Volatility in Indian Stock Markets

A study of Volatility in Indian Stock markets to understand the reasons for turbulence in the last two years.

Area
Finance
Market Microstructure
JEL Classification : G

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Abstract

The ups and downs of the financial markets are always in the news. After all, there's plenty to report. Wide price fluctuations are a daily occurrence on the world's stock markets as investors react to economic, business, and political events. Of late, the markets have been showing extremely erratic movements, which are in no way tandem with the information that is fed to the markets. Thus chaos prevails in the markets with investor optimism at unexpected levels. Irrational exuberance has substituted financial prudence. Has the stock market volatility increased? Has the Indian market developed into a speculative bubble due to the emergence of "New Economy" stocks? Why is this volatility so pronounced? In this paper we try to analyse these questions in the context of Indian stock markets. We try to unearth the rationale for these weird movements. We examine the fundamentalist view put forward by economists who argue that volatility can be explained by Efficient Market Hypothesis. On the other hand, the view that volatility is caused by psychological factors is tested. An empirical study of BSE Sensex and a set of representative stocks are carried out to find the changes in their volatility in the last two years. The stock market regulation in introduction of rolling settlement and dematerialization as a measure of reducing volatility is put to test. Thus, the paper will help the investors as well as market regulators to make the markets more efficient.

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1 Introduction

Alan Greenspan, Chairman of the Federal Reserve Board in Washington, described it as "Irrational Exuberance" at his speech in December 1996[1]. Some have referred to it as speculative bubble, some baby boom effect[1], whereas some have explained it as 'herd behavior'. So what is it that these people are referring to…? "**Volatility**" as is called in stock market parlance. This high volatility has given sleepless nights to a lot of investors as well as market regulators.

"Nightmare on Dalal Street, Sensex crashes 256 points " said Economic Times on 25th July 2000. Headlines like this have been quite frequent in recent times. The ups and downs of the financial markets are always in the news. Public interest in market movements has intensified as more and more investors have flocked to the stock markets to be a part of the bonanza. Wide sharp price fluctuations may be unnerving for the millions of such people, who are relatively new to investing.

2.0 But what is volatility?

Volatility of an asset is measured by the variability in the price over time measured as the variance or the standard deviation of the returns on the asset. The more the standard deviation the more volatile the asset is. This is also a measure of the riskiness of the asset since the more variation it has the more unpredictability associated with its returns. There are a lot of Market Models that measure the residual variances to measure volatility. The Market Volatility Index (VIX) quoted at Chicago Board Options Exchange (CBOE)[2] is constructed by the weighted average of the implied volatility of Standard & Poor 100 Index calls and puts. It is a broad measure of the overall volatility in the market. There have been a lot of empirical studies to test volatility in the stock markets globally. Research has proved that stock markets have become more volatile in the recent times due to the emergence of "New Economy" stocks[3] (the plot of returns and variance in Exhibit 1 and 2 shows how volatility has increased in BSE). These stocks have been valued highly as compared to their "Old Economy" counterparts on the expectations of giving very high returns in future. Thus this high expectations has brought about wide fluctuations in the prices making the markets turbulent. The methodology followed to study volatility in BSE is attached in Exhibit 3.

2.1 The Theories of volatility

There are two schools of thought that have divergent views on the reasons of volatility The economists in their fundamentalist approach argue that these market movements can be explained entirely by the information that is provided to the market. They have tried to put Forward Theories to explain this phenomenon and more still have tried to use these theories to predict future changes in prices. They go on to say that since the Efficient Market Hypothesis (EMH) holds the information changes affect the prices.

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1. Irrational Exuberance by Robert Shiller, Princeton University Press
2. Market Volatility Index (VIX) http://www.cboe.com/tools/statistics/summeriz.asp
3. Most Risky Stocks, The Economic Times, 14th August.

Others have argued that these movements have nothing to do with economic or external factors. It is the investor reactions, due to psychological or social beliefs, which exert a greater influence on the markets. The Popular Models Theory (Popular models are a qualitative explanation of price) proposes that people act inappropriately to information that they receive. Thus freely available information is not necessarily already incorporated into a stock market price as the EMH would have proved.

As it stands theorists cannot agree on whether or not it is economic or psychological realities which are the major cause of price fluctuations in the stock market. We maintain a status quo over the debate and try to probe the Indian Stock markets for both this approaches to figure out reasons for increase in volatility.

