of information cascade.). Prices so emerge, subsequently, fails to convey private information of predecessors but tend to generate an informationally inefficient adaptive belief favouring the ongoing market movements. Rise in prices thereby; tend to become a single obsessive topic of conversation, usually embellished with each telling, of the fortunes made who got into early. Those who are still on the sidelines seem to be wasting the golden opportunities and more and more people are drawn into the boiling market as technical traders. Caution is thrown into the winds, voices of reasons and moderations are shouted down, arbitragers operating against the asset price misalignment tend to drop out. Thus, movements in prices gradually results into generating evolutionary confidences in favour of price to price feedback which justify further expectation for increases. Ultimately a self fulfilling prophecy emerges whereby larger movements in prices results in more profit for technical traders accumulate more wealth which in turn justifies further demands. The great bubble of hope, unreason confidence and greed floats upward.

Thus, large price increases at the beginning of a bubble converts agents from fundamentalists group as well as from those who are standing on the sidelines into optimistic chartists group. For a more or less extended time span, the attraction of additional traders entering on the demand side heats up the bubble. Once the bubble has infected a certain number of traders, the exhaustion of the pool of additional participants causes to slow down the ongoing price trend. On the other hand, with a relatively large deviation from fundamentals, there is a high potential gain from the fundamentalist's strategy. Both tendencies gradually change the profit differential in favour of fundamentalists' strategy fostering transition of chartists to the fundamentalists group. In this situation under consideration, agents switch from the demand side to the supply side of the market. As a result, the price will eventually cease to rise further reaches its turning points shortly after the turning point of chartist's share. The ensuing price drop, then leads to an erosion of confidence among the remaining chartists which, in turn, will reinforce the downward price trend. The general pattern of downward waves is very similar with the upwards. Emerging pessimism causes a downward price trend which in turn confirms the speculator's

belief and reinforces contagion of fear. As a consequence , more and more fundamentalists join the pessimistic group in order not to incur huge losses.Again exhaustion of pool of additional sellers eventually leads to a slowdown of the negative trend.As the threat of capital losses diminishes, lasting undervaluation induces a change of the profit differential in favour of the fundamental strategy. Accordingly, when the ratio of fundamentalists increases in the population , again, a reversal of the price trend is brought about because of an increasing demand.At last, the resulting recovery induces a change of prevailing mood of the market.

Thus acquiring solely from numerical consideration, a sentiment of invincible power allows individual to yield to instincts, where the capacity of any group to rule over the other becomes a function of numbers (n) and wealth (w). With this assumption we virtually negate the hypothesis of rational expectation theorists that people with better information will rule over the market. Arbitrage operation thus appears to be useless if wealth not information decides destiny of the market.

In this backdrop, now we will attempt to analyze intricate relationship between wealth and numbers of fundamentalists (W_{nf}) and chartists (W_{nc}), its impact on asset prices and resource allocation ignoring the early dogma of "rationality", "independence of decision making" and "informational efficiency". We have viewed asset market to be typically populated by heterogeneous agents who differ in belief function, continuously update their belief and switch over to more profitable investment and trading strategy to benefit from it. The model is pointing towards certain solutions in asset price dynamics that may irritate the advocacies of "perfectionists", but capable enough to capture more accurately the underlying behaviour of market participants:

1) Investors in asset market continuously update their belief and expectation based on current experiences, i.e. the decisions of investors are context specific , they learn from experiences.
2) Investors favour one strategy ignoring the others.They switch over from one camp to another and it creates impact on both numbers (n) and wealth (W). The following situations may result:

(a) If $W_C = W_f$ (where W_C is the wealth of chartists and W_f is wealth of fundamentalists and where $W_C + W_f = 1$, when strength of both the camps are equal (see equation 10 and 11) their interaction will result into "tired looking anemic market".

(b) If $W_f \rangle W_C$ and W_f > 0.5 occurs, fundamentalists trading rule is generating more risk adjusted profit consistently than technical analysts. Fundamentalists become wealthier at the cost of noise traders and dominate the market. Because of their adaptive nature technical traders will gradually switch over from their " naïve" strategy to fundamental rule. Price will be moved based only on information and converges towards fundamental value. Thanks to bounded rationality , even when $W_f > 0.5$, price may deviate from fundamental but this will be short lived and much discussed phenomenon of mean reversion dynamics will take care of it (De Bondt and Thaler ,1985; Summers ,1986; Fama and French 1988; Poterba and Summers, 1988).

(c) When $W_f \langle W_C$ and W_C > 0.5, in this variety chartists dominate the market. Trend chasers consistently earn a risk adjusted return that is higher than fundamentalists.

