Chapter – IV

Data & Methodology
This chapter is divided in two sections Data and Methodology. In the data section the types of data, time period of the study, source of data and brief description about the data is illustrated. In the methodology section the limitations of prevailing methodology and method of overcoming that problem has been described.

SECTION I

In this section we are going to discuss the different aspects of data collection.

4.1 Data

The prices of all the shares reflect the whole stock market. But, practically it is difficult to measure the movement of all the stock prices and a stock index based on some selectively chosen shares may also represent the country's equity market. There are two types of stock index --- specific purpose stock index and generic stock index. The specific purpose stock index may represent some particular segment of the market e.g. mid cap index, or small cap index or some industry specific stock index. On the other hand, a generic stock index represents the whole share market. A stock index is a much better indicator than stand-alone scrip or even any other portfolio to represent a stock market.

4.1.1 Representative Indian Stock Indices

Some of the generic indices in India are BSE 30 sensitivity index or SENSEX, Nifty, Junior Nifty, BSE 100, BSE 200, BSE 500 etc. Some, people argue that higher the number of scrips in an index, better is the representation of the market. But, it is not quite true. Firstly, most investors are not interested what happened in the illiquid stocks. Many investors are interested to know what is happening in the large cap stocks to take their investment decision. Even if higher number of shares make an index perfect but that might not be a good instrument for taking
investment decision. Some investor might be interested to know about the movements of a particular junk stock but the investor might not be interested to know what is happening to the junk stock as a group combining with other stocks. So, the investors may not desire the information regarding the movements of other unimportant stock. In fact, it may be concluded that the presence of effect of unnecessary stocks may pollute the stock index figure and misguide the investors. So, stock index return may well be accepted as market return. For this reason only, SENSEX (with only 30 stocks) and S&P CNX Nifty (with only 50 stocks) are much popular indices than BSE 200 or BSE 500. In this context, it is important to remember here Roy & Khan (2003) who concluded that the average information content decreases along with the increase in number of shares in the stock index.¹

There are other advantages for taking the SENSEX and Nifty data for the purpose of our study. The methodology adopted for the construction of these indices is undisputed and time-tested. These two indices have the more historical data than other indices. For all these compelling reason, the Sensex data and S&P CNX Nifty is taken for the purpose of this study.

4.1.2 Types of Data

The daily share prices are too much volatile. To reduce the randomness stock index is taken instead of scrip or portfolios containing small number of scrips. Again, the daily stock index data is also subject to very high random fluctuations. To avoid such problem monthly data have been taken instead of daily data. The monthly data helps us to avoid erratic daily fluctuations. Again, daily closing data are not equidistant in the sense that after five consecutive data, there were data after two day's gap. On the other hand monthly data are much more equidistant. In

¹ Ajit Kumar Roy & Mohammad Shamimuddin Khan (2003), Measuring the information Content of Stock Price Index, Finance India (September), Vol. XVII, no. 3, pp. 975-985.
fact, Larsen and Wozniak (1995)\textsuperscript{2} and Shen (2003)\textsuperscript{3} had taken monthly return in their study. Jorion (2003) also observed that monthly return is approximately normally distributed, other distributions exhibit substantial skewness.\textsuperscript{4} So, the monthly data was considered most suitable for the purpose of arriving at any conclusion through statistical applications. The closing index figure of the last day of the month is taken instead of daily averages or weekly averages of the month.

4.1.3 Period of the Study

The economic reforms started from the mid eighties. One of the purposes of the study is to check whether there is any growth rate in the stock indices. But, the results of the economic liberalization started coming from 1991 onward. In fact, due to this many Indian researchers like Sharma (2004)\textsuperscript{5}, Kaur (2004)\textsuperscript{6} have taken the period after 1990-01 for their study. The period after 1990 is economically important. So, the period of study is taken from 1991-2004.

