Measuring productive efficiency of stock exchanges using price adjustment coefficients

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ABSTARCT

A stock exchanges 'efficiency can be measured by its liquidity and price discovery. An exchange that provides price discovery will have high liquidity. By measuring the speed of stock price adjustment to its intrinsic value with the arrival of new information we can understand price discovery process and productive efficiency of a stock exchange. I found that it takes around nineteen days for the prices of a sample of stocks representing BSE and NSE exchanges, to adjust to their intrinsic values during 1996-2002. The stock prices overreact to the information before adjusting to their intrinsic values. I also found that market-wide information adjusts faster than firm-specific information.

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Section I

Introduction:

The efficiency of a stock exchange in particular and capital market in general can be measured in terms of its liquidity and price discovery. Liquidity refers to the environment created by the stock exchange where trading can be done with minimum friction and maximum ease, resulting increase in trading volumes and traders' interest to trade in a particular market structure. Price discovery refers to the process by which securities adjusts to their intrinsic value. In other words, faster the price discovery the more efficient is the market structure. O'Hara (2002) interlinks these two aspects of efficiency and comments that "the exchange that provides price discovery will have high liquidity".

In an efficient price discovery process, observed stock price should always incorporate new information released in order to reflect the change occurred to the intrinsic value of the stock. Such a reflection or adjustment should be instantaneous if the process is considered to be strongly efficient (Fama, 1991). So the speed of adjustment of the observed price to the changed intrinsic value due to new information arrival is a measure of stock exchanges' efficiency in terms of price discovery. The time taken by an exchange to convert all new information into price signals measures its productive efficiency.

Speed of adjustment is based on the information sharing process among the market participants and the information dissemination of the companies to the market participants. As mentioned above, speed of adjustment should be instantaneous in an efficient market. Such an instantaneous adjustment occurs when the information shared among the market participants, the information disseminated by the companies and the information transmitted by the media is symmetric. The technology involved to process information for instantaneous adjustment is also an important factor.

Researchers attributed the speed of adjustment to two main factors (see O'Hara, 2002). First the fairness and integrity of prices due to the exchange prevention mechanism from fraud and self-dealing. Second, the information structure itself, which is based on the companies' disclosure practices and corporate governance. The efficiency of the second factor is again based on the exchange prevention mechanism and the regulators role to augment transparency. In a nutshell, price discovery is based on the characteristics of the traders, companies and the market design.

The purpose of this paper is to measure the speed of price adjustment to its intrinsic value or the productive efficiency in the National Stock Exchange (NSE) and Bombay Stock Exchange (BSE) using Damodaran (1993) adjusted price adjustment coefficient and a new simpler method based on stock prices auto-covariance ratio. The project was started with a more ambitious objective to measure the speed of adjustment of all the stock exchanges in India. But the recent trading volume among the regional exchange has been negligible compared to NSE and BSE. There had been days when some of the regional stock exchanges witnessed no trading for one full trading day. This pattern allowed me to pursue only NSE and BSE. Such a drain in the regional stock markets could be due to the problems associated with price discovery. When companies grow and become large with increasing capital needs they migrate to more large and liquid markets, where they can discover their true worth. In fact, some companies are going a step ahead and listing in global stock exchanges as they emerge into global companies.

The paper is divided into five sections. Introduction in section one is followed by the theory behind price adjustments coefficients in section two. Data and methodology are discussed in section three. Section four reports and analyses the empirical results and the concluding remarks are drawn in section five.

Section II

This section contains the evolution of speed of adjustment measure based on the works of Amihud and Mendelson (1986), Damodaran (1993) and Brisley and Theobald (1996). Later a new method for price adjustment process is introduced.

Black (1986) suggested that the observed price can be divided into two components namely, the noise and the intrinsic value. Where the noise represents the difference between intrinsic value and the observed price. Amihud and Mendelson (1986) formalised this relationship through the following equation.

$$(P_t - P_{t-1}) = g\,(Vt - P_{t-1}) + u_t \qquad -1$$

Where P_t is the observed price at time t, V_t is the intrinsic value at time t and u_t is the noise due to the valuation and interpretational errors. u_t has been interpreted as white noise with zero mean and finite variance s^2 .

Given the above definitions the change in the observed price (P_t - P_{t-1}) to the change in the intrinsic value (V_t - P_{t-1}) can be measured through the coefficient g. g in equation 1 represents the price adjustment coefficient. g with value 1 represents full price adjustment to the intrinsic value change. The value of g between $0<g<1$ represents partial adjustment to the change in the intrinsic value. In the extremes g with value 0 represents no adjustment to the change in the intrinsic value and $g>1$ represents overreaction of the price towards change in the intrinsic value with the arrival of new information.

Amihud and Mendelson (1986) decomposed the variance of noise into two components namely, the intrinsic value variance which arises due to heterogeneity in the valuation due to heterogenous beliefs among traders and the variance due to pure noise which arises due to irrational or unexplained behaviour.

From equation 1 P_t can also be interpreted as

$P_t = (1-g)\ P_{t-1} + g\ V_t + u_t$ -2

Then by induction approach we have,

$P_t = (1-g)^t \Sigma^{t}_{s=-\infty} (1-g)^{-s} (g\ V_s + u_s) - (1-g)^t \Sigma^{t-1}_{s=-\infty} (1-g)^{-s} (g\ V_s + u_s)$, where,

$g\ V_t + u_t = (1-g)^t (1-g)^{-t} (g\ V_t + u_t)$

$P_t = (1-g)^t \Sigma^{t}_{s=-\infty} (1-g)^{-s} (g\ V_s + u_s)$

$P_t = \Sigma^{t}_{s=-\infty} (1-g)^{t-s} (g\ V_s + u_s)$

$P_t = \Sigma^{+\infty}_{i=o} (1-g)^i (g\ V_{t-i} + u_{t-i})$ where $i = t-s$, then,

$P_t = g \Sigma^{+\infty}_{i=o} (1-g)^i\ V_{t-i} + g \Sigma^{+\infty}_{i=o} (1-g)^i\ u_{t-i}$ -3

If R_t is the return of security at time *t* then

$R_t = P_t - P_{t-1}$ -4

By substituting the value P_t from equation 3 we have

$R_t = g \Sigma^{+\infty}_{i=o} (1-g)^i (g\ V_{t-i} - V_{t-1-i}) + \Sigma^{+\infty}_{i=o} (1-g)^i (u_{t-i} - u_{t-1-i})$ -5

If security value follows a random walk with a drift then

$V_t = V_{t-i} + e_t + m$ -6

Where *m* represents the value return and e_t represents the valuation error.

