Asymmetry in Indian Stock Returns
An Empirical Investigation*

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The basic assumption of normality has been tested using BSE 500 stocks existing during 1991-2001. We found that there is significant positive skewness in Indian stock returns. We also found that this asymmetry is persistent over the years. The results contradict Obaidullah (1991) findings. However, the results are consistent with results in the US and Australia. The finding urges for considering risks of higher moments than variance.

Section - I

Introduction

In finance literature, the mean-variance or two-moment paradigm in asset pricing and portfolio selection is considered to be a well-established theory, which has been applied in many countries with slight modifications. It is still known to have a significant influence on the investment decisions of investors and companies.

Chiang (1967) concluded that the two moments theory, which is consistent with a normal distribution is applicable when the investor preferences are quadratic, as moments higher than quadratic carry no weight in the allocation decision. Pratt (1964) found that if the risks are infinitesimal then the third and fourth moments are smaller than second by at least an order of magnitude and hence can be safely ignored. Tsang (1972) pointed out that risks need only be small for two-moment characterisation to be adequate for practical problems.

In short, research done by several scholars over the years has led to the general assumption of normal distribution of stock returns. Indeed, this was the basic assumption for the pioneering works of Markowitz (1958), Sharpe (1964), Linter (1965) and Mossin (1966).

If asymmetry of stock returns exists, the normal distribution will not be applicable. The implications of the existence of asymmetry in stock return distribution are two-fold: If there is a positive asymmetry, it can be attributed to the entrepreneurial behaviour of investors (Beedles, 1986). A negative asymmetry can be attributed to the skeptical behaviour of the investor about the future of the economy. Negative asymmetry has been discussed by Friedman and Savage (1948). They have described the insurance phenomenon; (people prepared to pay a loading fee to avoid catastrophic losses). Since, catastrophes are unlikely events, by paying the loading fee, investors more often than not incur a loss.

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The purpose of this paper is to understand the behaviour of Indian stock returns, and gain some insights into the behaviour of Indian investors. The paper is divided into five sections as described below.

Section I : Introduction.
Section II : Previous studies.
Section III : Data and Methodology.
Section IV : Results.
Section V : Concluding remarks.

Section - II

Previous Studies

Obaidullah (1991) conducted the only known study on the distribution of Indian stock returns. He analysed the BSE sensex and BSE 100 indices during 1979-91 and 1984-91 respectively. He concluded that the distribution of monthly stock returns follow normal distribution. But the sample consisted of only actively traded companies. This sample cannot be considered representative of the entire stock market. Moreover, the period pertaining to Obaidullah (1991) study is not a good representation of the present economic conditions and the changed investor behaviour. Also Obaidullah (1991) did not discuss the implications of asymmetry as he found stock returns are symmetrical.

Many studies relating to Indian Capital markets, portfolio theory and corporate finance in India have assumed distribution of stock returns to be normal*. If the asymmetry is significantly evident then the results of the previous studies need to be revisited.

Studies in the US markets have revealed that there is positive skewness in the distribution of stock returns. Beedles and Simkowitz (1980) did an extensive work on the prevalence of positive skewness. In Australia there are mixed results on asymmetry. Stoike (1982) found little evidence of asymmetry, whereas Beedles (1986) found that the Australian stock returns are positively skewed. The variation in results is partly due to the different data sets used by them. Stoike used 144 stocks monthly lognormal return for a five-year period whereas Beedles used 1002 stocks normal return for eleven-year period.

The current study will have the following practical implications:

1. The study can form as a basis for further research in Indian Capital markets where the data has to assume to be normal.
2. The results will signify the importance of asymmetry as variance while assessing the risk of capital assets both for investors and corporate managers.
3. The results may throw up new insights into the typical investor behaviour in India.


Asymmetry in Indian Stock Returns: An Empirical Investigation
Section - III

Data and Methodology

We have used the Prowess Database, published by Center for Monitoring Indian Economy. The database provides the prices of BSE stocks. We have selected BSE 500 stocks and BSE indices namely BSE SENSEX, BSE 100 and BSE 200 for the study. Out of 500 hundred stocks 273 have been selected based on the period of existence. The time period is from January 1991 to January 2002. Thus we analysed monthly returns 273 stocks for 132 months, totalling 36036 observations in order to measure the asymmetry of individual stock returns and three indices to measure asymmetry of portfolios.