4.1.4 Comparison with other Countries

The present study is to determine long-term return from Indian Stock Market after liberalization. But, mere long-term return in absolute term is not sufficient enough to comment anything conclusive about the stock market. Presently, international developments are influencing local domestic market. So, it is also required to gauge and compare the return of the other market as well. Thus, apart from Indian stock indices Sensex and Nifty, ten other stock indexes of ten different countries

\textsuperscript{2} Glen A. Larsen (Jr) and Gregory D. Wozniak (1995), ‘Market Timing Can Work in the Real World’, *The Journal of Portfolio Management* (Spring), Vol.21, no.2, pp. 74-81
\textsuperscript{3} Pu Shen (2003), ‘Market Timing Strategies that worked’, *The Journal of Portfolio Management* (winter), Vol.29, no.2, pp. 57-68.
were taken into account. The stock indices are All Ordinaries index of Australia, S&P TSX Composite of Canada, CAC 40 of France, DAX index of Germany, Hang Seng of Hong Kong, Nikkei 225 of Japan, S&P 500 of USA, FTSE 100 of UK, Straits Times Index of Singapore and Swiss Market index of Switzerland. So, the study covers the stock index data of the developed countries like USA, UK were included along with the same of the emerging economies like Hong Kong, Singapore etc.

4.1.5 Note on Indian Stock Index

A note on SENSEX and S&P CNX Nifty would help us to understand different issues of stock index.

4.1.5.1 BSE 30 Sensex

Bombay Stock Exchange (BSE) 30 sensitivity index is popularly known as Sensex is the most widely accepted stock index of India. It represents the pulse of Indian Stock Market. It was first compiled in 1986. The Sensex comprised of shares of 30 important companies. The base year for the Sensex is 1978-79 and the base value is 100. The companies were chosen from the large, liquid and representative stocks. The Sensex is a market capitalisation weightage index. Earlier the Sensex used “full capitalization” method for arriving at Index figure but from September 1, 2003, the Sensex follows the methodology of “free float” for the purpose of determining the weightage of any particular scrip in the Sensex. The “free float” is the number of shares floated in the market and not held by promoter or strategic partners. The world famous institutions like Standard & Poor, Morgan Stanley Composite Index, FTSE and Dow Jones accepts the “free float” methodology for calculation of stock index.

Criteria for Stock Selection:
Quantitative Criteria:

(a) Market Capitalisation: The stock should be one of the top 100 stocks as far as market capitalization is concerned. The capitalisation weightage of the constituent stock should be at least 0.5% of the Sensex capitalization. The market capitalization would be averaged for six months for the purpose of calculation.

(b) Liquidity: The liquidity of the stock can be judged from three factors.

(i) Trading Frequency: The scrip should have been traded in each and every trading day in last one year. There should be no exception apart from some extreme cases like suspension of trading etc.

(ii) Number of trades: The scrip should be one of the top 150 scrips as far as no. of trades are concerned in last year.

(iii) Volume of trades: the scrip should be one of the top 150 scrips as far as volume of trades are concerned in last year.

(c) Continuity: Wherever the composition of the Sensex is changed, the value of the new series is calculated for the last one year. The correlation between old Sensex series and revised Sensex series for the past one-year is found out. The change is allowed if the correlation between old series and new series is not less than 0.98. This feature of the Sensex ensures the continuity of the historical time series data of Sensex.

(d) Industry Representation: The constituents of the Sensex are so chosen that it must represent the economy — through incorporating different industry. The company gets included in the Sensex must be leader in their industry group.
(e) Listing: The company should have a listing history of at least one year.

Qualitative: The company should have an acceptable track record in the opinion of the index committee.

The method of Calculation of Sensex:

The Sensex is calculated on the basis of "Market Capitalisation-weighted" methodology. The market capitalisation of a share is the product of its price and number of outstanding shares it has. Sensex is the sum of market capitalization of its constituent shares relative to its base price. The base period for the Sensex is 1978-79. The base value for that is 100. The calculation of Sensex involves dividing the total market capitalization of 30 scrips by a number called index divisor. The index divisor links the Sensex with the base period value and makes it comparable throughout the time series. An index committee of the Sensex quarterly reviews the composition of the Sensex.

Calculation of Closing Index: The closing Index is calculated taking weighted average of all the trades of the constituents of the Sensex in the last fifteen trading minutes of the day. If any scrip is not traded in the last fifteen minutes then the last price is taken for the price. If the scrip is not traded during the day, the price of the last traded price is taken for index calculation. The usage of Index closure algorithm prevents any intentional manipulation of the closing index value.