Substituting V_t from equation 6 in equation 5 we have

$R_t = g \Sigma^{+\infty}_{i=o} (1-g)^i (e_{t-i} + m) + \Sigma^{+\infty}_{i=o} (1-g)^i (u_{t-i} - u_{t-1-i})$, then

$R_t = mg \Sigma^{+\infty}_{i=o} (1-g)^i (e_{t-i} + u_{t-1-i}) + \Sigma^{+\infty}_{i=o} (1-g)^i (u_{t-i} - u_{t-1-i} + g u_{t-1-i})$

$R_t = m + g \Sigma^{+\infty}_{i=o} (1-g)^i (e_{t-i} + u_{t-1-i}) + \Sigma^{+\infty}_{i=o} (1-g)^i\ u_{t-i} - \Sigma^{+\infty}_{i=o} (1-g)^{i+1}\ u_{t-1-i}$

$R_t = m + g \Sigma^{+\infty}_{i=o} (1-g)^i (e_{t-i} + u_{t-1-i}) + \Sigma^{+\infty}_{i=o} (1-g)^i\ u_{t-i} - \Sigma^{+\infty}_{i=o} (1-g)^j\ u_{t-j}$, where $j = i+1$,

$R_t = m + g \Sigma^{+\infty}_{i=o} (1-g)^i (e_{t-i} - u_{t-1-i}) + u_t$, therefore,

$R_t = m + w_t + u_t$ - 7

where, $w_t = g \Sigma^{+\infty}_{i=o} (1-g)^i (e_{t-i} - u_{t-1-i})$

Note: e_t and u_t are independent

From equation 7 it is clear that the observed return R_t is composed of the value return m, error due to incorrect valuations w_t and the remaining errors reflected on the observed price u_t.

From equation 7 one can arrive at the variance, auto covariance and auto correlation of the observed return R_t.

Variance of R_t :

From equation 7 variance of R_t is

$Var(R_t) = g^2 Var(w_t) + Var(u_t) + Cov(w_t, u_t)$

$Var(R_t) = g^2 \Sigma^{+\infty}_{i=o} (1-g)^{2i} (\nu^2+\sigma^2) + \sigma^2$

Where ν^2 represents the variance due to valuation error e_t and s^2 is the variance due to other errors reflected on the observed price. Then,

$Var(R_t) = g^2 (\nu^2+\sigma^2) 1/1-(1-g)^2 + \sigma^2$

$Var(R_t) = g^2 (\nu^2+\sigma^2) 1/g-(2-g) + \sigma^2$

$Var(R_t) = (g/2-g) \nu^2 + (g/2-g + 1)\sigma^2$

$Var(R_t) = (g/2-g) \nu^2 + (2/2-g)\sigma^2$ -8

Amihud and Mendelson (1986) showed that variance in the observed return has two components (ν^2, σ^2) as discussed above. If g = 1 then equation 8 will be

$Var(R_t) = \nu^2 + 2\sigma^2$ -9

Equation 9 shows that when prices are fully adjusted, the contribution of variance due to noise (s^2) is twice the contribution value variance (n^2) to the total variance of the observed return R_t. In case of partial adjustment, equation 9 is downwardly biased towards value variance. Black's (1986) finding that volatility in the price is greater than volatility in the value, can substantiate the bias in equation 9.

From equation 8, when $g = 1$ the value return variance is fully transmitted into the observed returns. In case of partial adjustment where $0<g<1$ the value return variance is partly transmitted in to the observed price. When $g>1$ then, the transmission of variance other than value return variance (s^2) will higher than value return variance and thereby increase the total variance of the observed price return. This sort of other variance may occur due to the overreaction of traders to arrival of new information.

Auto-Covariance of R_t:

$Cov(R_t, R_{t-1}) = Cov(gw_t + u_t, gw_t + u_{t-1})$ where w_t and u_{t-1} are independent, then

$Cov(R_t, R_{t-1}) = g^2 Cov(gw_t + w_{t-1}) + g\, Cov(w_t, u_{t-1})$

$Cov(R_t, R_{t-1}) = g^2 \Sigma^{+\infty}_{i=o} \Sigma^{+\infty}_{j=o} (1-g)^i (1-g)^j Cov(e_{t-i} - u_{t-1-i}, e_{t-j-1} - u_{t-2-j}) - gVar(u_{t-1})$

$Cov(R_t, R_{t-1}) = g^2 \Sigma^{+\infty}_{i=o} \Sigma^{+\infty}_{j=o} (1-g)^i (1-g)^j [Cov(e_{t-i} - e_{t-j}) + Cov(u_{t-1-i} - u_{t-2-j})] - g\sigma^2$

$Cov(R_t, R_{t-1}) = g^2 \Sigma^{+\infty}_{j=o} (1-g)^{2j+1} (\nu^2 + \sigma^2) - g\sigma^2$

$Cov(R_t, R_{t-1}) = g(1-g)/2-g (\nu^2 + \sigma^2) - g\sigma^2$

$Cov(R_t, R_{t-1}) = g/2-g[(1-g)(\nu^2 + \sigma^2) - (2-g)\sigma^2]$

$Cov(R_t, R_{t-1}) = g/2-g[(1-g)\nu^2 - \sigma^2]$ - 10

Auto- Correlation of R_t:

Note: Correlation = Covariance / Variance i.e., equation 7 / equation 8

$Corr(R_t, R_{t-1}) = g/2-g[(1-g)(\nu^2 + \sigma^2) - (2-g)\sigma^2] / (g/2-g)\nu^2 + (g/2-g + 1)\sigma^2$

$Corr(R_t, R_{t-1}) = g(1-g)\nu^2 - g\sigma^2 / g\nu^2 + 2\sigma^2$ - 11

With the above set of equations one can estimate the price adjustment coefficient, contribution of noise variance, contribution of value variance, auto covariance and auto correlation for any given security.

However, one cannot estimate the time taken for the prices to adjust to the arrival of new information. As discussed in section I, the time taken for adjustment or speed of adjustment is the real metric that measures the efficiency of a market or a stock exchange.

Damodaran (1993) extended Amihud and Medelson's (1986) work to measure the speed of adjustment of securities and portfolios. Damodaran (1993) assumes that speed of adjustment is not instantaneous in reality. This assumption simplifies the whole process. He divided time into daily units for measurement. He also assumes that the maximum time for price adjustment is 20 days based on some simulation experiments.

Damodaran (1993) modified variance of return $Var(R_t)$ in equation 8 in the following way. At interval *j* $Var(R_t)$ can be represented as

$Var(R_{jt}) = (g_j/2-g_j) j\nu^2 + (2/2-g_j)\sigma^2$ -12

Where j = (1,2,3... . K days)

Note: K = 20th day as per Damodaran (1993) and *K* is the time required for $g = 1$.

