DETERMINING SPEED OF ADJUSTMENT COEFFICIENT: A STUDY OF NSE

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ABSTRACT

The study employs ARMA (1,1) model to estimate speed of adjustment coefficients in S&P CNX Nifty during 2004-2013. The sub-sample analysis reveals the evidence of overreaction in NSE during 2004-2008. The findings suggest that prices are speedily adjusting to intrinsic values during 2009-2013 for the stock market. It seems that the steps taken by the stock exchanges to reform market microstructure have led to improvement in speed of adjustment coefficients.

Keywords: Speed of adjustment, Underreaction, Overreaction.

I. INTRODUCTION

Studies of market efficiency focused on the question of how quickly information is reflected in prices. An efficient market is one in which information is quickly reflected in prices in an unbiased manner. It is well recognized that the inefficient resource allocation would occur if prices are not free to adjust to market conditions (Jackson III, 1997). The study of how financial asset prices adjust to information has long been a focus of attention (Theobald and Yallup, 2004). The efficiency of price discovery process of a security market can be accessed through the analysis of speed of adjustment process (Damodaran, 1993, Thobald and Yallup,2004, Rajesh, 2010). The structure of stock market and the level of technology used in it influence the speed of adjustment. The changes in them lead to more information dissemination that might result into faster processing of new information. Impact of changes in market microstructure on security speed of adjustment coefficient can be found by measuring whether there are underreactions or overreaction in security prices while adjusting to their intrinsic value. The security speed of adjustment gives us an idea about the degree of over or under reaction or full adjustment of prices to the arrival of new information. The speed of price reaction to the news is of interest not only to investors but also to stock exchanges. The transparency of prices in addition to the trading cost

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affects the competitive position of stock exchanges. Therefore, the subject isquite relevant to examine.

II. THEORETICAL BACKGROUND

Different approached have been applied to study how asset prices adjust to information. Fama (1970, 1991) referred semi-strong market hypothesis as the market where prices speedily and unbiasedly adjust to publicly available information. Rational expectations models also have been applied to understand price adjustment mechanism (Grundy and McNichols, 1989). A number of behavioural models have been used to examine undereactions (Barberis et al.1998, Hong and Stein, 1999, Fama, 1991).

Amihud and Mendelson (1987) examined the effects of trading mechanism on price behaviour of securities in NYSE stocks. They employed a simple model to know how prices follow a lagged partial adjustment process to intrinsic value with noise. The results suggested that the trading mechanism affected the price behaviour. The study did not measure the speed of security price adjustment.

Damodaran (1993) developed a simple approach that drew on attention in return processes to estimate price adjustment coefficients for the firm listed on NYSE and AMEX during 1977 to 1986. The study found evidence of lagged price adjustment coefficients to new information in shorter return intervals for firms. A number of estimators have been developed (for example Amihud and Mendelson,1987, Damodaran, 1993, Brisley and Theobald, 1996; Theobald and Yallup, 1998).

Recently, Thobald and Yallup (2004) provided the direct measures of the degree of price overreactions and underreactions to determine security speeds of adjustment towards their intrinsic values thereby. They pointed out the limitations of earlier estimators. For example, Damodaran (1993) and Brisley and Theobald (1996) do not have readily available sampling distribution and therefore, significance testing is not possible. They will also be subject to non- trading or non-synchronous problems. The estimators require prices to fully adjust with available information at a specified return interval that prevents the possibility of testing for over or underreactions at longer differencing intervals. Further, they mentioned that the estimators do not provide estimates of the total speed of adjustment coefficient.

Theobald and Yallup (2004) developed ARMA specification of the return process which overcomes the deficiencies associated with various estimators. The estimator developed by them is a function of autocorrelations which is introduced by underreactions and overreactions. Underreactions induce positive autocorrelations while overreactions lead to negative autocorrelations in the return series. The ARMA estimator has a sampling distribution for significance testing. It provides total speed of adjustment coefficient. Thin trading effect can be expressed with higher order moving average terms. Finally, the estimator does not require prices to fully adjust to information at any specified intervals as in case of Damodaran (1993) estimator. Therefore, ARMA estimator can be applied in all potential adjustment scenarios to measure overreaction or underreactions.

Few studies have examined information efficiency of stock exchanges with regard to Indian stock markets. Poshakwale and Theobald (2004) examined the lead-lag relationship between large and small market capitalization stocks using data of four stock market indices of BSE and NSE namely Nifty senior and junior Indices, SENSEX and BSENI indices. The studies found that large cap indices tend to lead small cap indices. The speed of adjustment of large capitalization stock was higher than small capitalization stock. Rajesh (2010) examined the impact of changes in market micro structure on market quality through security speed of adjustment coefficient using ARMA estimator for small and large capitalization stocks. The study did not find significant difference in the speed of adjustment coefficient of small and large capitalization stocks. Our study examines the speed of adjustment coefficient of Indian stock market namely S&P CNX Nifty of National Stock Exchange (NSE).

The plan of the paper is as follows. Section 3 discusses Research Design. Results are presented and discussed in section 4. Conclusions are drawn in section 5.