Adjustment for bonus shares and right shares:

(a) Adjustment for Right Shares: When a company that is a constituent of the Sensex issues right shares, the market capitalisation increases by the number of right shares based on the ex-right price. An adjustment is made on the Base Market Capitalisation to offset the effect of right shares.

The formula for adjusting Base Market Capitalisation is as follows:
New Base Market Capitalisation = Old Base Market Capitalisation \times \left( \frac{\text{New Base Market Capitalisation}}{\text{Old Base Market Capitalisation}} \right).

(b) Adjustment for Bonus Shares: As soon as, a company issues bonus shares its ex-bonus price reduces proportionately, so the market capitalisation of the company does not change. But, the number of shares changes. So, at the time of issuance of bonus of any Sensex constituent company, the number of bonus shares increases the total number of shares.

The original BSE SENSEX data for the period 1st January, 1991 to 31st December, 2004 has been provided in Appendix - I.

4.1.5.2 S&P CNX Nifty

This stock index became popular within a short span of time. Fifty Stocks that were being transacted in the National Stock Exchange were taken to construct this index. Earlier the index was constructed with the direct involvement of the exchange authority. But presently the index is being guided by the index committee of the world famous Standard & Poor. There are two criteria on which a stock is included in the S&P CNX Nifty. (1) Largest Stock in the market by Market Capitalisation (2) The Stock selected must be liquid by 'impact cost' criteria. The weightage of each stock in the index is proportional to its market capitalisation. The weightage changes when corporate actions that changes market capitalisation takes place.

Calculation of Closing Price: The weighted average of the stock prices of last 30 minutes of the day is taken as closing price. The NSE has very strong surveillance mechanism in operation. To be impartial, the supervisor involved in the surveillance system has no position in the market. The innumerous transactions
take place during the last half an hour for all the index constituent stock. So, the closing price of the index constituent stock is certainly fair in valuation.

The original CNX Nifty data for the period 1st January, 1991 to 31st December, 2004 has been provided in Appendix - II.

4.1.6. A Brief Note on Foreign Stock Indices

A very brief discussion on the stock indices of other ten countries are written down below:

4.1.6.1 All Ordinaries

The All Ordinaries Index is an important stock market indicator. There are 500 companies as its constituents. The market capitalisation is the only criteria to be its constituents; i.e. top 500 companies as per market capitalization ranking is considered for its constituents. The liquidity is not a criterion for selection except for foreign domiciled companies. This index covers almost 99% of total market as on 30th June, 2002. The original data of All Ordinaries for the period 1st January, 1991 to 31st December, 2004 was provided in Appendix - III.

4.1.6.2 S&P / TSX Composite Index

S&P / TSX Composite Index is widely considered as benchmark for Canadian Equities. There are 300 companies as its constituents. Before 1st May, 2002, the name of this index was TSE 300. Even after renaming there was no change of construction of index methodology. So, in this study, the data prior to 2002 have been considered for the purposes of analysis. The original data of TSX Composite for the period 1st January, 1991 to 31st December, 2004 has been provided in Appendix - IV.

4.1.6.3 CAC 40
CAC 40 is the French Stock Market index that tracks largest 40 companies on the basis of Market Capitalisation in the Paris Stock Exchange. The methodology of CAC 40 is similar to Dow Jones Industrial Average (DJIA).

The original data of CAC 40 for the period 1st January, 1991 to 31st December, 2004 has been provided in Appendix - V.

4.1.6.4 Nikkei 225

The Nikkei 225 is the most widely watched stock index of Japan and has been calculated way back from 7th September, 1950. The Nikkei 225 follows the calculation method of Dow Jones Industrial Average. This index consists of the share price of 225 companies. These 225 stocks are most actively traded issues on the Tokyo Stock Exchange. The index reflects ex-rights-adjusted average stock price. Like any other index, the Nikkei 225 is rebalanced from time to time to assure that all issues in the index are both highly liquid and representative of Japan's industrial structure.

The original data of Nikkei 225 for the period 1st January, 1991 to 31st December, 2004 has been provided in Appendix - VI.

