Low Risk Anomaly:
A New Enemy of Market Efficiency

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Finance theory suggests that higher return comes with higher risk. This paper examines low risk anomaly in Indian stock markets by using the constituent stocks of S&P CNX 500 index of NSE for a 11-year period starting from 2001 to 2011. Monthly rolling iterations are used to form low and high volatility portfolios. The findings of the study endorse the presence of low risk anomaly in Indian stock markets as low volatility portfolio outperforms market portfolio as well as its high volatility counterpart on risk-adjusted basis. The results are consistent with those of Clarke et al. (2006a and 2006b) and others for developed markets.

Introduction

According to the Markowitz 'modern portfolio theory' (Markowitz, 1952) and Capital Asset Pricing Model (CAPM), there is a direct relationship between risk and expected return. Higher required return comes with higher risk. In an efficient market, investors realize above-average returns only by taking above-average risks. Thus, investors who seek higher return need to take higher risk. It is believed that the so-called market portfolio is one of the efficient portfolios lying on the efficient frontier of risky portfolios offering highest possible return at a given level of risk. In fact, each portfolio on this efficient frontier offers different risk-return combinations, but the same utility, and therefore, the investor who wants higher return can choose a portfolio with higher risk and higher return combination, whereas a risk-averse investor may choose a low risk-low return portfolio on the efficient frontier.

It is believed that market portfolio gives highest excess return at a given level of risk as measured by Sharpe ratio[1]. However, recently found low volatility and minimum variance investment strategies show that portfolios with low volatility generate higher risk-adjusted returns. Now, the next question which immediately comes to mind is: Is it possible to have portfolios which give returns greater than high volatility portfolio and market portfolio with lesser risk? Is it possible to have a portfolio, as shown in Figure 1, which lies above the Capital

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[1]   Sharpe Ratio = (Portfolio Return – Risk-Free Return)/Portfolio Standard Deviation

Allocation Line?[2] This is the basic premise behind 'exploring low risk anomaly in stock markets'.

Figure 1: Is Portfolio with Greater Returns and Lesser Risk
than the Market Portfolio Possible?
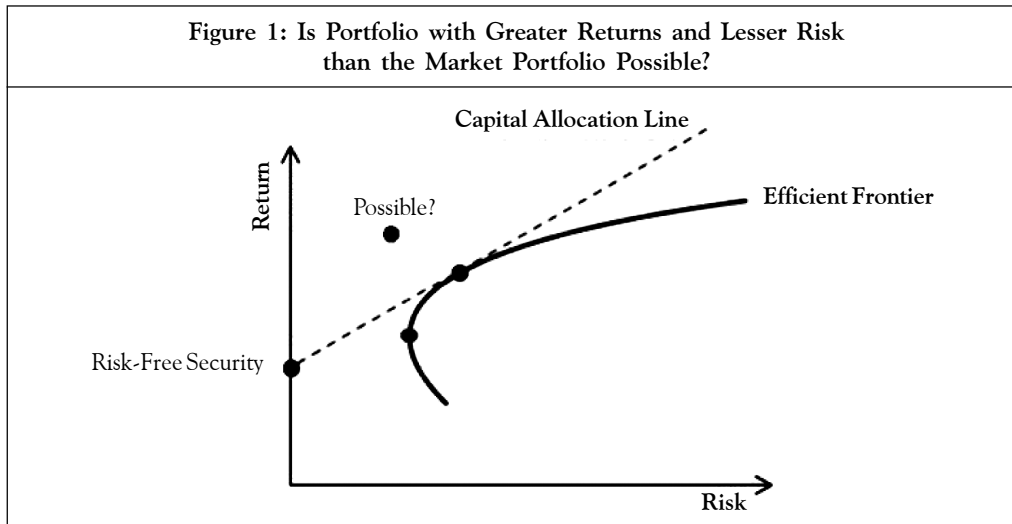
Many simple investment strategies are found to have delivered abnormal returns on a consistent basis, which should not be the case as per efficient market hypothesis. Many of these anomalies are still searching for proper explanations. One such strategy is the Low Volatility (LV) investment strategy. There are two ways to test and exploit risk anomaly: (a) LV portfolio; and (b) Minimum Variance (MV) portfolio. Many studies in developed market report superior returns associated with LV portfolios over the market portfolio as well as the portfolios with higher risk, with the risk being measured either by standard deviation of returns or by beta of the stock returns.