Asymmetry of stock returns, which signifies the data is not normally distributed, can be tested using the standard normality of the data tests. The two popular tests are Skewness and Kurtosis. The distribution percentile for 11 years helps to understand the persistence of the direction of possible asymmetry.

Percentage Return of the stock is

\[ R_t = \left( \frac{P_t - P_{t-1}}{P_{t-1}} \right) \times 100 \]

Where \( R_t \) is the monthly return of the stock for the month \( t \),

\( P_t \) is the closing price of the stock for the month \( t \) and

\( P_{t-1} \) is the closing price of the stock for the month \( t-1 \)

Praetz (1969) suggested log transformation of the return would return positive skewness of the return distribution. But such a transformation will control the real distribution pattern and the chances of observing the real behaviour of the investors is less obvious. For this reason we are using normal returns of the stocks.

We followed Stokie (1982) method of estimating the asymmetry.

To test the departure from the normality owing to significant Skewness is based on the distribution of the standardised third moment

\[ b_1^{1/2} = m_3/m_2^{3/2} \]

where \( b_1 \) is the third moment

In random samples of \( n \) observations from a univariate normal population where for a sample of \( \{x_i\} \) we define \( m_r = \sum (x_i - m_1)^r/n \). The distribution of Skewness statistic

\[ S_n = \left( \frac{b_1 n/6}{b_1 n/6} \right)^{1/2} \]

Is approximately normal distribution.

The test for departure from normality owing to significant kurtosis is based on the distribution of the standardised fourth moment

\[ b_2 = m_4/m_2^2 \]

Where \( b_2 \) is the fourth moment

In random samples of \( n \) observations from a univariate normal population where for a sample of \( \{x_i\} \) we define \( m_r = \sum (x_i - m_1)^r/n \). The distribution of Kurtosis
\[ K_n = (b_2 - 3)(n/24)^{1/2} \]

is approximately unit normal, with the approximation more and more uncertain the smaller \( n \) is and further it is taken out into tails of the distribution (D’Agostino and Pearson, 1973)

We used Kolmogorov-Smirnov (K-S) Statistic to test the significance of skewness and kurtosis. The null hypotheses assume the data is normally distributed. At 0.01 significance level the critical value is 0.05. Any values of K-S statistic above 0.05 rejects null hypotheses.

In order to test skewness and kurtosis we divided the data into two groups. We tested the 273 individual stock returns separately and also portfolio returns by using BSE SENSEX, BSE 100 and BSE 200 returns for 132 months. This would give an inference whether the asymmetry reduces by forming portfolios.

Section - IV

Results

Table 1 represents the descriptives of BSE stocks. It is evident from the results that the data is positively skewed almost every year from 1991 to 2001. The mean is higher than median during all years. Kurtosis is negative during 1995, but the result is not statistically significant. Out of 11 years, nine years return distribution is significantly asymmetrical.