4.1.6.5 Hang Seng

It is the most important stock index of Hong Kong. There are 33 constituent companies in this index. The index is arithmetically calculated and weighted by Market Capitalisation. The original data of Hang Seng for the period 1st January, 1991 to 31st December, 2004 has been provided in Appendix - VII.

4.1.6.6 Dax Index

DAX is the most popular stock index of Germany. DAX is abbreviation of the full form Deutscher Aktien index DAX. There are share prices of 30 companies in this index trade in German Stock Exchange. The Laspeyres Method of indexing is followed to calculate DAX. The capitalization weighted total return was used to
arrive at the final index figure. The base date of this index is 30th December, 1987 and base value is 1000. The original data of DAX Index for the period 1st January, 1991 to 31st December, 2004 is provided in Appendix - VIII.

4.1.6.7 Straits Times Index

This is the premiere stock index of Singapore. The index was first compiled and popularized by their famous Newspaper --- Straits Times. There are 55 companies as its constituents. It is a modified value weighted index. The computation under this method is somewhat complicated but it ensures that largest firms have the greatest impact on the index. The Straits Times Index represents 60% of the market value of the total Singapore Stock Market. The original data of Straits Times Index for the period 1st January, 1991 to 31st December, 2004 is provided in Appendix - IX.

4.1.6.8 Swiss Market Index

Swiss Market Index or SMI in short is the leading stock market index. The Association of Tripartite Stock Exchange is the sponsor of this index. The stocks are from three stock exchange of Zurich, Geneva and Basel. There are 21 companies as its constituents. The composition of the index is usually revised on 1st January and 1st July each year. The index is calculated as per capitalization weighted value method. The base date for this index is 30th June, 1988 and base value is 1500. The original data of Swiss Market Index for the period 1st January, 1991 to 31st December, 2004 has been provided in Appendix - X.

4.1.6.9 FTSE 100

FTSE 100 is most important stock index of United Kingdom. There are 100 blue chip companies traded on London Stock Exchange as its constituents. The stocks are chosen on the basis of one criteria --- capitalisation. The FTSE 100 covers 80% of the total market capitalization. This index is constructed on the basis of
capitalization-weighted method. The FTSE 100 is used as the basis for investment products such as derivatives, exchange traded fund etc.

The original data of FTSE 100 for the period 1st January, 1991 to 31st December, 2004 has been provided in Appendix - XI.

4.1.6.10 S&P 500

S&P 500 is widely regarded as the ideal proxy of the stock market of United States of America. The index is designed by the famous international rating agency Standard & Poor. There are 500 companies as its constituents. The index covers 80% market capitalization of the US stock market. The S&P 500 as it is today was introduced in 1957. The original data of S&P 500 for the period 1st January, 1991 to 31st December, 2004 has been provided in Appendix - XII.

The stock index of different countries has different number of constituent shares. Some people may argue that this may not be comparable. They say that index with higher number of shares are more representative. But it is too simple to be true at least in the long run. During a bull run, initially the large cap stocks moves up faster than the other stocks followed by mid cap stock and small cap stocks. On the other hand during a bear phase, initially small cap and junk stocks moves down faster followed by mid cap and large cap stocks. So, over a long period of time, the index with a small number of stocks fluctuates almost in line with indices with a good number of stocks. So, Indian stock index such as Sensex, an index with thirty stocks is certainly comparable with US S&P 500, an index with five hundred stocks.

4.1.7 Source of Data

The SENSEX data from 1991 to 2004 have been collected from www.bse.com. The historical data series of S&P CNX Nifty have been collected from www.nseindia.com. The dividends of the Sensex stocks are also taken into
consideration to arrive at total return from the stock index. The sensex return is calculated on historical prices. The nifty returns are calculated on current prices. The source of stock index data series of all other countries is finance.yahoo.com. The data relating to inflows from Foreign Financial Institutions were taken from www.sebi.com and www.rbi.com. The details about foreign stock indices were available from the web sites of the respective stock exchanges.

SECTION II

The different methodological issues have been discussed in the next section.