Here is a brief explanation of the LV and MV investment strategies:

a. Low Volatility Investing: This strategy sorts all the stocks by their volatility and/or beta and then takes a subset of these stocks, comprising those with the lowest beta and/or volatility.

b. Minimum Variance Investing: It relies on observations and/or estimates of correlations of individual stocks. Individual stocks have higher risk, but a well-diversified portfolio when optimized for minimum risk is identified as the MV portfolio.

These investment strategies have been noteworthy in the sense that they have been able to increase absolute results as well as risk-adjusted results over time. Both MV and LV portfolios reduce volatility and are least hit during the drawdowns[3], i.e., during the bearish periods when high beta/high volatility stocks plummet.

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[2] Capital Allocation Line is obtained by plotting all possible combinations of risky and risk-free assets. The graph displays the return that the investors can make by taking on a certain level of risk.

[3] Drawdown is defined as peak to trough decline during a specific period in the stock price.

In this paper, LV strategy is used to explore the risk anomaly in Indian equity markets. The risk is measured using volatility of the stock prices, which is calculated using the standard deviation of the monthly returns.

The remaining paper is organized as follows: it discusses the earlier research done on low-risk anomaly in developed markets, followed by a discussion of the methodology used in the study and the corresponding results. Subsequently, it describes the practical issues involved in implementing this strategy for actual investments, and finally, the conclusion is offered.

Literature Review

While risk anomaly might have existed for a long period of time, most of the researches focus on exploring, explaining and if possible exploiting return-based anomalies to generate superior investment strategies.

An early work by Haugen and Backer (1991), for the period 1972-1989, finds that repeatedly investing in a stock portfolio constructed to expose investors to minimum risk measured by variance outperforms the Wilshire 5000 index on risk-adjusted basis. Many studies (Chan *et al.*, 1999; Schwartz, 2000; and Jagannathan and Ma, 2003) report higher risk-adjusted returns for MV portfolio compared to market portfolio.

More recently, Clarke *et al.* (2006a and 2006b), in a study on the characteristics of LV and MV portfolios, report that MV portfolios, based on the 1,000 largest US stocks over the period 1968-2005, show volatility reduction of about 25%, while delivering comparable or even higher average returns than the market portfolio. This means that the MV portfolios possess around 75% of the risk of the market portfolio, with returns comparable to those of the broad market. The study also reports that MV portfolios deliver on an average 6.5% excess return above T-Bills with a volatility of 11.7%, whereas the market index in the same period gives average excess return of 5.6% with a volatility of 15.4%.

Blitz and Vliet (2007) report that portfolios of stocks with the lowest historical volatility are associated with Sharpe ratio improvements that are even greater than those documented by Clarke *et al.* (2006a and 2006b); further, it reports statistically significant positive alpha. In addition, it also reports that LV stocks have superior risk-adjusted returns relative to the FTSE World Development Index and low beta stocks have higher returns than predicted, while the reverse is true for high beta stocks.

Thomas and Shapiro (2009) use monthly returns for Russell 3000 Universe for the period, December 1986-October 2007 to report that low beta stocks outperform high beta stocks. According to this study, the lowest beta stocks do not necessarily produce the highest returns, thus attributing some success to portfolio construction.

Poullaouec (2010) reports that MSCI MV Index outperformed the MSCI World Index by +0.5% per annum over a long period of June 1988 to June 2010. However, a large component of the outperformance was concentrated in the period June 2000-June 2003. Strong underperformance occurred at the height of the tech bubble with superior performance in

the extended downturn that followed. This leads to a possible explanation that LV strategy tends to work better in a bearish market.

According to Scherer (2010), the MV portfolio tends to invest in two identified anomalies—capturing the return inefficiency of low risk and low beta stocks.

• 83% of MV portfolio's excess return compared to the index can be attributed to the Fama-French factors and the two anomalies of low volatility and low beta.

• Anomalies explain a sizeable 73% of the excess performance of the MV portfolio and nearly crowd out the Fama-French factors.

• Investors should decide the degree to which they invest in these two anomalies.