<table>
<thead>
<tr>
<th>Year</th>
<th>Mean</th>
<th>Median</th>
<th>5% Trimmed Mean</th>
<th>Std. Dev</th>
<th>Interquartile Range</th>
<th>Skewness</th>
<th>Kurtosis</th>
<th>Kolmogorov-Smirnov Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>1991</td>
<td>18.28</td>
<td>13.522</td>
<td>16.272</td>
<td>22.33</td>
<td>1.396</td>
<td>21.43</td>
<td>1.614</td>
<td>3.704 0.122*</td>
</tr>
<tr>
<td>1992</td>
<td>–2.26</td>
<td>–1.89</td>
<td>–2.55</td>
<td>10.989</td>
<td>0.686</td>
<td>12.429</td>
<td>0.34</td>
<td>3.026 0.065*</td>
</tr>
<tr>
<td>1993</td>
<td>24.1</td>
<td>18.64</td>
<td>21.49</td>
<td>30.87</td>
<td>1.926</td>
<td>27.87</td>
<td>4.55</td>
<td>39.62 0.12*</td>
</tr>
<tr>
<td>1994</td>
<td>–5.27</td>
<td>–6.16</td>
<td>–5.83</td>
<td>9.7</td>
<td>0.611</td>
<td>9.95</td>
<td>2.246</td>
<td>13.35 0.123*</td>
</tr>
<tr>
<td>1995</td>
<td>–7.526</td>
<td>–7.59</td>
<td>–7.57</td>
<td>9</td>
<td>0.56</td>
<td>13.67</td>
<td>0.068</td>
<td>–0.368 0.038</td>
</tr>
<tr>
<td>1996</td>
<td>–0.482</td>
<td>–0.957</td>
<td>–0.85</td>
<td>11.98</td>
<td>0.749</td>
<td>13.166</td>
<td>0.744</td>
<td>3.035 0.058*</td>
</tr>
<tr>
<td>1997</td>
<td>–11.225</td>
<td>–11.11</td>
<td>–11.327</td>
<td>8.51</td>
<td>0.531</td>
<td>9.7</td>
<td>0.31</td>
<td>2.046 0.049</td>
</tr>
<tr>
<td>1998</td>
<td>5.26</td>
<td>2.47</td>
<td>3.64</td>
<td>20.26</td>
<td>1.26</td>
<td>20.32</td>
<td>1.747</td>
<td>5.813 0.114*</td>
</tr>
<tr>
<td>1999</td>
<td>–1.08</td>
<td>–4.65</td>
<td>–3.56</td>
<td>23.76</td>
<td>1.4</td>
<td>19.82</td>
<td>2.86</td>
<td>12.619 1.51*</td>
</tr>
<tr>
<td>2000</td>
<td>0.814</td>
<td>–2.34</td>
<td>–2.45</td>
<td>1.082</td>
<td>1.08</td>
<td>12.78</td>
<td>4.701</td>
<td>39.963 0.168*</td>
</tr>
<tr>
<td>2001</td>
<td>–19.89</td>
<td>–21.25</td>
<td>–20.82</td>
<td>17.301</td>
<td>1.082</td>
<td>16.64</td>
<td>2.929</td>
<td>22.63 0.112*</td>
</tr>
</tbody>
</table>

* Significant at 0.01 level

Table 2 observes the persistence in the direction of skewness. Except for slight variation during 1997 and 2001 the returns are positively skewed. Similar inference can be drawn from table 3 and 4. The index returns are asymmetrically and they exhibit persistent positive skewness.
Table 2
BSE 500 Stock Returns Percentile Distribution during 1991-2001

<table>
<thead>
<tr>
<th>Percentiles</th>
<th>5</th>
<th>10</th>
<th>25</th>
<th>50</th>
<th>75</th>
<th>90</th>
<th>95</th>
</tr>
</thead>
<tbody>
<tr>
<td>–8.28</td>
<td>–3.86</td>
<td>4.75</td>
<td>13.52</td>
<td>45.12</td>
<td>45.12</td>
<td>64.48</td>
<td></td>
</tr>
<tr>
<td>–17.96</td>
<td>–15.32</td>
<td>–9.24</td>
<td>–1.89</td>
<td>9.8</td>
<td>9.8</td>
<td>15.74</td>
<td></td>
</tr>
<tr>
<td>–6.38</td>
<td>–2.908</td>
<td>6.86</td>
<td>18.64</td>
<td>52.94</td>
<td>52.94</td>
<td>69.18</td>
<td></td>
</tr>
<tr>
<td>–16.91</td>
<td>–15.076</td>
<td>–11.01</td>
<td>–6.16</td>
<td>3.79</td>
<td>3.79</td>
<td>10.03</td>
<td></td>
</tr>
<tr>
<td>–22.2</td>
<td>–18.8</td>
<td>–14.11</td>
<td>–7.59</td>
<td>4.34</td>
<td>4.34</td>
<td>7.4</td>
<td></td>
</tr>
<tr>
<td>–19.77</td>
<td>–15.03</td>
<td>–7.14</td>
<td>0.957</td>
<td>12.5</td>
<td>12.5</td>
<td>20.73</td>
<td></td>
</tr>
<tr>
<td>–24.01</td>
<td>–21.76</td>
<td>–16.35</td>
<td>–11.11</td>
<td>–0.529</td>
<td>–0.529</td>
<td>2.81</td>
<td></td>
</tr>
<tr>
<td>–19.73</td>
<td>–15.05</td>
<td>12.77</td>
<td>2.4</td>
<td>27.77</td>
<td>27.31</td>
<td>43.09</td>
<td></td>
</tr>
<tr>
<td>–26.29</td>
<td>–21.82</td>
<td>5.87</td>
<td>4.65</td>
<td>20.86</td>
<td>20.86</td>
<td>38.31</td>
<td></td>
</tr>
<tr>
<td>–17.72</td>
<td>–15.45</td>
<td>3.24</td>
<td>–2.34</td>
<td>13.75</td>
<td>13.75</td>
<td>25.72</td>
<td></td>
</tr>
</tbody>
</table>

