

Risk Anomaly : Empirical Evidence from the Indian Stock Market

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According to Sharpe (1964), there is a linear 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 it is believed that the so-called market portfolio is on the efficient frontier of risky portfolios offering highest possible return at a given level of risk.

It is believed that market portfolio gives highest excess return at given level of risk as measured by the Sharpe ratio.¹ However, recently found low volatility (LV) and minimum variance (MV) investment strategies show that portfolios with low volatility generate higher risk-adjusted returns. Now the next question is: Is it possible to have portfolios which give returns greater than high volatility (HV) portfolio and market portfolio with lesser risk?

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¹ Sharpe ratio = (Portfolio return - Risk free return)/Portfolio standard deviation

The LV investment strategy sorts all stocks by their volatility and/or beta and then takes a subset of these stocks – comprising those with the lowest beta and/or volatility.

These investment strategies have been noteworthy in the sense that they have been able to deliver higher absolute returns as well as risk-adjusted returns over time. LV portfolios reduce volatility and are the least hit during the drawdowns.²

Literature Review

It has long been documented that the relationship between risk and return is much more flat than that provided by CAPM in many studies such as Black (1972) and Haugen and Heins (1975). Haugen and Heins pointed out that the relationship was actually inverted. Extending their analysis through the 1990s, Fama and French (1992) also reported that the relationship was flat or even negative.

There are two important parts of literature review:

- Exploring anomaly
- Explanations since such persistence is difficult to explain using finance theory.

Low volatility investing has been inspired by the early work of Haugen and Baker (1991). For the period 1972 to 1989, the authors found that repeatedly investing in a stock portfolio constructed to expose investors to minimum risk (as measured by variance) would outperform the Wilshire 5000 index providing a higher Sharpe ratio. After this, many studies in the US market (Chan, Karceski, and Lakonishok, 1999); Schawartz, 2000; Jagannathan and Ma, 2003) reported both higher returns and lower realized risks for the minimum variance portfolio (MVP) versus a capitalization weighted benchmark (MWP).

Several studies have explained low risk anomaly and its sustainability.

Clarke, De Silva, and Thorley (2006) focused on the characteristics of low risk portfolios based on the 1,000 largest U.S. stocks over the period of 1968–2005. The portfolios achieved a volatility reduction of about 25 per cent while delivering comparable or even higher average returns than the market portfolio. Choueifaty and Coignard (2008), Scherer, (2011), Poullaouec (2010), Baker, Bradley, and Wurgler (2011), Baker, Bradley, and Taliaferro (2013), Soe, (2012), Carvalho, Xiao, Moulin (2012), and Pettengil, Sundaram, and Mathur (1995) have reported the existence of low risk anomaly.

² Drawdown is defined as peak to trough decline during a specific period in the stock price.

Blitz and Vliet (2007) reported that low volatility stocks have superior risk-adjusted returns relative to the FTSE World Development Index. The study also reports that low beta stocks had higher returns than predicted while the reverse held for high beta stocks. They also provide detailed analysis of the volatility anomaly and demonstrate its robustness across regions and to controls for size, value, and momentum effects. They attribute such sustainable outperformance to restricted borrowing as reported by Black (1972), decentralized investment approach, and behavioural biases such as preference for lotteries. Jason and Karceski (2002) provide behavioural explanation to low risk anomaly. Baker and Haugen (2012) attribute the persistence of low volatility effect in global markets to the preference given to HV stocks by fund managers owing to their compensation structure.

Methodology

The focus of this paper is: exploring and exploiting low risk anomaly for its persistence in the Indian stock market and searching for possible explanations. The study primarily draws its methodology from Clarke, de Silva, and Thorley (2006) and Baker and Haugen (2012).

The data set consists of all the constituent stocks from CNX 200 for which monthly price data for the period from the inception of the index to July 2013 are available. The CNX 200 Index represents about 88.75 per cent of the free float market capitalization of the stocks listed on NSE as on June 28, 2013.

We excluded the following companies from the sample:

- Companies for which data for past 36 months are not available and hence their volatility cannot be calculated.
- Companies with entire or significant non-availability of trading data within the window of the study.

This filtering avoided illiquid stocks or those stocks that stopped trading during the study period and could have contaminated results as they might have exhibited high volatility and poor returns. The objective was to avoid the size effect as mentioned by Merton (1987) and Banz (1981). Adjusted monthly closing prices of the stocks were obtained from the capital market database Capitaline. Data were collected for the period January 2001 to July 2013, while the analysis period starts after 36 months, i.e. from January 2004 to June 2011 for the first iteration. The period is long enough to include both bullish and bearish periods.

Portfolio Formation and Testing

Stock returns are measured monthly on adjusted monthly closing prices by using the formula $\ln(P_1/P_0)$, where P_1 is the current month's closing stock price, and P_0 is previous month's closing stock price.

In this study, risk of a stock or volatility 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. Stocks with at least 36 months data are considered for the estimation and are called eligible stocks.

The methodology consists of creating, at the end of every month, equally-weighted portfolios of 10 per cent (decile) of the eligible stocks based on ranking for the stocks on their past 36 months' volatility. Thus, Portfolio 10 (Decile 10) has the top decile volatile stocks (most volatile stocks) and Portfolio 1 (Decile 1) has the bottom decile volatile stocks (least volatile stocks). The bottom deciles portfolio is known as the Low Volatility (LV) portfolio. The performance of these decile portfolios is measured as the average of returns of all the stocks in the portfolios.

The exercise is repeated every month based on overlapping estimation and holding period (Iteration 1: January 2004-December 2006 estimation period, January 2007 holding period; Iteration 2: February 2004-January 2007 estimation period, February 2007 holding period and so on).