Then $Var(R_{kt})$ is

$Var(R_{kt}) = k\nu^2 + 2\sigma^2$ -13

Auto covariance of R_{kt} is

$Cov(R_{kt}, R_{kt-1}) = -\sigma^2$ -14

From equation 13 and 14 we can solve n^2 and s^2 at *K*

$\nu^2 \quad = \text{Var}(R_{kt}) + 2\,\text{cov}(R_{kt}, R_{kt-1}) / k$, and -15

$\sigma^2 \quad = -\,\text{cov}(R_{kt}, R_{kt-1})$ -16

From equation 12 we can solve for *gj*

$g_j = 2(-\sigma^2 + \text{Var}(R_{jt}) / \text{Var}(R_{jt}) + j\nu^2$ -17

Substituting the above n^2 and s^2 values in the equation 12 we have g_j with respect to k

$g_j = 2\,\text{Var}(R_{jt}) + \text{Cov}(R_{kt}, R_{kt-1}) / \text{Var}(R_{jt}) + j\,\text{Var}(R_{kt}) + 2\,\text{cov}(R_{kt}, Rk_{t-1})/k$

Re-arranging the above equation we have

$$g_j = \frac{2\,\text{Var}(R_{jt})/j + \text{Cov}(R_{kt}, Rk_{t-1})/j}{\text{Var}(R_{jt})/j + \text{Var}(R_{kt})/k + 2\,\text{cov}(R_{kt}, R_{kt-1})/k} \quad -18$$

Equation 16 is exactly the Brisley and Theobald (1996) corrected equation of Damodaran (1993). Damdoran’s (1993) price adjustment coefficient has been solved incorrectly, which was later corrected by Brisley and Theobald (1996).

g_j measures the speed of adjustment at every j interval till the kth interval. Damodaran (1993) and Brisley and Theobald (1996) found that it takes about five to six days for prices to fully reflect their intrinsic values for stocks listed in New York Stock Exchange (NYSE). Chance and Ariff (2002), used Damodaran (1993) adjusted measure to tests the price adjusted coefficients in the US, Japan and Hong Kong Markets. They found the evidence of lagged price adjustment in all the countries. They also found that the speed of adjustment varies from country to country, exchange to exchange and sector to sector. For example, in the US, over–the-counter stocks adjust to information faster than others. In Hong Kong, Buildings sector stocks adjust to information faster than other sectors. However, all these papers assume that the maximum number of days for information adjustment is 20 days.

<u>Price adjustment coefficient for portfolios:</u>

If the new information is purely firm-specific information then g_j is not an appropriate measure of price adjustment coefficients for portfolios. In case of portfolios, diversification eliminates the risk due to firm-specific information. Amihud and Medelson (1986) suggested the price adjustment coefficient measure for portfolios. Damodaran (1993) and Brisley and Theobald (1996) used the measure in their papers. The variance and covariances simply disappear for portfolios leaving only the serial correlation. G_{ts} the price adjustment coefficient for portfolios can be represented as

$G_{ts} = 1 - \rho_{t,\,t-1}$ - 19

One can compare g_j and G_{ts} for any given day to understand whether market-wide information transmits faster (slower) than firm-specific information. Damodaran (1993) found that market-wide information transmits faster than firm-specific information.

Problems associated with Damodaran (1993) and Brisley and Theobald's (1996) corrected measure:

Damodaran's (1993) measure has two major drawbacks. First, the assumption that price converges to its intrinsic value in 20 days. Lets consider a market where prices never converge to their intrinsic value due to constant errors in the valuation process. There is every possibility to have such constant error in the valuation in the short-term due to information asymmetry as discussed in section I. Prices overreaction due to traders erratic behavior could be a constant phenomena in the short-term. If some investors share private information or at least if the uninformed traders perceive that there is always a group of informed investors who have access to private information, then in the short-term there will be constant roller-coaster rides in the stock prices making the price not to converge to its intrinsic value until a correction occurs. There is every possibility that such a correction may not occur in twenty days time. And the chances of not converging are more in a less efficient market compared to NYSE. Damodaran's (1993) measure by construction converges on the 20th day irrespective of the previous day's coefficient. In a situation like this Damodaran's (1993) measure is no longer applicable to look for the real convergence. Second, the inclusion of *j* on the right hand side of the equation 12 leads to mathematical inconsistencies.

A simpler method for speed of adjustment:

Cognizant of the above problems one can estimate mathematically consistent speed of adjustment measure for any given *j* with out a limit in the number of *j* intervals.

We know that

$R_t = m + g \Sigma^{+\infty}_{i=o} (1-g)^i (e_{t-i} - u_{t-1-i}) + u_t$ then

Second order auto-covariance of R_t is

$$Cov (R_t, R_{t-2}) = g^2 Cov (gw_t , w_{t-2}) + g Cov (w_t, u_{t-2}) + g Cov (u_t, w_{t-2}) + Cov (u_t, u_{t-2}) \quad - 20$$

We know that u_t has zero mean and finate variance and u_t and w_t are independent, then

$g Cov (u_t, w_{t-2}) = 0$ and $Cov (u_t, u_{t-2}) = 0$, then

$$Cov (R_t , R_{t-2}) = g^2 Cov (gw_t , w_{t-2}) + g Cov (w_t, u_{t-2})$$

$$Cov (R_t , R_{t-2}) = \Sigma^{+\infty}_{i=o} \Sigma^{+\infty}_{j=o} (1-g)^i(1-g)^j Cov(e_{t-i} - u_{t-1-i} , e_{t-2j} - u_{t-3-j}) - g(1-g) \sigma^2 \quad - \quad 21$$

Substituting σ^2 and ν^2 in equation 15 we have

$$Cov (R_t , R_{t-2}) = \Sigma^{+\infty}_{j=o} (1-g)^{2j+2}(\nu^2 + \sigma^2)$$

$Cov(R_t, R_{t-2}) = (1-g)^2(\nu^2 + \sigma^2)(1/1-(1-g)^2)$

$Cov(R_t, R_{t-2}) = (1-g)^2(\nu^2 + \sigma^2)(1/g(2-g))$

$Cov(R_t, R_{t-2}) = g(1-g)^2/(2-g)(\nu^2 + \sigma^2)-g(1-g)\sigma^2$

We know that $g(1-g)/(2-g)(\nu^2 + \sigma^2)-g(1-g)\sigma^2 = Cov(R_t - R_{t-1})$, then

$g = 1- Cov(R_t, R_{t-2})/ Cov(R_t, R_{t-1})$ - 22[2]

g, the price adjustment coefficient is simply a ratio of second order covariance to the first order covariance. *g* measures the price adjustment for any given *j*.

When j is allowed with out any limit we loose the intuitive appeal of Damodaran's (1993) measure. We can no longer interpret with the same ease as we did with Damodaran's (1993) measure. The new measure does not look at number of days to converge prices to their intrinsic values rather it conveys to what extent prices converge to their intrinsic value at any given time.

Section III

Data and Methodology

The data is obtained from three different sources namely, PROWESS, DATA STREAM and NSE website. Multiple sources have been used for validation purposes. The data includes daily prices of stocks included in two major indices namely, BSE SENSEX and NSE NIFTY to represent BSE and NSE markets. The SENSEX and NSE NIFTY daily index values have been used to represent portfolios in the two stock exchanges. The study period ranges from January 1996 to August 2002. It was found that the prices of stocks listed both in NSE and BSE have almost similar prices during the study period. Novartis Ltd of NSE NIFTY stocks and HCL Technologies of BSE SENSEX stocks have been excluded from the analysis due to inconsistencies and unavailability of the data for the entire study period. There are three main reasons for selecting small sample size. First, trading frequency is an important factor for the speed of adjustment analysis, especially when speed is measured in daily units. SENSEX and NIFTY stocks are the most actively traded firms in India. The data indicates that majority of the firms other than firms in SENSEX and NIFTY have infrequent trading. In case of infrequent trading speed of adjustment cannot be attributed only to information arrival. The delay in the speed can also be attributed to the non-trading due to lack of interest or any other reasons. Second, stocks in the SENSEX and NIFTY represents more than fifty percent of the market capitalization of Indian stock market. Third, active stocks are good representation of investors' interest and reactions.