While considerable work has been done in developed markets in the last few years on exploration of low risk anomaly, nothing of the sort, neither its possible explanations nor developing investment strategies to exploit it, is available in the Indian context as of now. In addition, there are varying views presented by various researchers with respect to sustainability of such anomalies and possible explanations and ability to convert such anomalies into superior investment strategies. The current study is a first such work in the Indian context that is targeted to explore, test and, if present, to exploit risk anomaly to create a superior investment strategy based on it, using LV portfolios.

In the US market, low volatility investing for long term has become the latest investment philosophy after the 'value', 'size' and 'momentum' investing philosophies have been fully explored. In fact, the index provider MSCI offers several MV indices as benchmarks for financial institutions. S&P has just announced the launch of S&P 500 LV index[4]. Moreover, both iShare and Russell are planning to launch LV equity traded funds. Many big investment houses and mutual funds have started funds to benefit from this strategy, such as the Deutsche Bank in Europe and Canada, Martingale Asset Management[5], Morgan Stanley, and Analytic Investors LLC[6] for the US and global markets.

Once established, this investment strategy can be used for long-term investments in the Indian market too. Testing this phenomenon in the Indian market and thus exploring a successful long-term investment strategy is the sole motivation of this paper.

Data and Methodology

Sampling

The sample for the study consists of the constituent stocks of S&P CNX 500 index. The S&P CNX 500 index is a first broad-based benchmark of the Indian capital market. It represents about 94.92% of the free-float market capitalization and 91.68% of the total turnover on the NSE as on June 30, 2011. The S&P CNX 500 companies are disaggregated into 71 industry indices, viz., S&P CNX Industry Indices (www.nseindia.com). The reason behind selecting

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4   http://www.standardandpoo$com/indices/sp-500-low-volatility/en/us/?indexId=spusa-500-usdw-lop-us-l—7

5   http://www.mgale.com/strategies/low-volatility/130-30-largecap-core.html

6   https://www.aninvestor.com/lowvol/

S&P CNX 500 constituent stocks as sample is that in addition to being an index representing almost the entire market, it also helps in avoiding issues associated with small and illiquid stocks dominating the results.

Data Collection

Adjusted monthly closing prices[7] of the stocks on NSE for the period January 2001-June 2011 were obtained from the Capitaline database, with the analysis period being January 2004 to June 2011. The period from 2001 to mid-2011 is used for several reasons: beginning of 21st century brought a number of significant changes in the Indian stock market, an important example being the introduction of futures and options trading in major indices. This period also covers both bullish and bearish phases: the bear phase following the major secondary market scam in India in early 2000, the strong 'Bull Run' between 2004 and January 2008, the global financial meltdown of 2008-2009, and then the recovery period which started thereafter. Thus, this period signifies all the recent ups and downs in the Indian equity markets.

Out of the list of total available 500 companies of S&P CNX 500, certain companies were excluded from the final sample due to the following reasons:

- Companies for which 36 months historical data was not available and hence their volatility could not be calculated.

- Companies for which price and volume data for the test period was not available.

- Stocks replaced during the study period and not part of S&P CNX 500 index now.

Portfolio Construction

Monthly stock returns are calculated using adjusted monthly closing price of the companies by using the formula $\ln(P_1/P_0)$ where P_1 is the current month's closing stock price, and P_0 is the previous month's closing stock price. The risk of a stock is represented by its volatility, which is defined as the standard deviation of monthly returns over a period of 36 months. This period of 36 months is called the estimation period of the portfolio. Stocks with more than 36 months data are considered for estimation and are called eligible stocks.

Stocks are selected for the portfolios depending on their riskiness, which is represented by the volatility in the estimation period. The eligible stocks are arranged in descending order of their volatility and then divided into 10 portfolios. Thus, Portfolio 1 (Decile 1) contains highest volatility stocks (HV portfolio comprising most volatile stocks) and Portfolio 10 (Decile 10) contains lowest volatility stocks (LV portfolio comprising least volatile stocks).