2.2 A Speculative Bubble!

The soaring stock prices around the globe have taken valuations of stocks to unreachable heights and economists all around are hinting at creation of a speculative bubble which can burst in near future. In finance, "bubble" is an especially ominous—yet fascinating—term. A bubble is a speculative buying binge that sends the stock market—or any other asset, for that matter—to heights far beyond the realm of reason. A bubble leads to over-valuation of stocks taking them to undesirable heights based on speculative expectations. It creates a cycle of prosperity leading to mass investment delusion, and ending in catastrophe when the bubble bursts. There have been numerous incidents of this in past, which proves this theory of speculative bubbles. The tulip-bulb mania in 17 th-centur Holland; equities in USA 1920s and the crash in 1929; the fifty high-priced glamour stocks of the 1970s -- the so-called Nifty Fifty; the Japanese stock market in the 1980s.

Is the soaring Indian market a speculative bubble? By historical standards the stock markets have reached extremely high levels in recent years. But can we make such sweeping statements without probing into it? The BSE Sensex stood at 2761 on 21 st October 1998. By February 2000 it had reached 6000 showing an increase of 117% in short span of 15 months (See Exhibit 1 & 2 which shows the increase in volatility in BSE). Though there were some signs of Indian economy coming out of recession but the fundamental economic factors didn't show a proportionate increase. The Indian economy grew by 5.9 percent in 1999-2000 whereas the overall growth rate of Industrial production in April-December 1999 was 6.2%[4] (see Exhibit 4). The production growth in manufacturing sector, electricity generation and mining & quarrying during April-December 1999 was 6.7%, 7.7% and 0.0% whereas the capital goods showed a negative growth of -6.6% as compared to 11.3% growth during April-December 1998. The overall increase in corporate profits was 32% for the year 99-00[5]. Exports in dollar terms during April-December, 1999 increased by 12.9 per cent and the imports increased by 9% as compared to 7.2% in April-December 1998. There has been decline in the rate of inflation in1999, which on January 29, 2000 was 2.9% down from the peak 8.8 percent on September 25, 1998[6].

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4. Economic Survey, 1999-2000.
5. The Economic Times, 23rd May2000
6. www.economywatch.com

Rupee depreciated against US Dollar, Pound Sterling and Euro in January 2000. Do these changes substantiate the increase? Not really!

Thus we see that there was no spectacular change in the economy which could take the stock prices to such heights. If we take a long-term view at the changes in economic factors no clear reason emerges out for such increase. A look at the GDP growth rates since independence (1951-1999) from the graph in Exhibit 5 shows that there is no spike in GDP growths as can be seen in the stock prices increase in the recent years. A look at the gross domestic savings rate for the same period does not show any dramatic increase in the last few years Exhibit 6.

Thus we don't see any clear indicator, which could support the Bull Run in the stock markets during the period. The recent fall in the stock prices has partly washed off these unwarranted gains making the markets range-bound.

The same trend can also be seen in markets all over the globe. The stock markets have been riding this steep slope fuelled by the "New Economy" stocks. The Dow Jones Industrial Average which was at 3400 in 1994 has crossed 11700 by 2000, more than tripling in just six years In Europe, between 1994 and 2000 the stock market valuations of France, Germany, Italy, Spain and the United Kingdom had grown more than double. The developing countries of East Asia (Hong Kong, Indonesia, Japan, Malaysia, Singapore and south Korea) and Latin American Countries (Brazil, Chile, and Mexico) had also shown spectacular gains. Are all these markets over valued? Yale University economist Robert Shiller and author of "Irrational Exuberance" says "the valuation of stocks in the US markets have reached undesirable proportions, which are not backed by fundamental factors". In his study he compared the Standard & Poor Composite Stock Price Index from 1871 to January 2000 with the corresponding series of real S&P Composite earnings for the same years[7]. A look at the graph given in Exhibit 7 shows that the stock prices increases is not matched by the earnings growth. Another pattern, which emerges from the figure, is that the last two crashes in 1929 and 1966 were also precedented by such sharp increase in the stock prices as compared to earnings. So the moot question now is whether the markets can hold these high valuations Probably not…? Only time will prove it

3 The Psychological Phenomenon

Thus we see that both the Indian as well as global markets don't have any fundamental reason to substantiate the scale of growth over the last 2 years. Hence we try to probe the psychological view for volatility in stock market. We study how the change in habits and perceptions affected the price movements. What precipitating factors started this remarkable surge, making it crazy? We try to prove how these perceptual changes have changed volatility through empirical evidence. Our study was based on a set of

representative stocks (shown in Exhibit 3 to see the methodology for study.) whose volatility was measured to prove the factors highlighted below.