Table 3
BSE SENSEX, BSE 100 and BSE 200 Distribution Descriptives During 1991-2001

<table>
<thead>
<tr>
<th>Year</th>
<th>Mean</th>
<th>Median</th>
<th>5%Trimmed Mean</th>
<th>Std. Dev</th>
<th>Std. Error</th>
<th>Inter quartile Range</th>
<th>Skewness</th>
<th>Kurtosis</th>
<th>Kolmogorov-Smirnov Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>INDICES(1991-2001)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensex</td>
<td>1.36</td>
<td>0.299</td>
<td>0.819</td>
<td>10.15</td>
<td>0.887</td>
<td>13.54</td>
<td>1.338</td>
<td>5.4</td>
<td>0.074*</td>
</tr>
<tr>
<td>BSE100</td>
<td>1.36</td>
<td>0.859</td>
<td>1</td>
<td>10.59</td>
<td>0.925</td>
<td>12.76</td>
<td>1.17</td>
<td>5.29</td>
<td>0.061*</td>
</tr>
<tr>
<td>BSE200</td>
<td>1.31</td>
<td>0.364</td>
<td>0.865</td>
<td>11.54</td>
<td>1</td>
<td>12.98</td>
<td>1.7</td>
<td>9.8</td>
<td>0.074*</td>
</tr>
</tbody>
</table>

*D Significant at 0.01 level

Table 4
BSE SENSEX, BSE 100 and BSE 200 Distribution Percentiles During 1991-2001

<table>
<thead>
<tr>
<th>Percentiles</th>
<th>–11.97</th>
<th>–10.35</th>
<th>–5.74</th>
<th>0.29</th>
<th>7.79</th>
<th>12.95</th>
<th>18.55</th>
</tr>
</thead>
<tbody>
<tr>
<td>–13.62</td>
<td>–11.02</td>
<td>–5.06</td>
<td>0.859</td>
<td>7.7</td>
<td>13.82</td>
<td>17.52</td>
<td></td>
</tr>
<tr>
<td>–14.45</td>
<td>–10.87</td>
<td>–5.42</td>
<td>0.364</td>
<td>7.55</td>
<td>13.35</td>
<td>20.29</td>
<td></td>
</tr>
</tbody>
</table>
Section - V

Concluding Remarks

We analysed the distribution of stock and index returns of BSE. There exists positive significant asymmetry in both return distributions. These results contradict Obaidullah (1991) results and they are consistent with the findings in the US and Australian results. The results bring new paradigm in risk analysis of Indian stocks. We found that Indian investors may accept higher–variance investment over a lower variance investment with the same expected returns because it offers a higher probability of extraordinary payoffs. Statistically significant positive skewness captures such behaviour.

One more inference from the findings could be, diversifying may not be highly beneficial by using mean–variance framework. One has to look at the skewness and kurtosis while diversifying. However, observing the effect of skewness and kurtosis while increasing stocks in a portfolio would help in drawing a better inference. We leave this for the future researchers.

Reference:


