

CRISIL YOUNG THOUGHT LEADER SERIES

**CAUSES OF VERY HIGH PRICE VOLATILITY IN CAPITAL MARKET GLOBALLY,
INCLUDING INDIA. HOW CAN THIS MARKET RISK BE MANAGED BETTER?**

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EXECUTIVE SUMMARY

Market risk has long been the cause for concern for fund-managers worldwide. The purport of the following paper is to examine this risk. Globally the volatility across different markets is varied with the NASDAQ predictably ruling the roost with the highest volatility. Though comparison across markets gives a picture of relative volatility, the question as to whether there actually is excess volatility in the system cannot be unambiguously answered. While a comparison of expected volatility assuming random walk of stock prices and actual volatility seems to indicate no excess volatility in most markets, the everyday value-at-risk figures are mind-boggling especially for a country like India where the everyday value-at-risk is around 11% of the fiscal deficit.

Looking specifically at the Indian scene, the impact of the recent structural changes in the stock markets on volatility has been analysed. Though the introduction of the rolling settlement and introduction of futures have been widely perceived to be positive steps, they have been accompanied by certain caveats like inadequate day-trading regulations, lack of delivery-based settlement and inadequate stock-lending mechanisms. While removing these barriers is of considerable importance, additional measures like introducing futures in the mid-cap segment and allowing Mutual Funds to invest in markets outside India would help greatly in reducing market risk which in the case of India is substantially of a political nature.

INTRODUCTION

Academic research has over the past decade devoted considerable effort towards proving that it is not possible to consistently beat the market. Though a Warren Buffet may smirk at the above proposal, the number of index-based funds that have sprouted over the years is ample evidence of the reluctant acceptance of fund managers too of the supremacy of the market. However, the market risk, which cannot be diversified away, is a cause for concern.

VOLATILITY TRENDS IN THE GLOBAL MARKETS IN THE LAST FIVE YEARS

The volatility trends in seven prominent markets across the world are given in Table 1. The measure for volatility is the coefficient of variation.

Table 1: Coefficient of Variation across Stock Exchanges in the World

YEAR		S&P/TSX Toronto	FTSE London	Nikkei Tokyo	Hangseng Hongkong	DAX Frankfurt	Sensex Mumbai	NASDAQ New York
1997	Mean	6458.19	4694.81	18292.83	13294.70	3743.49	3821.98	1470.42
	Stddev	361.32	309.33	1555.55	1851.28	396.16	283.86	148.08
	C. of var.	0.056	0.066	0.085	0.14	0.11	0.074	0.10
1998	Mean	6757.29	5667.10	15276.09	9517.09	5057.18	3336.45	1812.22
	Stddev	709.08	278.70	1211.95	1323.81	473.61	401.71	166.19
	C. of var.	0.105	0.049	0.079	0.14	0.094	0.12	0.092
% Ch. over prev.		87.56	-25.36	-6.70	-0.11	-11.50	62.11	-8.94
1999	Mean	7058.78	6312.88	16948.73	12859.93	5391.62	4134.36	2787.56
	Stddev	502.88	260.48	1414.87	2019.61	542.25	572.12	466.19
	C. of var.	0.071	0.041	0.083	0.16	0.10	0.14	0.17
% Ch. over prev.		-32.11	-16.10	5.22	12.90	7.39	14.93	82.37
2000	Mean	9607.74	6349.43	16908.18	15855.66	7050.25	4625.88	3710.14
	Stddev	766.83	140.43	2097.00	1023.27	390.18	574.42	651.59
	C. of var.	0.080	0.022	0.12	0.065	0.055	0.12	0.18
% Ch. over prev.		12.03	-46.40	48.57	-58.91	-44.97	-10.27	5.01
2001	Mean	7731.72	5541.07	11966.61	12434.73	5611.34	3445.28	2005.28
	Stddev	620.27	397.35	1415.04	1725.22	725.58	429.00	301.77
	C. of var.	0.080	0.072	0.12	0.14	0.13	0.12	0.15
% Ch. over prev.		0.51	224.24	-4.66	114.98	133.64	0.28	-14.31

Table 2: Average Volatility across markets

	S&P/TSX	FTSE	Nikkei	Hangseng	DAX	Sensex	NASDAQ
Average Volatility	0.0784	0.05	0.0974	0.129	0.0978	0.1148	0.1384

Based on the last five years' data we can conclude that

- The London Stock Exchange has been the least volatile and the NASDAQ has been the most volatile.
- The fact that the German DAX has been almost twice as volatile as the FTSE while the Canadian TSX has been only half as volatile as the NASDAQ suggests that volatility is relatively independent of geographical location.
- There seems to be no discernable trend emerging about the change in volatility across markets over the last five years.
- The Indian markets are slightly more volatile than the global average though there has been a slight reduction in volatility over the last couple of years.