7. Irrational Exuberance, Robert Shiller, Princeton University Press.

3.1 The Information Boo

The speed of media (measured by the time required to send news from site to the viewer) has gone up tremendously in recent times. Hoards of Business news channel (Star News, Zee News, CNBC Asia, Jain TV etc) are providing information on the movements of stock round the clock. With screen based trading the information is also available with investors. The news feed provided by Reuters and Bloomberg keep the investor updated every minute. Such increased reporting of stock movements generally increase the demand for stocks. This has resulted in markets adjusting to such information faster than before which in turn increase market volatility[8].

3.2 The IT revolution

If you had asked someone for investment advice in 1999 he would have blindly said "ICE" the term coined by media for Information Technology, Communication and Entertainment stocks. The software companies backed by their dollar earnings have been showing excellent growth in the last few years. They are fulfilling the demand supply gap that was created in US due to the shortage of skilled manpower. These companies have been exploiting the labor rate differential to tap the technical skill in India. But future expectations were sky-high, which had made their fall imminent. Though they were showing high growth rates but it was quite impossible to sustain those three digit growth rates for long once they achieve the required critical mass. A simple foresight would have made it clear that the Demand Supply gap would not remain forever in an efficient markets situation and will soon die out. The markets realized this when Mark Mobius had hinted on the same about Amazon.com bringing the markets down. Thus the whole ICE saga seems to be a case of over-optimism on the part of investors. Greed substituted prudence, which attracted a lot of punters who tried to create overnight fortunes, thereby increasing the demand for stocks. A study of the volatilities of a few IT stocks is given in Exhibit 8,9 & 10.

3.4 The Internet Myth

Internet has made this world a global entity where potential is immense for business, if done in the smartest way. The importance of concept or idea made Internet a highly skill driven business and also highly volatile. A new concept can outplace a leader within no time. This whimsical nature of Internet Business was totally ignored by the stock markets globally. The positives that were highlighted by media totally outnumbered the pitfalls. The hype about business prospects that was created was not backed by a sustainable financial analysis. Thus companies were highly over valued on the basis of future business prospects though they were accumulating huge losses. Hence the innocent investor being ignorant of the darker side invested heavily leading to excessive demand of Internet Stocks. Though India didn't have many Internet stocks but has been dancing

to the tunes of NASDAQ which was heavily loaded with Internet stocks. Thus this proxy affect did create excess demand for many IT stocks in India.

8. Speed of Adjustment to Information, Market Microstructure Theory, Maureen O'Hara

3.5 The feedback effect

In feedback theory[9], the stock price increase forms a vicious circle whereby the initial increase (decrease) propels further price increase (decrease). This can be explained by the fact that an increase in the stock prices leads to a better sentiment for that stock which increases the demand and thus the price. This cycle continues increasing the stock price more than what it would have under the Efficient Market Hypothesis (EMH). Though this may seem quite perfect but this leads to a spiraling affect and increases volatility in stock markets.

A test was carried out to check the difference in volatility of stocks while they are rising as opposed to their fall. It is also seen that these feedback loops have different intensities during a Bull Run and a Bear run. It was seen that the price volatility was more when the stock was falling as compared to when it was rising which shows that the feedback was more during a bear run (Exhibit 8).

3.6 Cultural Changes

The liberalization has lead to opening up of the economy bringing in more private players in all areas. The private players have along with better profitability increased the compensation of executives to new highs. The companies had also started issuing ESOP's (employee stock option plan) to their employees thereby increasing the investor base in the country. This high level of compensation and stock options has brought a lot of new players to the stock markets thereby increasing the demand for stocks.

A recent survey by ET, SEBI & NCAER has shown that 7.66 million households (total investor base of 12.1mn) invested in the equity markets for the first time between March 1999 and March 2000[10]. This increase in the number of investors has increased the demand for stocks. This excessive demand coupled with the "ICE" affect has taken optimism to great heights leading to over valuation. This has increased the speculative activities, which is seen by the delivery to trading volume ratio, which is as low as 15%. Ergo high volatility.

4 Stock Market Regulations

SEBI, the watchdog for Indian Stock Markets has brought regulations, which have affected the volatility in stocks. Some of these regulations are increase of margin money, setting exposure limits, rolling settlement and dematerialization [11]. We analyse some of these regulations in how far it has been effective in reducing volatility.

4.1 Dematerialization

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The first major step was to introduce dematerialization of stocks, which reduced the bad deliveries in the stock market. This also had the added benefit of faster share delivery, which was reduced drastically from 45 days to 21 days.