As chartists become wealthier than fundamentalists, their wealth increases (initial wealth plus accumulated profit) and capacity to influence price movement also increases. The situation will attract new investors who so long avoided the market as gambling den, now to minimize regret of losing the option of earning quick bucks will enter into the market. New wealth under the command of trend chasers will be equal to $W_c + W_{c1}$ (new entrants and its wealth). Finally this will result into $W_{C'} + W_f \rangle 1$ (where $W_{C'} = W_c + W_{c1}$). Here prices and opinion index move broadly in a line with each other. Shifts in opinion index in favour of chartists may be taken as a characterization of displaying waves of optimism and pessimism which are

accompanied by deviation of asset's price from its fundamental value. The ratio of the chartists in determination of price increases during both optimistic and pessimistic waves and declines when revision towards the fundamental value sets in. Further, socio psychological hindrances restrict independence of decision by the fundamentalists. They fail to pursue any strategy that punishes but not reward investors. This result into a condition where W_f tends to w_c but $w_c \neq 1$and $w_f \neq 1$, which would cause a trading deadlock.

Of course, the timing and extent of future bursts of optimism and pessimism as well as the timing of its reversals remains unforcastable, but the qualitative picture remains as described. If investors can predict that market would collapse on time 't'undeniably it will occur before "t" say at "t-1".

In sum, to reach the market upheavals, the heterogeneous model under the condition of bounded rationality, requires the decisions to be context specific. Adaptive belief is to be formed among the majority traders in favour of evolutionary fitness of using technical trading rules. More and more traders including the prior fundamentalists are turned into technical traders with sufficient numbers and wealth. This ultimately results in making the arbitrage operation powerless and subsequent changes in prices become a model endogenous phenomenon generating out of the trading process itself. If this happens then any small changes in prices due to random news are reinforced and can become more and larger due to trend following trading rules. But the trend cannot persist forever. Once sufficiently large numbers of traders have been converted to follow the technical traders, the self reinforcing forces in prices tend to slow down. Now an exogenous development in fundamental condition tends to reverse the direction of market movements and bring it back to its normal level of tranquility. Thus heterogeneous market model with bounded rationality and evolutionary learning predicts the market to switch irregularly between phases of low volatilities and high volatilities. Large changes in price movements tend to be followed by large changes – of either sign-and small changes tend to be followed by small changes, irregularly interchanging with each other. In this backdrop, our major emphasis in the empirical part of the present thesis would be on examining the patterns of price movements in Indian context. Pattern in prices in turn can be taken

as an explanatory device for explaining the influences of social psychological underpinning of human decision making under uncertainties towards market upheavals.

3.3. Hypothesis:

The present study hypothesize that to maximize expected utility participants in the market behave rationally ,they use all available information independently, form unbiased estimation about the future and maintains an optimum relation between risk and return.

3.4. Research Questions:

To test the above stated hypothesis the following research questions are raised in the background of heterogeneous market model with evolutionary adaptive belief system under the condition of bounded rationality.

1) Whether their decisions in the market become context specific?
2) Do investors continuously follow a trading rule that satisfy rational expectation model?
3) Do investors constantly evaluate the profitability of other strategies and never hesitate to switch over to relative profitable tools, no matter whether it is ridiculous or rational?
4) Do the prices moves randomly?

3.5. Methodology:

In the context of evolutionary adaptive belief with bounded rationality, prices ultimately become an outcome of strategic complimentarity or substitutability in favour of a trading rule. If strategic complimentarity occurs in favour the technical rules , prices tend to deviate from fundamentals.Evolutionery learning from sustained deviation of price from fundamentals gradually tend fundamentalists to ignore their own decision rules. Fundamentalists switch over to technical rules significantly reduces their importance in price determination. Increased dominance of trend chasers ultimately results in generating a self fulfilling dynamics whereby large deviations from fundamentals justify further deviation. Moreover once sufficiently large number of traders has been converted to follow the technical traders the self reinforcing forces in prices tend to slow down. Now an exogenous development in fundamental condition tends to reverse the direction of market movements and bring it back to its normal level of tranquility. Thus movements in prices in this evolutionary learning set up may be characterized by irregular switches between phases of low volatilities, where price changes are small, and phases of high volatility where small price changes become large due to trend following trading rules. In this context we will apply Generalised Autoressive Conditional Heteroskedastic model (GARCH) and Extreme Value Theory to identify empirically the evidences of prolonged rise and fall in asset prices and its clustering over stretches of time in Indian capital market. The presence of extreme movements in price changes and its clustering over time, may be taken as macro effects on prices of socio- psycho economic dynamic forces in forming adaptive belief at the micro level of agent's interactions, proposed under the heterogeneous market model with bounded rationality.

3.6. Data and time period:

In the present study we have considered a period ranging from July 1997 to September 2013.Historical daily price data on BSE SENSEX 30, the widely recognized price index in Indian context comprising nearly forty percentage of market capitalization have been collected. The entire data base consists of BSE SENSEX 30

daily closing values which is adjusted for dividends have been obtained from web portal of Bombay Stock Exchange, India.

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