4.2 Methodology

The Stock Market is very much volatile in nature. It is very difficult to arrive at any reliable representative figure. The statistical applications would be too much mechanical for a place where the prices move randomly without following any pattern. In this regard it requires a lot of diligence at the time of adopting a suitable methodology.

4.2.1 Point to Point Growth Rate

In the estimation of growth the simplest procedures has been to consider the value of index at two arbitrarily chosen points of a period. If $Y_0$ is the index at the beginning of the period and $Y_n$ is the index at the end of the period then average annual growth rate would be $\frac{1}{n} (Y_n - Y_0) \times 100$. But this system suffers from a lot of problems. Firstly, the process does not take into account all the data in the time series. Secondly and most importantly, the process would hardly be acceptable where data were too volatile and erratic. Here instead of end points suitable representative data points should be considered.
In this connection, some study relating to growth of stock index and return from that in India are mentioned herein. Bhole (1995) has taken Sensex data for the period 1985-86 to 1993-94 and demonstrated trends in secondary market. But his methods lack statistical power. Bhole & Pattnaik (2002) found annual change in sensex has varied over a wide range of -46.8% to 266.9% during 1983-84 to 1999-2000. We understand calculation of annual return for a long period might not be representative for a long period in a stock market. There is some study relating to growth of stock index in abroad as well. Jorion & Goetzmann (1999) studied 39 countries for very long period to estimate long-term expected return on equities. They computed compounded growth rate in nominal term, real term and dollar term. But compounded growth rate can not help in finding representative return for the share price that are too volatile. Let us discuss the problem of point-to-point growth rate calculation in brief.

4.2.1.1 Limitation of Point to Point Growth Rate Calculation

The point-to-point growth rate calculation is easily comprehensible and easily calculable. The period for point-to-point long-term growth rate of stock indices in this study is from January 1991 and December 2004. The formula used is that of determining compound rate of return: \( A (1+r)^n = S \); where \( A = \) Initial value of stock index i.e. on January 1991, \( r = \) is monthly rate of return, \( n = \) Number of months, \( S = \) Final Value of stock indices on December 2004. The monthly rate was multiplied by 12 to arrive at annual rate of return.

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<tbody>
<tr>
<td>P to P change</td>
<td>3.07</td>
<td>2.83</td>
<td>2.42</td>
<td>3.00</td>
<td>4.39</td>
<td>6.72</td>
<td>6.62</td>
<td>0.49</td>
<td>1.63</td>
<td>3.97</td>
<td>2.22</td>
<td>3.52</td>
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<td>(times)</td>
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<tr>
<td>Growth(%)*</td>
<td>8.03</td>
<td>7.44</td>
<td>6.32</td>
<td>7.87</td>
<td>10.61</td>
<td>13.69</td>
<td>13.57</td>
<td>-5.04</td>
<td>3.50</td>
<td>9.89</td>
<td>5.70</td>
<td>9.03</td>
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</table>

* Monthly compound growth rate annualized

**Table 4A: Point-to-point Growth of Different Indices**
It is found from the table that Indian stock indices BSE Sensex and S&P Nifty registered highest growth during the period in the sample of twelve countries. The absolute point-to-point change was more than 6.5 times resulting an compounded growth rate of over 13.5% per annum. The stock indices of Australia, Hong Kong, Switzerland and US registered decent gain in the range of 8-10% per annum. The Nikkei of Japan is the only stock index that registered negative growth during the period of study. Even during last fifteen years the Japanese stock indices registered 5.04% decline per annum. The other Asian stock index considered in the study is the Straits Times of Singapore. The Stock index of Singapore rose only 1.63 times during last fifteen years and as such growth rate is poor at 3.5% per annum. The stock indices of Canada, France, Germany and UK register decent growth during the period. The stock indices of these countries rose to more than twice. The growth of these indices ranges from 5.7% to 7.9% per annum.

The point-to-point growth suffers from one severe limitation. This type of growth rate considers two end points only and completely ignores all other data points in between these two data. This extreme emphasis on two end points leads to distorted growth rate specially in case of two volatile share prices and stock indices. If starting point of stock index is too low (might happen in case of bear phase) and end point of the stock indices are too high (might happen in case of bull phase) then we would found very high growth rate. On the other hand, if starting point of stock index is high and end point is low then we would find even negative growth. In fact, the prices are so volatile in the stock market that one might find the above situations very frequently.