9. Irrational Exuberance, Robert Shiller, Princeton University Press.
10. The new Bull, The Economic Times, 12th June 2000.
11. BSE Guideline I-VI on Compulsory Demat Trading and Rolling settlement; http://www.bseindia.com

This reduced the inventory period for stocks during delivery. This will result in higher circulation and lead to increase in the availability of stocks for trading. Dematerialization will also reduce the bad delivery risk, which accounted for more than 6-8% of trades prior to dematerialization. Thus the coupled affect of reduced inventory period and bad delivery risk lead to an increase in the demand of demat stocks.

A study was carried out to analyse the change in volatilites after the introduction of compulsory dematerialized trading. We found that the volatilites over a one-year period had increased as shown in Exhibit 11 & 12. This increase may be due to the over increase of volatility in the market.

4.2 Rolling Settlement

Rolling settlement was introduced to reduce the speculative activities in volatile stocks from 10th January 2000. A study was carried out to analyse the change in volatilities before and after the introduction of rolling settlement. We found that the stocks had that volatilities during the six-month period have gone up as shown in Exhibit 13 & 14. This might be due to the free-fall in the share prices that occurred after the introduction of rolling settlement.

Thus we see that the market regulations have not been very much effective in curbing the volatility in the markets.

5 Conclusion

Our study examines the hot issue of volatility in the Indian stock markets. Though no fundamental factors emerge for the existence of such high volatility we find that other perceptual factors have led to this mad rush for stocks leading to volatility. The market regulators have been trying their best to curb these speculative uprising but have not been able to keep it in control. We believe that such bubbles cannot be curbed by imposing circuit breakers or margins but by allowing free trade. A more analytical media reporting which highlights better risk management coupled with investor learning will surely lead to more stable market.

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- Living in a High Volatility World - www.onmoney.com
- http://www.cboe.com/tools/historical/vix2000.txt

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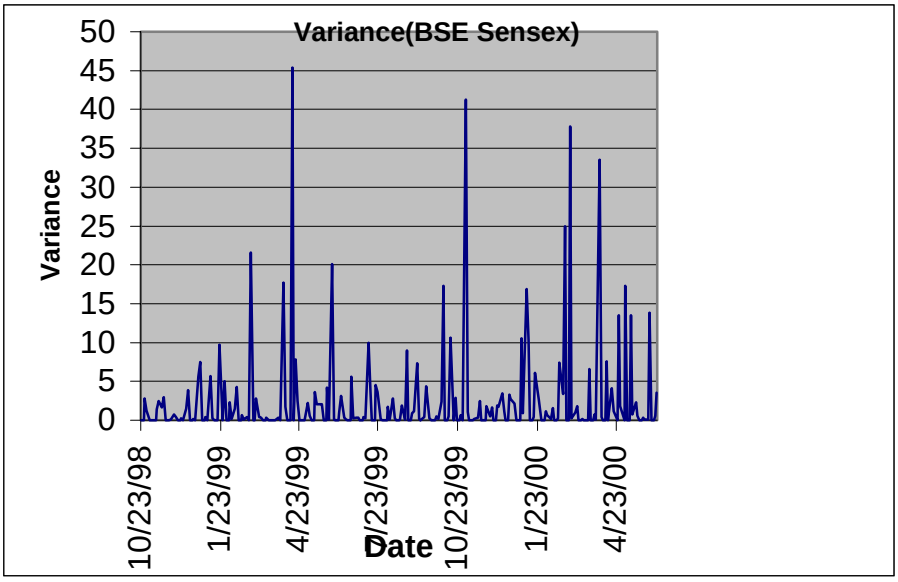
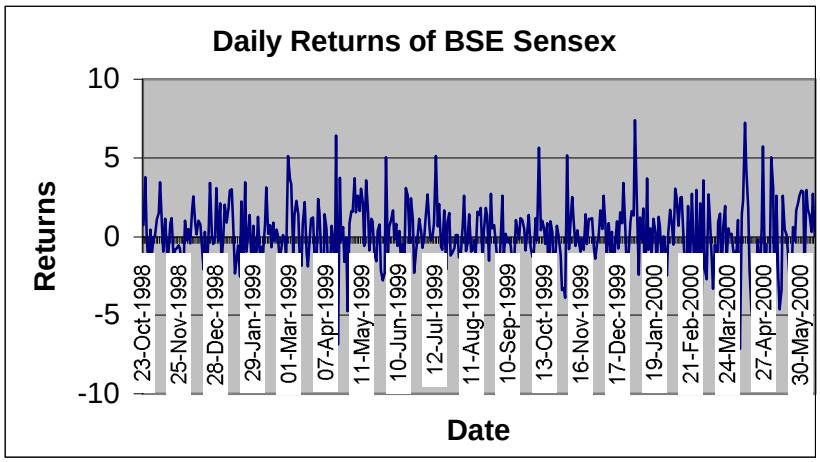
Exhibit 1
Returns variance for BSE Sensex (2 days)



Source: Prowess, CMIE (Centre for Monitoring Indian Economy)
The above graph shows the movement of volatility in the BSE Sensex during the period 21/10/1998 t 09/06/2000. The variance calculated is on two-day basis and is plotted against the respective interval. We can conclude from the graph that the market was highly volatile during the period. The variance ranged from 0 to 45.3

Exhibit 2
Daily Returns of BSE Sensex



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Source: Prowess, CMIE (Centre for Monitoring Indian Economy)
The above graph shows the movement of percentage returns in the BSE Sensex during the period 21/10/1998 to 09/06/2000. The returns are on daily basis and are plotted against the respective date.

Exhibit 3

Methodology

One of the best measures of volatility is the variance, or the standard deviation of expected returns or the actual returns. It is a statistical measure of the dispersion of returns around the expected (actual) returns whereby a larger variance or standard deviation indicates greater dispersion all other factors being equal. The more dispersed the expected (actual) returns the greater the uncertainty of that stock.

We have found out the variance of the three distinct categories of stocks that were instrumental in a very high degree of volatility between 21/10/1998 when the Sensex was at 2874 to 11/02/2000 when it closed at 5933 after reaching a peak of more than 6000. Then it declined to 4729 as on 09/06/2000. That is the one major reason we chose this period. This period is also important because during this period both the rolling settlement and the dematerialization of stocks occurred which played a significant part in our choosing this period. The respective stocks were chosen because they were highly volatile during this period. The stocks chosen are

- Infotech stocks (sample size =13)

We found out the variance associated with each Infotech stock during the period, the variance during the period the stock increased to its maximum value and then the variance during the period of fall.

- Demat stocks (sample size =10)

We found out the variance associated with each demat stock during the period, the variance during the period it was not dematerialized and then the variance during the period after dematerialization. The stocks chosen are representative sample of all the stock that has been dematerialized.

- Rolling settlement stocks (sample size =10)

We found out the variance associated with each rolling settlement stock during the total period, the variance during the period it was not under the rolling settlement and then the variance during the period after the rolling settlement.

- BSE Sensex (overall market movement)

The variance of Sensex was also calculated over the total period and over the period it reached its maximum from the initial minimum value.