III. RESEARCH DESIGN

Sample and Period of study

The study uses data on daily closing price of S&P CNX Nifty of India from January 1 2004 to July 7, 2013. The daily data of Nifty is obtained from NSE web sites respectively. The entire sample is divided into two sub periods. The first period starts from January 1, 2004 to December 31, 2008 while second period from January 1, 2009 to July 2, 2013 to examine whether speed of adjustment coefficient has improved in the recent past. The second period is most recent and some changes took place during the period to reform market microstructure like use of state-of-the art information technology, transactions in futures and options, fined tuned risk management system, securities lending and borrowing, increased FII inflows across the world stock markets, gradual lifting of restrictions on capital flows and relaxation of exchange controls in many countries, steps to increase financial awareness, several innovations in products and services etc. These changes might have influenced the speed of price adjustment.

Methodology

Daily returns are identified as the difference in the natural logarithm of the closing index value for the two consecutive trading days. It can be presented as:

$$R(t)=\log(Pt)-\log(Pt-1) \qquad \text{Equation 1}$$

Where R(t) is logarithmic daily return at time t. Pt-1 and Pt are daily prices of an asset at two successive days, t-1 and t respectively.

Amihud and Mendelson (1987) specified the stochastic process for observed price series and intrinsic value series using noise model. The observed price series are assumed to adjust towards their intrinsic values incompletely. The Intrinsic value is assumed to follow a random walk. The speed of adjustment coefficient captures the extent of adjustment. The following two equations give us the specifications for observed price and intrinsic value series:

$$\Delta Pt= \pi\{V(t)-P(t-1)\}+u(t) \qquad \text{Equation 2}$$

$$\Delta V(t)= \mu +e(t) \qquad \text{Equation 3}$$

Where ΔPt is the change in actual (or observed) price, expressed as natural logarithm, π the speed of adjustment coefficient, which will be in the range of [0, 2] for non-explosive processes. u(t) is white noise term. $\Delta V(t)$ is the change in logarithmic intrinsic values, μ is the mean of the intrinsic value random walk process and e(t) is an error term which is serially uncorrelated inefficient markets. The speed of adjustment coefficient, π =1, when prices fully and unbiasedly adjust whereas it will be greater than one, when there is overreaction and less than one, when there is underreaction. An alternative time series estimator can be derived by differencing and rearranging equation 2 as:

$$R(t) = (1- \pi)R(t-1)+ \pi\Delta V(t)+ \Delta u(t) \qquad \text{Equation 4}$$

$$R(t)= \pi \mu+(1- \pi) R(t-1) + \pi e(t)+u(t)-u(t-1) \qquad \text{Equation 5}$$

The autocorrelations induced by underreactions or overreactions are reflected as an ARMA(1,1) process. The price adjustment effects will be contained in the A R (1) coefficient that will suggest estimates of the speed of adjustment coefficient. When adjustment is full (π=1), the process will be MA (1) process. It indicates that the 'noise' created by bid/ask, drive the return process. The autoregressive component will be stationary when $|1- \pi|<1$ i.e. $0< \pi<2$, then AR component is stationary and prices are finite. MA component of high order will capture the effect of non-synchronicities.

IV. RESULTS

Present study uses ARMA(1,1) model to examine the security speed of adjustment. The order of one is selected based on Autocorrelation and Partial Autocorrelation Functions. Table 1 presents the results of security speed of adjustment coefficients as given by ARMA (1, 1) model. To assess the speed of adjustment coefficient, π is estimated and presented in the table 1. The results provide insight into the efficiency of the market and the extent to which reactions may depart from full adjustment. The results of speed of adjustment coefficient for NSE reveal that there was overreaction during 2004-2008. Daniel et al.(1998) demonstrate that prices will overreact in a market which is characterized by overconfident investors and self-attribution biases. While in second period, the market is closer to full adjustment since the value of π is near to one. It becomes closer to full adjustment in second period. It seems that the reforms initiated by the stock exchanges have led to improvement in speed of adjustment coefficients. Our study is different from other studies as it tries to estimate speed of adjustment coefficient of broad based indices of Indian stock markets in comparison to other studies conducted for Indian stock markets, which analyzed the speed of adjustment coefficients of small and large capitalization stocks. Therefore, the findings of our study will add more information and insight to the existing issues of measuring speed of adjustment.

V. CONCLUSION

The main objective of the study is to analyze the speed of adjustment coefficients in NSE of India. The sub-sample analysis reveals the evidence of overreaction in NSE during 2004-2008. Values of π indicate that prices are speedily adjusting to intrinsic values during 2009-2013. Further study is needed to investigate the factors that could provide explanations for the presence of under and overreactions in both the stock markets.

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Table 1: Securities Speed of Adjustment Coefficients-ARMA(1,1) model-daily data

NSE		
Differencing Interval in days	2004-2008	2009-2013
	π	π
1	0.9332*	1.4817*
2	1.4227*	0.9700*
3	0.9917*	0.9698*
4	1.6940*	0.9261*
5	1.1873*	0.9361*
6	1.7766*	0.9542*
7	1.2660*	0.9453*
8	1.8392*	1.0151*
9	1.5131*	1.0031*
10	1.8667*	0.9346
11	1.3889*	0.9629*
12	1.8873*	0.9588*

Differencing Interval in days	2004-2008	2009-2013
	π	π
13	0.8832*	0.9481*
14	1.4590	0.9555*
15	1.5589*	0.9720*
16	1.4808*	0.9951*
17	1.3165*	0.9412*
18	1.9220*	0.9960*
19	1.3035*	0.9169*
20	1.4709*	0.9535*
21	1.4043*	0.9038*
22	1.2343*	0.9278*
23	1.5875*	0.9496*
24	1.4018*	0.9486*
25	1.3298*	1.0040*

*indicates statistically significantly different from 1 at 5% level.