Let us consider the Indian scenarios. We found that the BSE Sensex is increasing at the rate of 13.5% per annum for the period January 1991 to December 2004.
Now, let us consider period that would some sub-period to check the growth rate and to verify whether the figure is consistent with overall growth rate.

The BSE Sensex from January 1991 to March 1992 moves from 982 to 4285 in 14 month horizon. This yields a monthly compounded annual return of 133% during the period. The Sensex moves from 2811 to 5447 during November 1998 and February 2000 yielding and average return of 54% per annum. Again, from April 2003 to December 2004, the Sensex moves from 2960 to 6603. This results a yield of around 50% per annum. On the other hand, from August 1994 to November 1995, the Sensex hovers around from a high of 4588 to a low of 2994 resulting a decline for more than 33% for a fifteen-month horizon. During the period of April 1998 to October 1998, the

<table>
<thead>
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<th>Positive Return period:</th>
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<tr>
<td>Month (Closing)</td>
<td>BSE Sensex</td>
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<tr>
<td>January 1991</td>
<td>982</td>
</tr>
<tr>
<td>November 1998</td>
<td>2811</td>
</tr>
<tr>
<td>April 2003</td>
<td>2960</td>
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<table>
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<tr>
<th>Negative Return Period:</th>
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<tbody>
<tr>
<td>Month (Closing)</td>
<td>BSE Sensex</td>
</tr>
<tr>
<td>August 1994</td>
<td>4588</td>
</tr>
<tr>
<td>February 2000</td>
<td>5447</td>
</tr>
<tr>
<td>April 1998</td>
<td>4006</td>
</tr>
</tbody>
</table>

Table 4B: Positive and Negative Return form Sensex

Sensex declined from 4006 to 2816 resulting 68.7% annualized declined. Again, from February 2000 to September 2001 the Sensex declined from 5447 to 2811 in
the nineteen-month period. This, in effect, results a decline of 41% on annualized basis.

From the above discussion, we believe that, depending upon market condition, point-to-point growth might demonstrate very high level of volatility --- sometimes exhibiting very high growth rate, sometimes with very low or negative growth rate. Thus this method of calculating growth would mislead us. So, the point-to-point growth rate should not be used as representative of any data set.

4.2.2 Alternative Methods
In this study, growth rate of the stock indices have been calculated considering all the data points in two methods.

(A) Growth rate of stock indices taking logarithmic values

(B) Growth rate of stock indices taking moving average

4.2.2.1 Growth rate of stock indices taking logarithmic values
The stock prices are too volatile and their distribution do not form normal curve and hence not applicable to statistical calculations and analysis. But it is established that stock prices are log normal. So, the distribution of logarithmic values of stock prices would follow normal curve. Along with many other researchers, Sharma (2004) used lognormal data for statistical applications in his study of stock market seasonality in Indian stock market.7

(1) All the monthly values of stock indices were considered
(2) The values stock index were converted into log values
(3) They were applied to linear trend in the form: \( \log y = b_0 + b_1 t \); where \( y = \) stock index value; \( b_0, b_1 = \) constant term of the equations; \( t = \) time i.e. no. of month.
(4) Slope would be $b_1$.

(5) Taking Derivation both sides of the linear trend equation with respect to time ($t$)

$$\frac{1}{y} \cdot \frac{dy}{dt} = b_1$$

We get growth rate per month ($b_1$). Growth rate per annum (in percentage) = $b_1 \times 12 \times 100$.

### 4.2.2.1 Growth Rate of Stock Indices Taking Moving Average

The main advantage of this method over the previous one is that this method takes care of the problem of cyclical fluctuations of stock indices and eliminates the effect of the cyclicality from the stock indices. In this context it is required to postulate some hypothetical trend equations and to select one of them on some statistical criteria and estimate the growth parameters in this equation by ordinary least squares or some other methods.