[2] A similar approach was used by Theo bald and Yullap (2001).

The methodology involves estimating price adjustment coefficients for SENSEX and NIFTY stocks and for SENSEX and NIFTY indices (portfolios) using equations 18,19 and 22 in section II. First Damodaran (1993) corrected measure was estimated using equation 18 to estimate speed of adjustment for individual stocks. Second, equation 19 has been applied to measure portfolio speed of adjustment through the serial correlation estimates. Third, SENSEX and NIFTY indices auto-covariance ratios were estimated to measure the general speed of adjustment of portfolios using equation 22.

Section IV

Results:

Table one and two represents Damodaran (1993) corrected price adjustment coefficients (g) for individual stocks in NSE NIFTY and BSE SENSEX. The results are quite interesting and contrasting with the US results. They are almost similar for BSE and NSE stocks suggesting that firm specific risks are unique irrespective of the market structure.

Out of forty-nine stocks in table one, forty-six stocks have g greater than one. In fact six of them have g greater than two. This is an over whelming indication of overreaction of the prices for the arrival of new information. In the US on an average stocks exhibited g lower than one for at least first four days of the information arrival suggesting under reaction or slow adjustment process. The average of forty-nine stocks in table one indicates opposite direction in Indian stocks. The highest g is the first day after the information arrival and then g gradually decreases converging close to one on the nineteenth day after the information arrival. The results are same for SENSEX stocks. This indicates that speed of adjustment is quite slow in India compared to the US stock market. The traders on an average overreact to the information arrival and the overreaction is highest on the first day of the information arrival. The results are consistent with Debondt and Thaler (1985) investor overreaction theory. The results also fit with the explanation of investor overconfidence and self attribution by Daniel, Hirshleifer and Subhramanyam (1998). The stocks exhibit short-term momentum with the information arrival and a long- term reversal.

Individual stocks exhibit drastic variation in their price adjustment process indicating the dominant role of firm-specific factors in the price adjustment process. The overreaction is highest for Infosys Limited (2.7511) and lowest for State Bank of India (1.3653). Britannia Ltd., Castrol India Ltd., and Zee Telefilms Ltd exhibit under reaction to the information arrival. Although, it is difficult to establish any causal relationship for this behaviou, it looks quite obvious after looking at table three that firm specific information dominates the price behaviour. Table three reports price adjustment coefficients of portfolios (SENSEX and NIFTY indices). The results indicate that the index values 'price adjustment coefficients are almost close to one on a given day till the twentieth day. This indicates that market wide information is adjusted into the prices faster than firm-specific information. Damodaran (1993), Brisley and Theobald (1996) and Chance and Ariff (2002) found similar evidence in the US, Hongkong and Japan. One explanation for this behavior could be due to the inefficiencies in the information dissemination process. It is a known fact that traders in any given market are divided into informed and uninformed traders. Informed traders like fund managers constantly value stocks and also share superior or private information apart from the market-wide information. Where as uninformed investors share only market-wide information due to limited resources. As the market-wide information is commonly shared by all market participants (informed and uninformed) price adjustment due to market-wide information will be faster than firm-specific information. Incase of firm-specific information uninformed traders wait for the moves of informed traders for their investments decisions. Although, in an efficient market information shared by all market participants should be symmetric there is strong evidence of asymmetries across the global markets. If capital market efficiency is a function of economic development then developing economies should have higher gaps in the information dissemination process compared to developed economies. There is considerable evidence that uninformed traders exhibit herd behavior (Lux, 1995) due to the gap in the information dissemination process. In that case, uninformed overreact (underreact) as a response to the moves of informed traders reflecting herd behavior.

Table four reports auto-covariance ratios of BSE SENSEX and NSE NIFTY indices. As explained in section two, auto-covariance ratio measures the speed of adjustment on any given day. For consistency with Damodaran estimate twenty days auto covariance ratios are reported in table four. The results indicate that BSE SENSEX has an auto-covariance ratio close to one, indicating quick and efficient price adjustment. On the other hand, NSE NIFTY exhibits over reaction to the information arrival. Table five explains the reason behind differential price adjustment process of BSE and NSE market portfolios. The auto-covariances of SENSEX and NIFTY are quite low indicating that the price change is almost independent. Two lag auto- covariance values are lower than one lag auto covariance values indicating that the explanatory power of past price diminishes with the increase in time. However, NIFTY has negative auto-covariance for the second lag. A negative auto-covariance indicates an price reversal. This can be to correction from the overreaction occurred during the first day of information arrival. This indicates that NSE NIFTY index exhibits overreaction one day after the information arrival followed by a correction on the next day.

To explore further on this issue auto-covariance ratios of NSEDIFTY and BSE 100 have been estimated. The results are reported in table 6. Again NSEDIFTY has a price adjustment coefficient higher than BSE 100. Indicating overreaction occurs in NSE indices compared to BSE indices. Such an overreaction in the NSE indices is not due to the domination of firm specific factors. This could be due to the number of index funds constructed using the indices. The more the number the higher would be the activity of the index fund managers with the information arrival which in turn causes increased activity of the uninformed investors resulting overreaction in the prices. The index funds on NSE indices are higher than BSE indices.

Section V

Concluding remarks

I examined the price discovery process in Indian capital market by measuring speed of adjustment of prices to their intrinsic values due to the arrival of new information. Damodaran (1993) adjusted price adjustment coefficient, serial correlations and auto-covariance ratios are used for the purpose. I found that stock prices overreact to the information arrival both in BSE and NSE. The price overreaction varies from firm to firm. There is no indication that price adjustments vary with the size of the firm. The price over reaction gradually reduces with the increase in time and full adjustment occurs on the nineteenth day of the information arrival. Using serial correlation measure suggested by Amihud and Mendelson (1986) I found that, in case of portfolios, information adjustment occurs with in a day. This indicates firm-specific factors cause price overreaction and the overreaction is eliminated in portfolios through diversification. However, auto-covariance ratios suggest that overreaction occurs even in portfolios if the information dissemination is inefficient. This might happen due to the increased level of activity by the index funds and uninformed investors during the price discovery process. NSE NIFTY and NSE DIFTY indices exhibit overreaction.

The results have many implications for both researchers and practitioners. First, the price adjustment process in Indian stock markets is very slow. Second, Price overreaction indicates inefficiencies in the information dissemination process in Indian stock markets. Due to the unavailability of firm-specific information uninformed investors exhibit herd behavior resulting potential losses with an eventual price reversals. Third, an index portfolio eliminates the price effects caused due to firm-specific factors. This indicates an index portfolio is a safer bet for risk-averse uninformed investors. Fourth, the research indicates that the even portfolios are prone to overreactions. Future research on the effect of index funds activity on the stock prices might help to understand the inconsistencies between BSE and NSE indices price discovery processes.