ARE THE MARKETS MORE VOLATILE THAN EXPECTED?

If stock prices are assumed to follow a 'random walk' as defined by a Geometric Brownian motion viz. $ds/S = \mu dt + \sigma dz$ where dz is assumed to follow a Wiener process, then the stock returns are normally distributed with mean μ and standard deviation of $\sigma\sqrt{dt}$ (because $dz = \epsilon\sqrt{dt}$ where ϵ is a random variable taken from a standard normal distribution.)

From the above, we can compute the theoretical volatility across longer time periods to be proportional to the square root of the volatility in one year and compare with the actual values. If the actual values are higher than the theoretical value, we can conclude that markets are more volatile than expected. The following table gives an indication of the difference between the theoretical and actual volatilities across markets. The base year has been taken as 1997 for the purposes of estimating theoretical volatilities. *The cells that have been shaded indicate excess volatility.*

Table 3: Volatilities theoretical and actual across markets

	S&P/TSX	FTSE	Nikkei	Hangseng	DAX	Sensex	NASDAQ
1 Year mean	7731.72	5541.06	11966.61	12434.73	5611.33	3445.28	2005.28
1 yr. Stddev	620.27	397.35	1415.04	1725.22	725.58	429	301.77
C. of Var.	0.080	0.071	0.118	0.138	0.129	0.124	0.150
2 Year mean	8669.73	5945.24	14437.39	14145.19	6330.79	4035.58	2857.71
2 yr. SD (act)	1168.86	502.16	3050.35	2222.03	925.72	778.11	992.19
2 year SD (Theo.)	877.19	561.93	2001.17	2439.83	1026.12	606.70	426.76
% difference	33.25	-10.64	52.43	-8.92	-9.78	28.25	132.49
C. of Var.	0.134	0.084	0.211	0.157	0.146	0.192	0.347
3 Year mean	8132.74	6067.78	15274.50	13716.77	6017.73	4068.50	2834.32
3 yr. SD(act)	1253.72	469.85	2876.09	2240.16	930.23	717.57	854.30
3 year SD (Theo.)	1074.34	688.23	2450.92	2988.17	1256.74	743.05	522.68
% difference	16.69	-31.73	17.34	-25.03	-25.98	-3.42	63.44
C. of Var.	0.154	0.077	0.188	0.163	0.154	0.176	0.301
4 Year mean	7788.88	5967.61	15274.90	12666.85	5777.59	3885.49	2578.80
4 yr. SD (act)	1288.13	463.78	2563.42	2740.22	937.05	725.95	866.12
4 year SD (Theo.)	1240.54	794.70	2830.08	3450.44	1451.16	858.00	603.54
% difference	3.83	-41.64	-9.42	-20.58	-35.42	-15.39	43.50
C. of Var.	0.165	0.077	0.167	0.216	0.162	0.186	0.335
5 Year mean	7522.74	5713.05	15878.48	12792.42	5370.77	3872.79	2357.12
5 yr. SD (act)	1279.40	671.13	2682.93	2599.15	1181.46	662.09	895.03
5 year SD (Theo.)	1386.97	888.50	3164.13	3857.71	1622.45	959.27	674.77
% difference	-7.75	-24.46	-15.20	-32.62	-27.18	-30.97	32.64
C. of Var.	0.170	0.117	0.168	0.203	0.219	0.171	0.379

We see from the above table that the NASDAQ has consistently shown excess volatility followed by the Canadian TSX. All the other markets, including India does not seem to have any volatility in excess of that predicted by the Random Walk Model. *So is the talk about excess volatility mere hype?*

EVERYDAY VALUE AT RISK ACROSS MARKETS

Another measure of the volatility is the everyday Value at Risk due to the volatility in capital markets. The following table gives an indication of the actual value at risk everyday in stock markets worldwide.