The long-term trend analysis would help to determine the slope of the trend line. From the slope, growth rate can be calculated. In this study, ten forms have been used to check which form suits with the data series most. (1) Linear trend equation (form $y = b_0 + b_1t$) (2) Logarithmic form [(form $y = b_0 + b_1 \ln (t)$)] (3) Inverse (form $y = b_0 + b_1/t$) (4) S curve (form $y = e^{b_0 + b_1/t}$) (5) Quadratic equation ($y = b_0 + b_1t + b_2t^2$) (6) Cubic equation ($y = b_0 + b_1t + b_2t^2 + b_3t^3$) (7) Power form [$y = b_0 (t^{b_1})$] (8) Exponential form ($y = b_0 e^{b_1t}$) (9) Compound rate ($y = b_0 \times b_1^t$) and (10) Growth Curve ($y = e^{b_0+bt}$).

The trend analysis from raw stock index data causes a problem. The daily share prices are too much volatile. For this reason, this study is restricted to stock index only. Again, the daily stock index data is also subject to very high random fluctuations. Due to random short-term fluctuations trend analysis might not be

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very representative. To avoid such problem monthly data have been taken instead of daily data. To reduce the randomness stock index is taken instead of scrip or portfolios containing small number of scrip.

In the context of estimating growth rate of agricultural production, Sawant (1983)⁸ and Sawant & Achuthan (1995)⁹ suggested moving averages of the original data would fit more in the trend analysis in case of volatile data series. The process of moving average is done to minimize the undesirable effect of volatile fluctuations on the estimated growth rate. But the process of moving averages adds the disturbance (error) term consecutively, which frequently causes problem of autocorrelation. The autocorrelation in the data series hampers the process of fitting a trend. Whether there is any existence of autocorrelation or not that can be checked by Durbin-Watson Test.¹⁰

To remove the problem of autocorrelation due to moving average process, Cochrane-Orcutt¹¹ two stage procedures are applied as suggested by Chattopadhyay & Das (2000)¹².

Daterao et. al. (1996) applied FRACTALS and CHAOS theory to explain certain behaviour of stock prices, which are thought to be random for historical and statistical methods. They concluded that the Indian Stock Market is characterized by two cycles, a medium term cycle of five months duration and a long-term cycle

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¹¹ ibid

of 50 months.\textsuperscript{13} Madhusoodanan (1997) concluded that there exist some kinds of cycle of length around four and half years.\textsuperscript{14} He further concludes that there is 95% confidence that the investment in stock for long-term will produce positive results.\textsuperscript{15} In this background, moving average of as high as 50 month has been taken for this long-term study to neutralize the effect of long-term cycle form the data series.

After removing the autocorrelation problem, the data series would have to be applied to different types of trend equations as mentioned above. Then $R^2$ (Explained Sum of Squares \slash Total Sum of Squares) and adjusted $R^2$ would have to be calculated. $F$ ratio would also have to be calculated to find out statistical significance. The trend with highest $R^2$ is the most fitted trend of the data series. From the trend equation we can get slope of the trend and hence the growth rate of the stock index over the period.

This way the best-fitted trend would have to be calculated for all other ten countries and the growth of Stock index would have to be calculated. Then the comparison of the growth of stock index of India with the growth of stock index of other ten countries can be carried out.

\textit{4.2.2.1.1 Steps in Determining Growth Rate under Moving Average method}

To apply and implement the above method of determining the growth rate under the moving average, the stock index data series of India and all other ten countries have been processed.


\textsuperscript{15} ibid
(i) The monthly stock index data are taken. The closing figure of the last day of the month is considered for the purpose. The data is taken from January 1991 to December 2004.

(ii) The moving average procedures are applied. A 50-month moving average procedure is applied. This is non-centred. The data is made centred.

(iii) To find out Durbin–Watson d statistic and observed the autocorrelation in the data in all cases.\(^\text{16}\)

(iv) Cochrane–Orcutt procedures are applied to remove the auto correlation problem in the data series.\(^\text{17}\)

(v) After first stage of Cochrane–Orcutt procedures, there is existence of auto correlation in all cases. As a result, Cochrane–Orcutt two stage procedures are applied.\(^\text{18}\)

(vi) Ten types of trend equation is fitted for the autocorrelation free data.