Exhibit 4

Rate of Industrial Production in India 1995-2000

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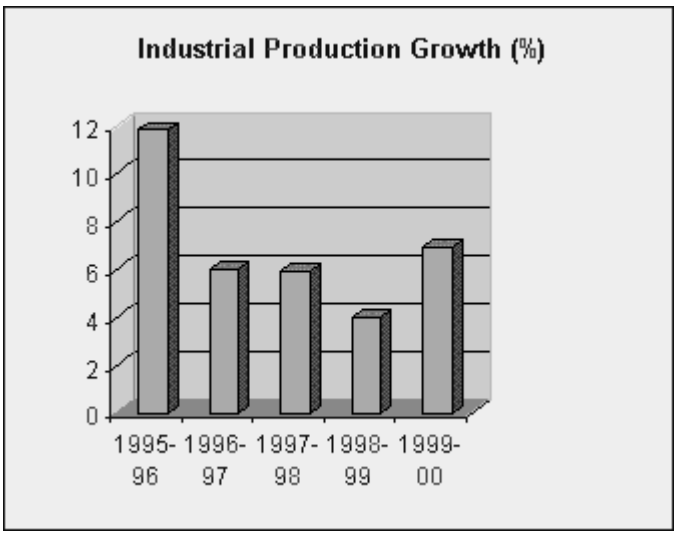
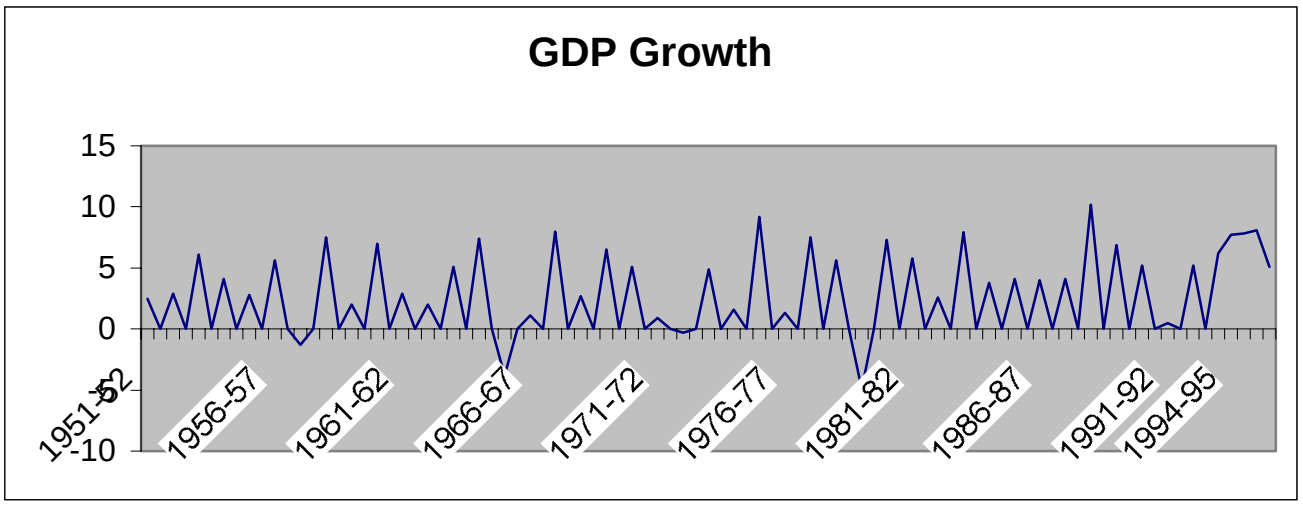


The IP growth has not shown much increase in the recent years substantiating such high increase in stock prices.

Source: www.economywatch.com

Exhibit 5

The GDP growth since Independence (1951-1999) which shows that it has not grown substantially in last few years as compared to the stock prices as seen in exhibit 3.



Source: www.economywatch.com

Exhibit 6

Savings Rate for the period 1951-1999

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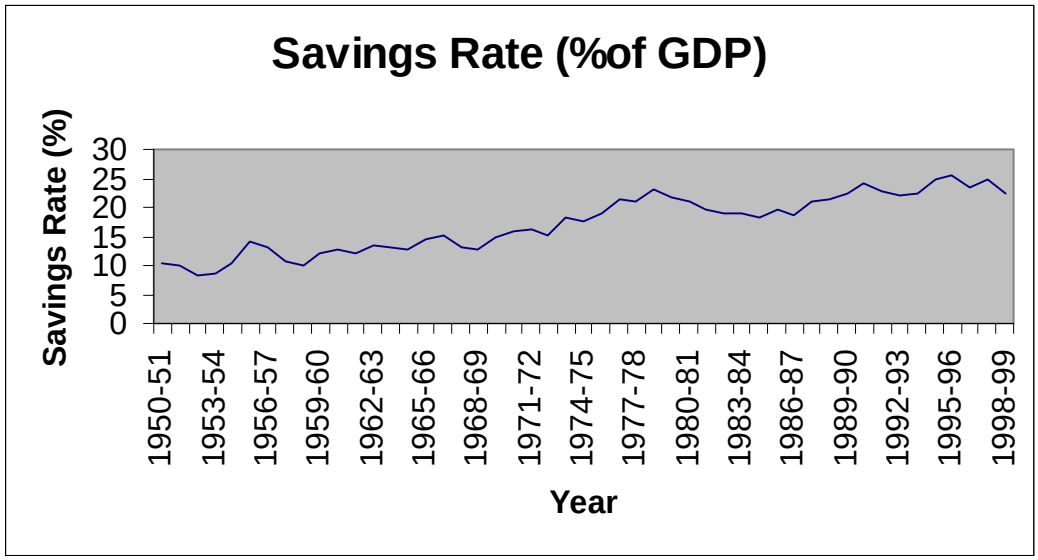
The savings rate has not gone up substantially in the last few years and has been more or less flattened since 1995-96