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[7] Stock price is adjusted for stock splits, stock dividends (bonus shares as it is termed in India), rights issue, etc. which facilitates calculation of return without any difficulty, i.e., if the current price of a stock is $100, and the company has just gone ex-bonus with bonus of 1:1, it means price before the bonus may be, say, $200. Now if we go by absolute price, then in that case, the last month closing price may be somewhere around $200 and this month closing price is around $100, which means negative returns. However, that may not be true as the stock has gone ex-bonus and therefore the price should be adjusted backwards to half of the price prevailing before the bonus of 1:1 to make it comparable to the present price.

Table 1: Average and Volatility of Monthly Returns Over the Testing Period and Sharpe Ratios of the Portfolios											
	P1 (HV)	P2	P3	P4	P5	P6	P7	P8	P9	P10 (LV)	CNX 500 Index (Market Portfolio)
Average of Monthly Returns (%)	1.00	0.89	1.14	1.25	1.07	1.49	1.43	1.19	1.34	1.72	1.2
Volatility of Monthly Returns (%)	12.6	11.2	10.4	10.1	8.9	8.6	8.3	7.2	6.4	5.1	8.7
Sharpe Ratio	0.03	0.02	0.05	0.06	0.05	0.10	0.09	0.08	0.11	0.21	0.06

For each month, performance of a decile portfolio is measured as the simple average of returns of all the stocks in the portfolio for that month, implying that the portfolios are equal weighted.

Frequency of Transaction

The composition of a portfolio changes every month depending on the selection criterion, i.e., the volatility of the stocks in the previous 36 months. Hence, for the first portfolio of January 2004, the estimation period is the 36-month period starting from January 2001 to December 2003. The price movements in this period are used to calculate the volatility to construct LV portfolio at the end of December 2003 and it is held for next one month. Now for February 2004, the estimation period is February 2001 to January 2004 and the price movements in this period are used to work out the LV portfolio at the end of January 2004 and is held for the next one month. Similarly, the portfolios are formed in the way described above for each month. Returns of the portfolios for each month are then calculated on a rolling basis. Portfolios have been constructed till June 2011 using this iterative process, and in total, there are 90 such iterations used in the analysis[8].

Test of Significance

The study uses standard two-sample *t*-test for testing the difference between returns of LV and HV portfolio and LV and market portfolio, whereas for testing the difference between the variance of LV and HV portfolio and LV and market portfolio, *F*-test for equality of variances is employed.

Results and Discussion

The average of monthly returns for each decile portfolio and the volatility of the monthly returns over 90 months are presented in Table 1. The same is graphically depicted in Figure 2.

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[8] One-iteration corresponds to one month. Monthly portfolios starting from January 2004 to June 2011 are taken into consideration, implying a total of 90 months which correspond to 90 iterations.

Figure 2: Average Monthly Returns of Decile Portfolios and Their Volatility (January 2004 to June 2011) (%)
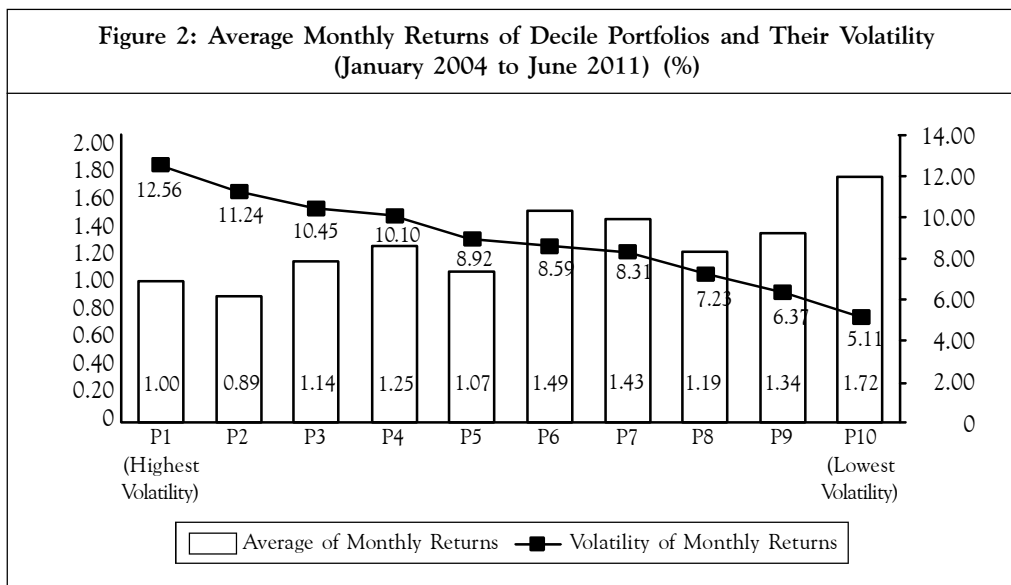
As evident from Figure 2, the LV portfolio has an absolute average monthly return of 1.7%, while the HV portfolio has an absolute average monthly return of 1%. In the same period, CNX 500 index, the broad market index, shows an absolute average monthly return of 1.2%. Comparing P1, P10 and CNX 500 index, it is seen that the risk associated with P10 is the lowest at 5.11% in comparison to 12.6% and 8.7% of P1 and CNX 500 index, respectively. Table 2 reports that even though P10 gives higher absolute returns compared to both HV portfolio and CNX 500 index returns, the *t*-statistics is not significant at even 10% which makes it statistically insignificant. However, as evident from Table 3, the *F*-value indicates