Table 4: Daily Value at Risk at 99% confidence level across markets

Value at Risk at 99% Confidence			
Market	Mcap (\$ million)	Daily Volatility (%)	Value at Risk (\$ million)
Japan	4546937	0.78	82636.0
USA	16635114	0.11	42635.8
Germany	1432190	0.35	11679.5
UK	2933280	0.14	9568.4
Canada	800914	0.5	9330.6
Hongkong	609090	0.4	5676.7
India	148064	0.78	2690.9

While the figure is a whopping \$82 billion in the United States, the figure for India is \$2.7 billion or Rs.13000 crore. Compare this daily figure with India's budgeted fiscal deficit for the year 2001-02 viz. Rs.116314 Crore. *Can we afford this much of price volatility even if it is less than expected? Do we have the requisite risk management tools to combat this volatility?*

RECENT STRUCTURAL DEVELOPMENTS IN THE INDIAN STOCK MARKET

The two most recent developments as part of the stock market reforms have been

- a) Introduction of futures in June 2000
- b) Introduction of Rolling Settlement in July 2001

The impact of the above two developments on the volatility of the Indian Markets have been tested as follows:

IMPACT OF INTRODUCTION OF FUTURES IN INDIA

Two years data of the standard deviation of the monthly returns of the NSE fifty before futures were introduced has been compared with the two years data of the standard deviation of the monthly NSE fifty returns after futures were introduced. The following table is the Anova output of the analysis.

Table 5: Excel ANOVA Output at 95% confidence

SUMMARY						
Groups	Count	Sum	Average	Variance		
Before Futures	24	96391.09	4016.295417	764341.0078		
After Futures	24	86474.072	3603.086333	281485.7852		
ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	2048900.959	1	2048900.959	3.918241476	0.053767429	4.051742053
Within Groups	24054016.24	46	522913.3965			
Total	26102917.2	47				

We can see from the above table that at 95% confidence there has not been a significant change in volatility in the Indian markets after the introduction of futures. The F value of 3.92 is below the F_{cr} of 4.052.

IMPACT OF INTRODUCTION OF ROLLING SETTLEMENT OF STOCKS IN INDIA

One year data of the standard deviation of the monthly returns of the NSE fifty before the introduction of rolling settlement has been compared with one year data of the standard deviation of the monthly NSE fifty returns after rolling settlement was introduced. The following table is the Anova output of the analysis.

Table 6: Excel ANOVA Output at 95% confidence

SUMMARY						
Groups	Count	Sum	Average	Variance		
Before Rolling Sett.	13	51201.302	3938.5617	220979.96		
After Rolling Sett.	13	41491.26	3191.6354	54722.742		
ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	3626342.9	1	3626342.9	26.306183	2.999E-05	4.2596753
Within Groups	3308432.5	24	137851.35			
Total	6934775.4	25				

We can see from the above table that at 95% confidence there has been a significant change in volatility in the Indian markets after the introduction of rolling settlement. The F value of 26.31 is well above the F_{cr} of 4.259. The extremely low p value of 2.99E-05 suggests that the introduction of rolling settlement has to a great extent reduced volatility in the Indian stock markets.

HOW CAN MARKET RISK BE MANAGED BETTER IN INDIA?

In an effective market a hedger must be able to eliminate to a great extent the effects of volatility and transfer it to the speculator. The remaining part of this paper is to focus on the barriers to risk-reduction in the Indian markets and suggestions to combat them.

Cash based Settlement of Derivatives – Advantage Speculators

Though futures have been introduced in India, it is debatable as to whether they can effectively provide respite to the hedger or aid in price discovery, given that settlement is cash-based. While this is a speculator's delight, for the hedger it just means paying more in transaction costs and impact costs. Consider the evidence. A hedger who holds a certain stock and wants to guard against a steep down-movement buys a put option. At expiry if the price is well below the strike price of the option the hedger is expected to offset the losses he makes out of the reduction in stock prices by exercising the option. However in a cash-based settlement system, the hedger realizes only the cash differential in the derivatives market and has to sell his stock in the cash market to replicate the position of one put and a stock. This introduces two costs, which the hedger unnecessarily has to incur

1. The transaction costs (brokerage) of dealing in the cash market, which incidentally are higher than in the derivatives market.

2. The impact cost of the stock price moving undesirably in the time between expiry of the option and his taking a position in the cash market.

Thus the hedger apart from the explicit premium paid for the hedge has also to incur implicit avoidable costs while the speculator's objective of making profits with minimal transaction costs is satisfied. This is a blatant case of allocational mismatch of risks and could be a cause for increased volatility in the Indian markets due to the upper hand enjoyed by speculators.