Source: www.economywatch.com

Exhibit 7

Exhibit 8
Infotech Stocks

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Company name	Total Volatilit	Date to Max* Volatilit	Max to Now** Volatilit	Holding*** Period Returns	Returns /Risk
Aftek Infosys	6.047611947	5.814299178	6.676088384	9349.88%	1529.51%
Infosys	4.094881276	3.670689521	5.798131214	1326.18%	299.44%
Global Telesystems	5.299637627	4.752826827	7.38518688	1809.59%	322.59%
HCL Infosystem	4.644813215	4.322880181	5.734819089	168.14%	14.67%
HFCL	5.357735437	4.785486413	7.588025535	5043.10%	922.61%
Satyam	4.691511584	4.118144884	6.795449938	1145.52%	222.85%
Pentamedia Graphics	4.895078826	4.363440221	6.580462933	190.82%	18.55%
Silverline Tech.	5.162321538	4.686057929	6.749275036	698.21%	115.88%
Wipro	4.767730971	3.990677429	6.959096938	590.50%	102.88%
DSQ Software	5.530700701	5.032709845	7.545498412	360.38%	47.08%
BFL Software	4.798134642	4.142083935	6.683758073	109.81%	2.04%
Aptech	4.382654709	3.980112521	5.653763158	334.48%	53.50%
Hughes Software	5.949493248	4.715706266	6.090180416	208.68%	18.27%
BSE Sensex	2.066241221	1.814847207	2.851880559	169.86%	33.81%

Note : *--- 21/10/1998 to respective date for its maximum value
**** --- respective date for its maximum value to 09/06/2000**
*****--- 21/10/1998 to 09/06/2000**

Source: Prowess, CMIE (Centre for Monitoring Indian Economy)

We have found out the volatility of individual stocks (Infotech) during the downtrend and the uptrend of the individual stocks and can easily conclude from the data

- The stocks have shown a low degree of volatility when the stock is moving up as compared to the volatility shown by the stocks during the downtrend in the stocks.
- Volatility is higher when the market is on a downtrend so the investor should look into a short-term investment rather than a long-term investment in the infostocks.
- During this period BSE Sensex has also shown a similar pattern as shown by the major IT stocks and the sentiments is same across markets.
- The holding period returns also suggest that higher the risk doesn't necessarily mean that the returns will be higher as can be seen from the returns generated by Aftek Infosys. From the volatility we can not conclude that which stock to buy and what not to buy but we have to find out the ratio of returns to the risk associated with it.
- Investors who will time their entry and exit properly will be able to achieve returns commensurate with risk they are taking.

Exhibit 9 Ranking of Infotech (overall) stocks

Company	VOLATILITY	RANK
Aftek Infosys	6.047611947	1
Hughes Software	5.949493248	2
DSQ Software	5.530700701	3
Maars Software	5.478933122	4
Himachal Futuristics	5.357735437	5
Global Telesystems	5.299637627	6
Silverline Tech.	5.162321538	7
Pentamedia Graphics	4.895078826	8
BFL Software	4.798134642	9
Wipro	4.767730971	10
Satyam Computers	4.691511584	11
HCL Infosystem	4.644813215	12
Visual Soft	4.640683546	13

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Aptech	4.382654709	14
Tata Infotech	4.221661045	15
Infosys Tech.	4.094881276	16

Source: Prowess, CMIE (Centre for Monitoring Indian Economy)
Exhibit 9: It gives the ranking of all the Infotech stocks (based on our sample) based on the variance associated with it during the period 21/10/98 to 09/06/2000.

Exhibit 10
Ranking of Infotech stocks

Company	VOLATILITY	RANK
Aftek Infosys	6.047611947	1
Hughes Software	5.949493248	2
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Global Telesystems	5.299637627	5
Silverline Tech.	5.162321538	6
Pentamedia graphics	4.895078826	7
BFL Software	4.798134642	8
Wipro	4.767730971	9
Satyam Computers	4.691511584	10
HCL Infosystem	4.644813215	11
Aptech	4.382654709	12
Infosys Tech.	4.094881276	13

Source: Prowess, CMIE (Centre for Monitoring Indian Economy)
Exhibit 10: It gives the ranking of the Infotech stocks (excluding demat and rolling settlement stocks) based on the variance associated with it during the period 21/10/98 to 09/06/2000.