	LV Portfolio (P10)	HV Portfolio (P1)	LV Portfolio (P10)	CNX 500 Index

Table 2: Results of *t*-Test for Difference of Returns Between LV and HV Portfolios and LV and Market Portfolio

	LV Portfolio (P10)	HV Portfolio (P1)	LV Portfolio (P10)	CNX 500 Index
Mean	0.017188859	0.010020728	0.017188859	0.012033497
Variance	0.002614119	0.01577212	0.002614119	0.007540876
Observations	90	90	90	90
Pooled Variance	0.009193119		0.005077498	
Hypothesized Mean Difference	0		0	
df	178		178	
t-Statistic	0.501511345		0.485333797	
$P(T<=t)$ one-tail	0.308315497		0.314018198	
t (Critical) one-tail	1.653459126		1.653459126	
$P(T<=t)$ two-tail	0.616630995		0.628036397	
t (Critical) two-tail	1.973380889		1.973380889	

	LV Portfolio (P10)	CNX 500 Index	LV Portfolio (P10)	HV Portfolio (P1)
Mean	0.017188859	0.012033497	0.017188859	0.010020728
Variance	0.002614119	0.007540876	0.002614119	0.01577212
Observations	90	90	90	90
df	89	89	89	89
F	0.346659823		0.16574303	
$P(F<=f)$ one-tail	5.47263E–07		7.77156E–16	
F (Critical) one-tail	0.7042808		0.7042808	

Table 3: F-test for Difference of Variances Between LV and HV Portfolios and LV and Market Portfolio

that variance of returns of LV portfolio is much lower than both HV portfolio as well as CNX 500 index variances, which implies that LV portfolio enjoys superior Sharpe ratio compared to both HV and index portfolio, which in turn results in superior risk-adjusted returns. In addition, the Sharpe ratio of P10 is highest (0.21) as compared to those of CNX 500 index (0.06) and P1 (0.03).