Finally, it is important for a stock market to have a design that allows price discovery. However, it is the traders, companies and regulators who really make it happen.

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able 1

rice adjustment coefficients based on Corrected Damodaran (1993) measure for NSE NIFTY scrips during 1996 to 2002

SE NIFTY SCRIPS	DAY1	DAY2	DAY3	DAY4	DAY5	DAY6	DAY7	DAY8	DAY9	DAY10	DAY11	DAY12	DAY13	DAY14	DAY15	DAY16	DAY17	DAY18	DAY19	DAY20
sea Brown Boveri Ltd.	1.8164	1.6186	1.6582	1.6172	1.3929	1.3427	1.4701	1.3373	1.2531	1.5762	1.2607	0.8118	1.0032	1.0530	1.0690	0.9310	0.9506	0.6888	0.9136	1
sian Paints (India) Ltd.	1.8851	1.7153	1.7038	1.6213	1.4875	1.5349	1.6256	1.3316	1.6007	1.4320	1.2133	1.2698	1.1959	1.4021	1.2053	1.0811	1.0084	1.7855	1.2344	1
ssociated Cement Cos. Lt	1.5118	1.5110	1.4342	1.6200	1.7905	1.4256	1.4924	1.3107	1.3451	1.3317	1.2511	1.0966	1.3491	1.9833	1.1300	1.1445	1.1762	1.0830	1.0521	1
S E S Ltd.	1.6234	1.6293	1.6325	1.4985	1.2951	1.3395	1.4033	1.3675	1.2978	1.2087	1.3031	1.1321	1.2843	1.4013	1.0758	1.2205	1.2622	1.1356	1.1800	1
ajaj Auto Ltd.	1.9360	1.7986	1.7537	1.6680	1.6049	1.5789	1.4519	1.5194	1.3472	1.7927	1.1662	1.1855	1.3015	1.2742	1.0720	1.1123	1.1596	1.1519	1.2267	1
harat Heavy Electricals Lt	1.9876	1.8833	1.8668	1.8156	1.7074	1.6898	1.5240	1.5894	1.5233	1.5438	1.3333	1.3613	1.4056	1.3109	1.3407	1.2232	1.1054	1.1663	1.0738	1
ritannia Industries Ltd.	0.7853	0.7276	0.7405	0.7496	0.7105	0.7066	0.7722	0.6605	0.7512	0.7239	0.6828	0.5996	0.5880	0.6411	0.6888	0.5771	0.5478	0.7190	0.6032	1
astrol India Ltd.	0.6690	0.6672	0.6573	0.6989	0.7340	0.6694	0.7550	0.6199	0.7320	0.6155	0.6746	0.6394	0.6592	0.9054	0.6547	0.6378	0.6390	0.8261	0.6619	1
ipla Ltd.	2.1237	2.0182	1.9939	1.8205	1.7314	1.5648	1.5570	1.3496	1.4805	1.3385	1.1676	1.0174	1.2057	1.2764	1.0303	1.1520	1.0943	1.0917	0.9779	1
olgate-Palmolive (India) L	1.8607	1.7542	1.7371	1.7302	1.5995	1.3109	1.5048	1.3597	1.3895	1.1809	1.3158	1.2890	1.3323	1.3101	1.2790	1.2191	1.1112	1.1008	1.1546	1
abur India Ltd.	2.1152	2.0013	1.8767	1.8371	1.6963	1.5743	1.6014	1.3226	1.3078	1.3409	1.3822	1.2384	1.2509	1.1202	1.1190	1.0264	1.1214	1.9736	1.0075	1
igital Globalsoft Ltd.	1.6493	1.6618	1.4759	1.6166	1.5302	1.4565	1.4508	1.1662	1.1316	1.1295	1.3685	1.2785	1.4203	1.3352	1.2812	1.2201	1.1983	1.1956	1.1458	1
r. Reddy'S Laboratories Lt	1.9067	1.7794	1.6344	1.6316	1.5877	1.5171	1.4668	1.3241	1.2624	1.2242	1.1604	1.2294	1.3085	1.2319	0.9713	0.9581	0.9668	1.7354	0.8250	1
laxosmithkline Pharmaceu	1.7926	1.7268	1.7630	1.6692	1.5936	1.5371	1.6265	1.3724	1.3446	1.1910	1.2286	1.4475	1.2861	1.4227	1.2616	1.1336	1.3084	1.1665	0.9254	1
rasim Industries Ltd.	1.7554	1.6994	1.6138	1.7074	1.6249	1.4082	1.5058	1.4125	1.2539	1.3886	1.3082	1.2154	1.2225	1.1769	0.9919	0.9663	1.0965	1.2202	1.0052	1
ujarat Ambuja Cements L	1.7556	1.6636	1.5721	1.5549	1.9128	1.2862	1.3834	1.4784	1.3527	1.1923	1.2007	1.0694	1.0998	1.1660	0.9820	0.9462	1.0379	1.0076	1.1228	1
D F C Bank Ltd.	1.7399	1.7128	1.6055	1.6125	1.4509	1.2432	1.5146	1.4606	1.2719	1.2543	1.2122	1.2086	1.2220	1.0667	1.1650	1.1373	1.0419	0.9479	0.9280	1
ero Honda Motors Ltd.	1.9929	1.9477	1.8756	1.8212	1.9632	1.6437	1.6957	1.9880	1.5000	1.4622	1.5750	1.3375	1.2837	1.0400	1.3548	1.4008	1.4299	1.4431	1.3560	1
indalco Industries Ltd.	1.6681	1.6079	1.8775	1.5784	1.3607	1.2539	1.0500	1.3903	1.3932	1.2154	1.2549	0.9401	1.2677	1.0233	1.2294	1.0452	1.3319	1.1568	1.1816	1
industan Lever Ltd.	2.0576	1.9926	1.9186	1.8380	1.8201	1.7401	1.6566	1.5530	1.5442	1.3205	1.5820	1.5558	1.3042	1.4210	1.3738	1.4553	1.3328	1.9913	1.1177	1
industan Petroleum Corpn	1.9138	1.8609	1.8176	1.7528	1.7255	1.7066	1.6214	1.4734	1.4519	1.4937	1.3462	1.5603	1.4602	1.4917	1.4172	1.3394	1.6792	1.2372	1.3337	1
ousing Development Finar	2.0108	1.8855	1.7971	1.7730	1.5276	1.4452	1.5416	1.3999	1.3101	1.2819	1.5143	1.1894	1.3445	1.2734	1.2566	1.0291	1.2297	1.0933	1.9810	1
C I C I Bank Ltd.	1.7530	1.6056	1.6685	1.5607	1.4763	1.4816	1.3880	1.3988	1.2996	1.0548	1.0897	1.1896	1.0890	1.2240	1.2096	0.9203	1.0133	1.0264	0.8990	1
T C Ltd.	1.7084	1.6678	1.4769	1.6034	1.4912	1.5337	1.5444	1.2952	1.2235	1.3848	1.2519	1.2317	1.1042	1.3764	0.9440	1.0653	1.1536	1.3376	0.9082	1
ndian Hotels Co. Ltd.	1.9424	1.7700	1.6221	1.6763	1.3908	1.6092	1.4964	1.4690	1.4209	1.3349	1.1265	1.1555	1.3247	1.2336	0.8141	0.8698	1.0566	1.0027	0.9842	1