Exhibit 11
Demat stocks

Company	Total Volatilit	Before demat* Volatilit	After demat** Volatilit	Holding*** Period Returns	Returns /Risk
Siemens	3.929573879	3.676337993	4.105007476	169.75%	17.75%
Nicholas Piramal	3.11522051	2.71826671	3.370456702	154.32%	17.44%
Hero Honda	2.990217783	2.458738691	3.312420014	163.88%	21.36%
HPCL	4.003819756	3.648205508	4.244729743	79.06%	-5.23%
Jindal Vijaynagar	5.841386663	5.271313015	6.218581786	148.33%	8.27%
Raymond	4.269737575	4.441282205	4.144842792	132.46%	7.60%
Finolex cables	3.634842815	3.911752994	3.414956817	331.57%	63.71%
Cummins India	3.220621459	3.078210271	3.316511348	141.59%	12.91%
Videocon Intl	4.527725623	4.845450096	4.275550268	118.77%	4.14%
Asian Paints	2.491905464	2.198608217	2.683072392	149.96%	20.05%

Note : *--- 21/10/1998 to 30/06/1999
**** --- 01/07/1999- 09/06/2000**
*****--- 21/10/1998 to 09/06/2000**

Source: Prowess, CMIE (Centre for Monitoring Indian Economy)

We have looked into the effects of the dematerialization of shares in the stock's volatility. There is a distinct trend of increase in volatility after the dematerialization of shares. This may be due to a large number of investors investing in the stocks resulting in an increased trading volume that caused the volatility to increase.

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- Increasing volatility has not resulted in increasing returns.
- The old economy stocks are not showing very high returns.
- These stocks are defensive stocks because they give medium returns on low risk as compared to the Infotech stocks.

Exhibit 12

Demat stocks ranked by Volatility

Company	VOLATILITY	RANK
Jindal Vidyasagar	5.841386663	1
Videocon int'l.	4.527725623	2
Raymond	4.269737575	3
HPCL	4.003819756	4
Siemens	3.929573879	5
Finolex cables	3.634842815	6
Cummins India	3.220621459	7
Nicholas Piramal	3.11522051	8
Hero Honda	2.990217783	9
Asian Paints	2.491905464	10

Source: Prowess, CMIE (Centre for Monitoring Indian Economy)

Exhibit 12: It gives the ranking of the rolling settlement stocks based on the variance associated with it during the period 21/10/98 to 09/06/2000.

Exhibit 13
Rolling Settlement Stocks

Company	Total Volatilit	Before* Settlement Volatilit	After** Settlement Volatilit	Holding*** Period Returns	Returns /Risk
BFL software	4.798134642	3.96136711	6.663405799	109.81%	2.04%
Citicorp securities	6.232587283	5.909901418	6.711036025	1019.00%	147.45%
Cybertech	5.360082772	4.913990902	6.340853371	214.13%	21.29%
Hitech Drilling	4.028730071	3.703422926	4.863327244	41.30%	-14.57%
Lupin labs	4.577487778	4.079503545	5.66552118	177.66%	16.96%
Maars Software	5.478933122	4.884965211	6.812173131	177.02%	14.06%
Morepen labs	3.626399297	3.242788575	4.490149603	369.83%	74.41%
Sri Adhikari Bros	5.550950397	5.301469601	5.979046871	1110.14%	181.98%
Tata Infotech	4.221661045	3.852953962	5.083237455	32.31%	-16.03%
Visual soft	4.640683546	4.423960722	5.122362662	1855.06%	378.19%

Note: *--- 21/10/1998 to 09/01/2000
** ---10/01/2000- 09/06/2000
***--- 21/10/1998 to 09/06/2000
Source: Prowess, CMIE (Centre for Monitoring Indian Economy)
We have looked into the effects of the rolling settlement in the stock's volatility. There is a distinct trend of increase in volatility after the dematerialization of shares. This may be due to a large number of investors investing in the stocks resulting in an increased trading volume that caused the volatility to increase.

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Findings
- volatility has increased in the period after the rolling settlement
- The returns of Infotech stocks and that of entertainment stocks are high as compared to the other stocks.
- The stocks with high risk are giving the highest returns. But the ratio of returns and risk gives the value to be highest for visual soft, which is not the most volatile.

Exhibit 14
Rolling settlement stocks Ranked by Volatility

Company	Volatilit	Ran
Citicorp Securities	6.232587283	1
Sri Adhikary Bros.	5.550950397	2
Maars Software	5.478933122	3
Cybertech	5.360082772	4
BFL Software	4.798134642	5
Visual Soft	4.640683546	6
Lupin labs.	4.577487778	7
Tata Infotech	4.221661045	8
Hitech Drilling	4.028730071	9
Morepen labs.	3.626399297	10

Source: Prowess, CMIE (Centre for Monitoring Indian Economy)
Exhibit 14: It gives the ranking of the demat stocks based on the variance associated with it during the period 21/10/98 to 09/06/2000.

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