Increased volatility at the expense of mid-cap and small-cap stocks

Due to leverage advantages offered by the derivatives segment, money is increasingly moving from the cash market to the derivatives market. But because derivatives are currently available for only thirty large cap stocks, small and medium cap company stocks are increasingly become illiquid. The following table gives an indication of the extent of reduction in volatility in the medium capitalization stocks after the introduction of futures.

Table 7: Comparison of volatilities between mid-cap and large-cap companies before and after introduction of futures

		CNX Midcap	S&P Nifty
One Year before Futures	Average	1006.95	1449.19
	SD	169.88	117.83
	Coeff. Of Var.	0.169	0.081
One Year after Futures	Average	793.55	1267.74
	SD	91.16	102.73
	Coeff. Of Var.	0.115	0.081
	% Change	-31.91	-0.33

There has been a 32% reduction in volatility of mid-cap stocks while the volatility of the NSE-50 itself has reduced by less than 0.5%. This is testimony to the reduced interest in the mid-cap stocks due to movement of funds into the derivatives segment of the thirty large capitalization stocks on which derivatives trading is allowed.

Rolling Settlement and increase in day trading

Though the introduction of rolling settlement was a move in the right direction, it has led to a surge in day trading. Almost 80% of traded value can be attributed to day trading. A trader with as little as Rs.10000 can generate volumes as high as Rs. 2-3 lakhs by leveraging and carrying out four to five trades a day. Thus a high amount of volatility can be attributed to the relatively unregulated environment in which day traders operate. The naked short selling which day traders can engage in can also accelerate any adverse movement in a stock.

India could take a leaf out of the US markets' book where day trading is adequately regulated and initial margins in stocks are as high as 50%. Moreover there are also definite regulations with respect to short selling of shares. A great amount of volatility in the Indian markets can be eliminated through effective regulation and increasing the daily delivered quantity to traded quantity ratio.

Barriers to the arbitrage mechanism

Theoretical arbitrage opportunities cannot be easily exploited in India. For example if the futures price of a certain share is below the current stock price, the arbitrage mechanism dictates that arbitrageurs sell the share short and buy the future. But in the absence of a deep stock lending market it is not possible to sell shares short. In the absence of an efficient price discovery mechanism which arbitrage facilitates, artificial elements can introduce more than expected volatility. Thus stock-lending institutions must be encouraged for arbitrage opportunities to be exploited.

Diversification across markets to eliminate political risk

While it is acknowledged that market risk, which cannot be diversified away, has to be borne, even this risk can be reduced by taking positions in different markets. If Mutual Funds in India are allowed to take positions in foreign markets a very effective means of

diversifying part of the risk in the Indian markets due to perennial political uncertainty could be found.

Table 8: Correlation Matrix across stock markets based on 1995-2001 figures

	Hangseng	Nikkei	TSE Canada	DAX Germ.	Sensex	FTSE	NASDAQ
Hangseng	1	0.488	0.670	0.498	0.751	0.351	0.652
Nikkei	0.488	1	0.015	-0.049	0.628	0.040	0.277
TSE Canada	0.670	0.015	1	0.867	0.570	0.653	0.798
DAX Germ.	0.498	-0.049	0.867	1	0.522	0.841	0.860
Sensex	0.751	0.628	0.570	0.522	1	0.473	0.736
FTSE	0.351	0.040	0.653	0.841	0.473	1	0.807
NASDAQ	0.652	0.277	0.798	0.860	0.736	0.807	1

Using the above correlation matrix the combined value at risk on any day for the seven markets is \$122855.95 million. Compare this with the sum of the individual VARs of the seven markets viz. \$164217.9 million – a difference of \$ 41361.95 million, which is a reduction of around 25.2% from the sum of the individual VARs. Thus the benefits of investing across markets for mutual funds cannot be overemphasized. The only deterrent is that in times of crises, the correlation between markets tends towards one thus eliminating the advantages of diversification.

CONCLUSION

Thus the following are some of the ways of reducing the market risk in Indian markets

- 1) Introduce delivery-based settlement system for derivatives.
- 2) Allow derivatives trading in the mid-cap segment also.
- 3) Regulate day trading environment.
- 4) Promote stock lending.
- 5) Allow diversification across markets.

REFERENCES

None – data obtained from the websites of the various stock exchanges.