ndian Petrochemicals Corp	1.7398	1.7239	1.5484	1.5474	1.4368	1.5949	1.3331	1.3651	1.3790	1.3912	1.4098	1.3198	1.4368	1.1577	1.2539	1.1394	1.2405	1.1808	1.3627	1
nfosys Technologies Ltd.	2.7511	2.2151	1.8937	1.6093	1.4543	1.3630	1.1377	1.0031	0.9182	0.8406	0.8037	0.8371	0.7378	0.7253	0.6708	0.5845	1.1412	1.1961	0.4706	1
arsen & Toubro Ltd.	1.6982	1.6166	1.5531	1.6213	1.3564	1.3975	1.3670	1.4498	1.2807	1.3497	1.3488	1.2219	1.2680	1.2548	1.0233	1.1735	1.0680	1.0561	1.1539	1
ahanagar Telephone Niga	1.7499	1.6462	1.6556	1.4927	1.3070	1.4561	1.4858	1.2880	1.3038	1.2415	1.1510	1.2381	1.2649	1.2428	1.3186	1.0136	1.0866	1.0283	1.1924	1
ahindra & Mahindra Ltd.	1.6743	1.5289	1.5226	1.4827	1.3113	1.3146	1.1529	1.2752	1.2019	1.2034	1.3478	1.3207	1.2690	1.3771	1.2288	1.4361	1.1848	1.2908	1.3186	1
I I T Ltd.	1.6666	1.7028	1.6919	1.4954	1.4888	1.4786	1.5477	1.5705	1.5997	1.3567	1.4341	1.2224	1.3049	1.3374	1.1778	1.2533	1.1647	1.2512	1.1215	1
estle India Ltd.	2.0070	1.8653	1.8116	1.7505	1.5985	1.3840	1.4264	1.2816	1.3620	1.7634	1.1786	1.2977	1.2209	1.1434	0.9637	0.7778	0.8447	0.7386	0.9037	1
riental Bank Of Commerc	1.8633	1.7814	1.7516	1.7703	1.6687	1.5894	1.5743	1.6367	1.5017	1.4432	1.5020	1.2527	1.4615	1.3445	1.2944	1.3932	1.3306	1.0645	1.1320	1
rocter & Gamble Hygiene	1.6832	1.6653	1.4858	1.2901	1.3240	1.8589	1.2033	1.5373	1.3759	1.3227	1.2347	1.1127	1.2497	1.1574	1.1539	1.0261	1.0713	0.6459	0.9250	1
anbaxy Laboratories Ltd.	1.9709	1.8285	1.7742	1.7585	1.6020	1.4080	1.5411	1.3809	1.5002	1.2497	1.2316	1.3658	1.3856	1.2367	1.2713	1.3206	1.8410	1.0386	0.8428	1
eliance Industries Ltd.	1.5563	1.3990	1.4527	1.5145	1.3297	1.5597	1.4183	1.3028	1.2469	1.4693	1.3971	1.4364	1.2283	1.4109	1.2621	1.2882	1.2209	1.3179	1.8607	1
eliance Petroleum Ltd.	1.8410	1.8438	1.7596	1.5124	1.7151	1.4420	1.4089	1.4114	1.4256	1.3700	0.9690	1.3189	1.3004	1.1841	1.0798	1.3441	1.1358	1.0791	0.9209	1
atyam Computer Services	1.9625	1.4211	1.3545	1.3288	1.2855	1.0556	1.1589	1.0993	1.2383	1.0789	1.0797	1.3560	1.2488	1.0712	1.1673	1.0688	1.6781	1.1223	0.8716	1
laxosmithkline Consumer	1.6588	1.4844	1.3580	1.2660	1.3174	1.0902	1.4031	0.9600	1.2318	1.0742	0.8893	1.2416	1.7213	1.0922	0.8913	0.7328	0.8306	1.1071	1.0643	1
tate Bank Of India	1.3653	1.2631	1.0892	1.2108	1.1168	1.3473	1.1122	1.1743	1.0410	0.9358	1.1324	1.2830	1.0159	1.3698	1.1185	1.0549	1.0876	1.1574	0.8889	1
un Pharmaceutical Inds. L	1.7848	1.7401	1.6090	1.5090	1.4654	1.4698	1.3710	1.4111	1.1551	1.2402	1.1695	1.3793	1.1365	1.1611	1.0329	1.8993	1.1317	0.9367	1.0252	1
ata Chemicals Ltd.	1.6931	1.8120	1.6768	1.4873	1.5814	1.4510	1.6113	1.5662	1.3919	1.3706	1.2005	1.3480	1.4852	1.5296	1.4488	1.2996	1.3613	1.3862	1.3494	1
ata Engineering & Locomo	1.9396	1.8651	1.7906	1.6798	1.5652	1.5345	1.6173	1.4420	1.3800	1.1758	1.3646	1.3177	1.1909	1.3076	1.1469	1.1202	1.1566	1.1446	1.0967	1
ata Iron & Steel Co. Ltd.	1.4986	1.5752	1.4421	1.5746	1.3128	1.4509	1.4999	1.2785	1.2613	1.2593	1.0989	1.2328	1.3608	1.4301	1.2906	1.2548	1.3724	1.2784	0.9742	1
ata Power Co. Ltd.	1.8183	1.7702	1.7242	1.7087	1.6633	1.4671	1.5701	1.5133	1.5291	1.3269	1.5126	1.4621	1.4084	1.5310	1.3511	1.3000	1.2552	1.2066	1.2090	1
ata Tea Ltd.	1.7457	1.7133	1.6197	1.4903	1.5068	1.1880	1.4147	1.2414	1.0687	1.0532	1.1387	1.0621	1.2221	1.1211	1.1385	1.0039	1.0773	1.0149	0.8455	1
idesh Sanchar Nigam Ltd.	1.5221	1.6444	1.5831	1.4075	1.5003	1.4642	1.4894	1.2739	1.3024	1.2713	1.2518	1.0854	1.0781	1.8867	1.2088	1.2448	1.0944	1.5215	0.8411	1
ipro Ltd.	1.9854	1.6944	1.5423	1.9146	1.4862	1.5695	1.4356	1.4090	1.1511	1.2296	1.0953	1.1218	0.8880	1.0550	0.9940	0.6455	1.0809	0.9202	0.9937	1
ee Telefilms Ltd.	0.7776	0.7625	0.7420	0.8032	0.6916	0.7844	0.7682	0.7414	0.7493	0.7001	0.6950	0.7725	0.7388	0.6578	0.6962	0.6980	0.7605	0.6566	0.7290	1
verage(market)	**1.7533**	**1.6626**	**1.5960**	**1.5571**	**1.4753**	**1.4147**	**1.4112**	**1.3380**	**1.2936**	**1.2598**	**1.2165**	**1.2011**	**1.2232**	**1.2438**	**1.1245**	**1.0997**	**1.1484**	**1.1556**	**1.0590**	**1**
tandard deviation	**0.3372**	**0.2957**	**0.2847**	**0.2583**	**0.2618**	**0.2364**	**0.2216**	**0.2368**	**0.1991**	**0.2304**	**0.2091**	**0.2051**	**0.2144**	**0.2445**	**0.1945**	**0.2522**	**0.2301**	**0.2884**	**0.2641**	**0.0000**

able 2

rice adjustment coefficients based on Corrected Damodaran (1993) measure for BSE SENSEX scrips during 1996 to 2002