(vii) The best-fitted trend equation is choosen from the statistical significance, F ratio, R squared and adjusted R squared.

4.2.3 Comparing the Distribution of Two Types of Growth Rates

Two alternative methods have been applied to determine the growth rate of stock indices. A question might arise which growth rate is more representative. To answer this we need to check the nature of distribution for both the series. If we determine the Coefficient of variation, Skewness and the Kurtosis, we would be able to understand which method would be more suitable for statistical application. The lower the Coefficient of Variation and skewness of a data series, the more applicable for the statistical applications. For normal curve, which is most suitable for


\(^\text{17}\) ibid

\(^\text{18}\) ibid
for statistical application the Kurtosis is 3. Again, for comparison within the group the distribution should be similar as comparable as soon as possible.

4.2.4 Reliability on the Growth Rate

The stock prices are very volatile so also the stock indices are. The factual rate of return merely might not be conclusive about the nature of return in any stock market. The share prices moves up and comes down. In fact, a mean reversionary tendency is found in the stock market. So, not only the individual share prices but the prices of portfolios and stock indices also revert to the mean. Now, there would be attempt to determine to degree of mean reversion in Indian stock indices.

4.2.4.1 Tendency for Mean Reversion

One of the very important characteristics of a particular share prices, portfolio and stock indices is mean reversion tendency. Dreman & Berry (1995) concluded that over a period of five years or more stock prices revert to mean. The growth of stock indices does not speak anything equivocally. Due to mean reversionary nature the prices after climbing to a high there would be price reversal towards the mean and after moving down to lows there would be price reversal towards the mean. [DeBondt & Thaler (1985), Fama & French (1988), Jegadish (1991) and Barberis (2000), Poterba & Summers (1988)]. The trend equation considers

all the points in the data series. So, when we calculate growth, the possible higher
growth gets reduced due to the price reversal nature of the stock prices and stock
indices. The higher the tendencies for mean reversion lower would be the net
growth rate as envisaged by trend equation. Now, let us discuss about the
tendency of mean reversion for all the stock indices to have an idea about the
growth rate of the stock indices.

4.2.4.1.1 An Instrument for Detecting the Degree of Mean Reversion

_Poterba & Summers_ (1988) measured mean reversion through variance ratio
test.\(^\text{25}\) In this study, an easier approach was tested. We know that growth rate
reflects the degree of departure from the mean. On the other hand, co-efficient of
variation reflects the relative degree of fluctuations of a series. The higher the
growth rate, lower is the tendency for the mean reversion. Again, the higher is the
co-efficient of variation, more prominent the mean reversion should be. So, we
understand, lower (Growth rate / C.V.) ratio would represent higher degree of
mean reversion and higher (Growth rate/ C.V.) would represent poor tendency for
mean reversion. The positive ratio indicates tendency for price reversal at a figure
higher than mean. On the other hand, negative ratio indicates tendency for price
reversal below the mean.

4.2.5 Dividend Income & Total Return

The dividend paid during the year should also be taken into consideration along
with the growth in the stock index. In fact, stock index return = stock Index growth
+ dividend earning.

The main problem of determining dividend income is the selection of investment
horizon. An investor who invested for a very long time might be interested to know
his dividend earning in comparison to his initial investment. The average of yearly

\(^{25}\) ibid
dividend yield might not be very correct way for determining long-term dividend yield because in this method, the intermediary price is also taken into account. In fact, higher the investment horizon, higher would be the dividend yield per annum. Here, yearly dividend income is calculated on the basis of one-year investment horizon, five-year investment horizon and taking the full period investment horizon. The 31st March is the period for year ending it is assumed that by the end of the month June the dividend is paid out to the shareholders. So, we have taken the dividend yield figure for the month of June.

4.2.6 Methodology at a Glance

In a nutshell, the steps of the methodology of the study may be listed as follows:

1. Growth Rates of Indian stock indices would have to be determined under two methods --- log value method and moving average method. Growth rates of other stock indices would also have to be calculated.

2. Checking the distribution of data series to compare both methods

3. Reliability of the growth rates --- checking the degree of mean reversion

4. Determination of Dividend income and total return from the Indian stock market.