Let us consider a case of investing $100 each in HV, LV and S&P CNX 500 index portfolios and rebalancing them as per the criteria of the portfolios on the monthly basis. The results are graphically presented in Figure 3.
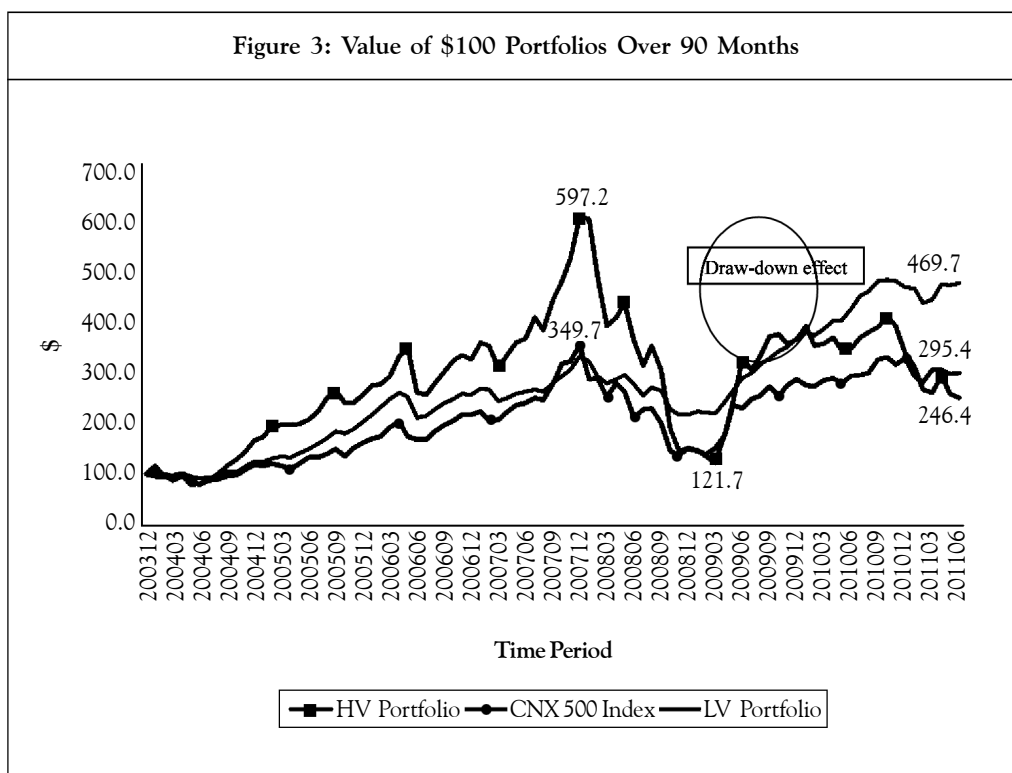

Figure 3: Value of $100 Portfolios Over 90 Months

Figure 3 shows that the HV portfolio reaches a high of $597.2 during the bull run which is almost two-and-a-half times more than the index return and about three times more than the return of LV portfolio. Further, it is observed that it is the HV portfolio returns which fell to $121.7 during the economic recession, while the returns of index and LV portfolio decreased by a much lesser extent. This phenomenon is called the 'drawdown' effect. In this effect, as evident from Figure 3, the HV portfolios are the worst hit when the broad market falls. Thus, the LV portfolios provide a cushion against the adverse effects of the bear market.

Again, it is the HV portfolio which shows the fastest recovery after the economic turmoil. Figure 3 helps us infer the caveat that "high volatility portfolios give higher returns for good markets, while they fall the highest when the markets are bad." Also, over the long term, it is the LV portfolios which give higher returns than the index and HV portfolios. This supports the fact that LV strategy requires patience and that it is a strategy for long term. It may not work in short run. Despite the significant uptrend in the Indian markets for the major part of the study, the LV strategy has delivered superior risk-adjusted returns, and this offers enough evidence that LV can be used as a good long-term strategy in volatile markets to beat both HV portfolios and the broad market index.

Table 4 presents a comparison with regard to the number of months for which LV portfolio gave higher returns than HV portfolio. It can be clearly seen that in spite of the massive 'bull run' that the Indian stock markets saw from January 2004 to December 2007 that took the benchmark index, BSE Sensex from just above 3,000 in January 2004 to 21,000 plus by the end of December 2007, and the NSE's flagship index, S&P CNX NIFTY from close to 1,000 to 6,000 plus, the LV portfolio beats the HV portfolio, giving higher returns in 47 months out of 90 months of the testing period and that too with significant lesser risk. When LV and HV returns are compared to that of CNX 500 index, it is seen that HV portfolio gave higher returns for 48 months, while LV portfolio gave higher returns for 47 months. This is remarkable, because it is generally believed that LV portfolios tend to outperform during the bearish periods, while the results of this study indicate that LV portfolio delivered superior risk-adjusted returns during the entire study period, which in fact was dominated by an unprecedented 'bull run' in Indian stock markets.

Table 4: Comparison of LV, HV and CNX 500 Index Portfolios Based on Superior Return Months		
Comparison of Returns	Months	Total Months
LV Returns > CNX Returns	47	90
LV Returns < CNX Returns	43	
HV Returns > CNX Returns	48	90
HV Returns < CNX Returns	42	
LV Returns > HV Returns	47	90
LV Returns < HV Returns	43	

Implementation Issues

As mentioned earlier, the sole purpose of this research paper is to explore the possibility of using the LV strategy in Indian market for higher absolute returns over long term. A few things which need to be considered and taken care of before actually implementing this strategy are as follows:

Transaction Costs and Management Fees: The calculation of the average monthly returns for the portfolios has not taken the transaction costs into consideration. While the comparison result between the HV and LV portfolios will be the same, the actual returns will be lesser than the ones mentioned. According to Arman (2010), fees for managing fund intends to explore low risk anomaly range from 15 bps (passive) to 70 bps (active), similar to those of other quant-driven strategies.