SE SENSEX SCRIPS	DAY1	DAY2	DAY3	DAY4	DAY5	DAY6	DAY7	DAY8	DAY9	DAY10	DAY11	DAY12	DAY13	DAY14	DAY15	DAY16	DAY17	DAY18	DAY19	DAY20
ssociated Cement Co	1.5118	1.5110	1.4342	1.6200	1.7905	1.4256	1.4924	1.3107	1.3451	1.3317	1.2511	1.0966	1.3491	1.9833	1.1300	1.1445	1.1762	1.0830	1.0521	1
S E S Ltd.	1.6234	1.6293	1.6325	1.4985	1.2951	1.3395	1.4033	1.3675	1.2978	1.2087	1.3031	1.1321	1.2843	1.4013	1.0758	1.2205	1.2622	1.1356	1.1800	1
ajaj Auto Ltd.	1.9360	1.7986	1.7537	1.6680	1.6049	1.5789	1.4519	1.5194	1.3472	1.7927	1.1662	1.1855	1.3015	1.2742	1.0720	1.1123	1.1596	1.1519	1.2267	1
harat Heavy Electrical	1.9876	1.8833	1.8668	1.8156	1.7074	1.6898	1.5240	1.5894	1.5233	1.5438	1.3333	1.3613	1.4056	1.3109	1.3407	1.2232	1.1054	1.1663	1.0738	1
astrol India Ltd.	0.7127	0.7131	0.7031	0.7492	0.7889	0.7201	0.8165	0.6687	0.7933	0.6613	0.7373	0.6981	0.7169	0.9876	0.7173	0.7002	0.7029	0.9074	0.7274	1
ipla Ltd.	2.1237	2.0182	1.9939	1.8205	1.7314	1.5648	1.5570	1.3496	1.4805	1.3385	1.1676	1.0174	1.2057	1.2764	1.0303	1.1520	1.0943	1.0917	0.9779	1
olgate-Palmolive (Indi	1.8607	1.7542	1.7371	1.7302	1.5995	1.3109	1.5048	1.3597	1.3895	1.1809	1.3158	1.2890	1.3323	1.3101	1.2790	1.2191	1.1112	1.1008	1.1546	1
r. ReddyS Laboratorie	1.9067	1.7794	1.6344	1.6316	1.5877	1.5171	1.4668	1.3241	1.2624	1.2242	1.1604	1.2294	1.3085	1.2319	0.9713	0.9581	0.9668	1.7354	0.8250	1
laxosmithkline Pharm	1.7926	1.7268	1.7630	1.6692	1.5936	1.5371	1.6265	1.3724	1.3446	1.1910	1.2286	1.4475	1.2861	1.4227	1.2616	1.1336	1.3084	1.1665	0.9254	1
rasim Industries Ltd.	1.7554	1.6994	1.6138	1.7074	1.6249	1.4082	1.5058	1.4125	1.2539	1.3886	1.3082	1.2154	1.2225	1.1769	0.9919	0.9663	1.0965	1.2202	1.0052	1
ujarat Ambuja Cemen	1.7556	1.6636	1.5721	1.5549	1.9128	1.2862	1.3834	1.4784	1.3527	1.1923	1.2007	1.0694	1.0998	1.1660	0.9820	0.9462	1.0379	1.0076	1.1228	1
ero Honda Motors Ltd	1.9929	1.9477	1.8756	1.8212	1.9632	1.6437	1.6957	1.9880	1.5000	1.4622	1.5750	1.3375	1.2837	1.0400	1.3548	1.4008	1.4299	1.4431	1.3560	1
indalco Industries Ltd.	1.6681	1.6079	1.8775	1.5784	1.3607	1.2539	1.0500	1.3903	1.3932	1.2154	1.2549	0.9401	1.2677	1.0233	1.2294	1.0452	1.3319	1.1568	1.1816	1
industan Lever Ltd.	2.0576	1.9926	1.9186	1.8380	1.8201	1.7401	1.6566	1.5530	1.5442	1.3205	1.5820	1.5558	1.3042	1.4210	1.3738	1.4553	1.3328	1.9913	1.1177	1
ousing Development F	2.0108	1.8855	1.7971	1.7730	1.5276	1.4452	1.5416	1.3999	1.3101	1.2819	1.5143	1.1894	1.3445	1.2734	1.2566	1.0291	1.2297	1.0933	1.9810	1
C I C I Bank Ltd.	1.7530	1.6056	1.6685	1.5607	1.4763	1.4816	1.3880	1.3988	1.2996	1.0548	1.0897	1.1896	1.0890	1.2240	1.2096	0.9203	1.0133	1.0264	0.8990	1
T C Ltd.	1.7084	1.6678	1.4769	1.6034	1.4912	1.5337	1.5444	1.2952	1.2235	1.3848	1.2519	1.2317	1.1042	1.3764	0.9440	1.0653	1.1536	1.3376	0.9082	1
fosys Technologies Lt	2.7511	2.2151	1.8937	1.6093	1.4543	1.3630	1.1377	1.0031	0.9182	0.8406	0.8037	0.8371	0.7378	0.7253	0.6708	0.5845	1.1412	1.1961	0.4706	1
arsen & Toubro Ltd.	1.6982	1.6166	1.5531	1.6213	1.3564	1.3975	1.3670	1.4498	1.2807	1.3497	1.3488	1.2219	1.2680	1.2548	1.0233	1.1735	1.0680	1.0561	1.1539	1
ahanagar Telephone I	1.7499	1.6462	1.6556	1.4927	1.3070	1.4561	1.4858	1.2880	1.3038	1.2415	1.1510	1.2381	1.2649	1.2428	1.3186	1.0136	1.0866	1.0283	1.1924	1
estle India Ltd.	2.0070	1.8653	1.8116	1.7505	1.5985	1.3840	1.4264	1.2816	1.3620	1.7634	1.1786	1.2977	1.2209	1.1434	0.9637	0.7778	0.8447	0.7386	0.9037	1
anbaxy Laboratories L	1.9709	1.8285	1.7742	1.7585	1.6020	1.4080	1.5411	1.3809	1.5002	1.2497	1.2316	1.3658	1.3856	1.2367	1.2713	1.3206	1.8410	1.0386	0.8428	1
eliance Industries Ltd.	1.5563	1.3990	1.4527	1.5145	1.3297	1.5597	1.4183	1.3028	1.2469	1.4693	1.3971	1.4364	1.2283	1.4109	1.2621	1.2882	1.2209	1.3179	1.8607	1
eliance Petroleum Ltd	1.8410	1.8438	1.7596	1.5124	1.7151	1.4420	1.4089	1.4114	1.4256	1.3700	0.9690	1.3189	1.3004	1.1841	1.0798	1.3441	1.1358	1.0791	0.9209	1
atyam Computer Serv	1.9625	1.4211	1.3545	1.3288	1.2855	1.0556	1.1589	1.0993	1.2383	1.0789	1.0797	1.3560	1.2488	1.0712	1.1673	1.0688	1.6781	1.1223	0.8716	1
tate Bank Of India	1.3653	1.2631	1.0892	1.2108	1.1168	1.3473	1.1122	1.1743	1.0410	0.9358	1.1324	1.2830	1.0159	1.3698	1.1185	1.0549	1.0876	1.1574	0.8889	1
ata Engineering & Loc	1.9396	1.8651	1.7906	1.6798	1.5652	1.5345	1.6173	1.4420	1.3800	1.1758	1.3646	1.3177	1.1909	1.3076	1.1469	1.1202	1.1566	1.1446	1.0967	1
ata Iron & Steel Co. Lt	1.4986	1.5752	1.4421	1.5746	1.3128	1.4509	1.4999	1.2785	1.2613	1.2593	1.0989	1.2328	1.3608	1.4301	1.2906	1.2548	1.3724	1.2784	0.9742	1
ee Telefilms Ltd.	0.7619	0.7573	0.7964	0.7484	0.7938	0.7438	0.7280	0.7199	0.7476	0.8695	0.6481	0.7339	0.7524	0.6773	0.6849	0.7907	0.6935	0.6936	0.8860	1
verage	**1.7676**	**1.6614**	**1.6101**	**1.5669**	**1.4936**	**1.4007**	**1.3969**	**1.3313**	**1.2885**	**1.2544**	**1.2015**	**1.2009**	**1.2028**	**1.2398**	**1.1110**	**1.0856**	**1.1669**	**1.1609**	**1.0613**	**1**
tandard deviation	**0.3814**	**0.325**	**0.30954**	**0.2678**	**0.2787**	**0.2308**	**0.2341**	**0.2443**	**0.1948**	**0.2438**	**0.2166**	**0.201**	**0.185**	**0.235**	**0.194**	**0.2046**	**0.2378**	**0.2499**	**0.2965**	**0**

Table 3
Price adjustment coefficients of BSE SENSEX and NSE NIFTY indices during 1996-2002 (Gts = 1- rt, t-1)

	BSE SENSEX	NSE NIFTY
DAY1	0.958260964	0.95077229
DAY2	0.957741126	0.95085338
DAY3	0.95732728	0.95092153
DAY4	0.956754185	0.95099881
DAY5	0.955733945	0.95117957
DAY6	0.95544867	0.95119091
DAY7	0.955172205	0.95119839
DAY8	0.955522415	0.95105368
DAY9	0.955141115	0.95109335
DAY10	0.955356324	0.9510733
DAY11	0.955080993	0.95110169
DAY12	0.953387523	0.95118161
DAY13	0.952414876	0.95143343
DAY14	0.951265932	0.95154295
DAY15	0.951253974	0.95153793
DAY16	0.949410771	0.95152076
DAY17	0.94532987	0.95198027
DAY18	0.942827617	0.95213151
DAY19	0.940413863	0.95192622
DAY20	0.942750795	0.95262312

Table 4
Auto covariance ratio of BSE SENSEX and NSE NIFTY indices during 1996-2002

	BSE SENSEX	NSE NIFTY
DAY1	0.916694229	1.47149051
DAY2	0.9175261	1.47467921
DAY3	0.919484058	1.4766298
DAY4	0.92194429	1.48364315
DAY5	0.922129995	1.4840761
DAY6	0.922828889	1.48862872
DAY7	0.922630777	1.48692857
DAY8	0.922901762	1.48684708
DAY9	0.924078034	1.48465032
DAY10	0.924439349	1.48466141
DAY11	0.921851258	1.4880195
DAY12	0.922129435	1.49203764
DAY13	0.926747891	1.49646344
DAY14	0.926034951	1.49631267
DAY15	0.928928192	1.49957538
DAY16	0.926342951	1.50439476
DAY17	0.927782042	1.50891484
DAY18	0.92787033	1.49278628
DAY19	0.925290221	1.49661358
DAY20	0.924679222	1.49918454

Table 5
Auto covariances of BSE SENSEX and NSE NIFTY during 1996-2002

	BSE SENSEX		NSE NIFTY	
	Covar(Rjt,Rjt-2)	Covar(Rjt,Rjt-1)	Covar(Rjt,Rjt-2)	Covar(Rjt,Rjt-1)
DAY1	0.0000014	0.0000174	-0.0000069	0.0000146
DAY2	0.0000014	0.0000173	-0.0000069	0.0000146
DAY3	0.0000014	0.0000173	-0.0000069	0.0000146
DAY4	0.0000013	0.0000173	-0.0000070	0.0000145
DAY5	0.0000013	0.0000173	-0.0000070	0.0000145
DAY6	0.0000013	0.0000173	-0.0000071	0.0000145
DAY7	0.0000013	0.0000173	-0.0000071	0.0000146
DAY8	0.0000013	0.0000173	-0.0000071	0.0000146
DAY9	0.0000013	0.0000174	-0.0000071	0.0000146
DAY10	0.0000013	0.0000174	-0.0000071	0.0000146
DAY11	0.0000014	0.0000174	-0.0000071	0.0000146
DAY12	0.0000013	0.0000173	-0.0000071	0.0000145
DAY13	0.0000013	0.0000173	-0.0000072	0.0000145
DAY14	0.0000013	0.0000173	-0.0000072	0.0000145
DAY15	0.0000012	0.0000173	-0.0000072	0.0000145
DAY16	0.0000013	0.0000172	-0.0000072	0.0000144
DAY17	0.0000012	0.0000171	-0.0000073	0.0000143
DAY18	0.0000012	0.0000172	-0.0000071	0.0000144
DAY19	0.0000013	0.0000172	-0.0000070	0.0000142
DAY20	0.0000013	0.0000171	-0.0000071	0.0000142

Table 6
Auto covariance ratios of BSE 100 and NSE 100 (DIFTY) during 1996-2002

	BSE100	NSE 100
DAY1	1.088675	1.550616
DAY2	1.088545	1.554369
DAY3	1.088417	1.557151
DAY4	1.088087	1.568252
DAY5	1.087893	1.573415
DAY6	1.087991	1.578477
DAY7	1.088113	1.574681
DAY8	1.088067	1.574782
DAY9	1.088071	1.572654
DAY10	1.088114	1.57269
DAY11	1.088096	1.576158
DAY12	1.08795	1.580603
DAY13	1.087758	1.584663
DAY14	1.087917	1.583969
DAY15	1.087859	1.586267
DAY16	1.088131	1.589863
DAY17	1.08794	1.595225
DAY18	1.088532	1.580977
DAY19	1.088948	1.583392
DAY20	1.088707	1.574561