Monthly Rebalancing: Monthly rebalancing considered for the study is just to explore the low volatility anomaly. In practice, when funds are started on this strategy, the rebalancing period can be longer than one month, besides lower transaction as well as portfolio rebalancing costs and may be higher returns.

Quantitative Approach: The LV approach explored in this paper is purely based on the historical data and hence is quantitative in nature. It does not reflect the future expectations. In practice, after screening the stocks depending on the LV strategy, some level of qualitative analysis can be done so as to maximize returns.

Long-Term Strategy: This is not an effective strategy for short term, but works fine in long term. The success of this strategy depends on the long-term purview of the investor, i.e., the investor needs to have patience to reap the real benefits of this strategy.

Conclusion

The findings of the study are consistent with global markets and it shows an evidence for the presence of low risk anomaly as LV portfolio outperforms both HV portfolio and market portfolio on risk-adjusted basis. While LV portfolio delivers higher absolute returns over both HV and market portfolios, the result is statistically not significant. However, when it comes to variance of returns, LV portfolio has much lower variance than both HV and market portfolios and the result is highly statistically significant. In addition, LV portfolio suffers much smaller drawdown as compared to its HV counterpart. Thus, it can be considered as a very good strategy when the markets do not have any specific direction and the volatility, in general, is very high. In such situations, it ensures minimum erosion of wealth but ensures that the investor does not miss out on the upside returns totally. Finally, this study confirms that the behavior of emerging markets like the Indian stock market is similar to the mature US market and that similar anomalies exist in both the markets. This opens new doors, for the Indian markets, to investment strategies which have been successful in developed markets. ❖

References

1. Arman G (2010), *Low Volatility Equity Portfolios*, October, Rogerscasey.

2. Blitz David C and Vliet Pim Van (2007), "The Volatility Effect", *The Journal of Portfolio Management*, Vol. 34, Fall, pp. 102-113.

3. Chan L, Karceski J and Lakonishok J (1999), "Portfolio Optimisation: Forecasting Covariances and Choosing the Risk Model", *Review of Financial Studies*, Vol. 12, pp. 937-974.

4. Clarke Roger, Harindra De Silva and Steven Thorley (2006a), "Exploring the Risk Anomaly in the Equity Market", *Economics and Portfolio Strategy*, December.

5. Clarke Roger, Harindra De Silva and Steven Thorley (2006b), "Minimum-Variance Portfolio in the US Equity Market", *The Journal of Portfolio Management*, Vol. 33, No. 1 (Fall), pp. 10-24.

6. Haugen R and Baker N (1991), "The Efficient Market Inefficiency of Capitalization-Weighted Stock Portfolios", *The Journal of Portfolio Management*, Vol. 17, No. 3, pp. 35-40.

7. Jagannathan R and Ma T (2003), "Risk Reduction in Large Portfolios: Why Imposing the Wrong Constraints Helps", *The Journal of Finance*, Vol. 58, No. 4, pp. 1651-1684.

8. Markowitz H (1952), "Portfolio Selection", *Journal of Finance*, Vol. 7, No. 1, pp. 77-91.

9. Poullaouec T (2010), *Things to Consider When Investing in Minimum Volatility Strategies*, State Street Global Advisors Asset Allocation Research.

10. Scherer B (2010), "A New Look at Minimum Variance Investing", http://dx.doi.org/10.2139/ssrn.1681306. Retrieved from www.ssrn.com

11. Schwartz T (2000), "How to Beat the S&P 500 with Portfolio Optimization?", Working Paper, DePauls University.

12. Thomas Ric and Shapiro Robert (2009), "Managed Volatility: A New Approach in Equity Investing", The Journal of Investing, Vol. 18, No. 1 (Spring), pp. 15-23.

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