Tests of Significance

- Comparison of risk-to-reward ratio for LV, HV, Index portfolio, and our own index - equally weighted portfolio of all candidate stocks.
- Each pair will be tested for significant difference in the risk-to-reward ratio if it is because of return difference/risk difference or both.
- For return difference, two sample t-test will be used. For variance (Standard deviation) difference, two sample ANOVA will be used.

Figures in Table 1 show that the LV portfolio noticeably outperforms both HV and market portfolios by delivering superior absolute returns with much lower risk. The HV portfolio apparently loses with negative returns and highest standard deviation. The LV portfolio delivers monthly average return of 1.2 per cent with standard deviation of 6.1 per cent and risk reward ratio of 0.19. Corresponding numbers for the equally weighted market portfolio are 0.1 per cent, 9.6 per cent and 0.011 respectively. The HV portfolio has delivered negative returns. While 0.6 per cent per month is not a great return to have from equity investments, it is important to notice that our study period covers the worst period of global financial crisis and hence the positive returns delivered by the LV portfolio is even more important, especially when markets have almost delivered nothing.

Figure 1 shows a very interesting picture. Rs.100 invested in the beginning of our study period in each of the LV, HV, and market portfolios would have ended the 78 months investment period with market value of Rs.217.62, Rs.13.05, and Rs.75.22 respectively. This shows the fallacy of average returns. When we use monthly average returns, market portfolio seems to be giving positive average return of 0.1 per cent but when we see the result of investing Rs.100 in the market portfolio, we see that the investor's wealth actually goes down and loses almost 25 per cent of principal, leave alone getting any positive returns. The HV portfolio leads to clear destruction of wealth with almost 87 per cent of wealth loss. The only portfolio that delivers wealth increase during turbulent times is the LV portfolio where there is a 117 per cent increase in wealth. The difference is highly significant. Besides, the biggest benefit associated with the LV portfolio compared to its HV and market counterparts is that it has the lowest drawdown when the market starts sliding.

Results

Table 1: Average of Monthly Returns, Volatility of Monthly Returns, and Reward to Risk Ratio

	Mean Return	Standard Deviation	Reward/risk Ratio
EWI	0.1%	9.6%	0.011189
LV	1.2%	6.1%	0.19317
HV	-1.5%	14.4%	-0.10284

Figure 1: Performance of EWI, LV, and HV Portfolios

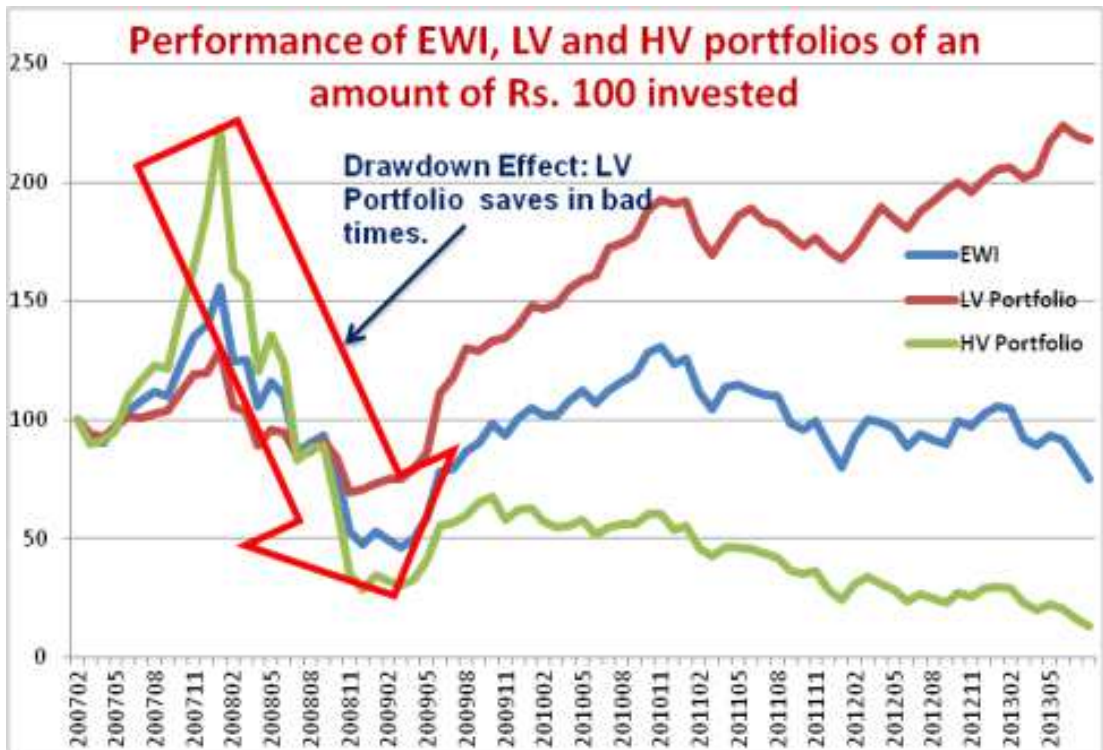


Table 2: Testing Significance of Difference of Returns between LV and Market Portfolio

	EWI	LV
Mean	0.001074	0.011872
Variance	0.009219	0.003777
Observations	78	78
Pooled Variance	0.006498	
Hypothesized Mean Difference	0	
Df	154	
t Stat	-0.83652	
P(T<=t) one-tail	0.202078	
t Critical one-tail	1.654808	
P(T<=t) two-tail	0.404156	
t Critical two-tail	1.975488	

Table 3: Testing Significance of Difference of Variances Portfolio

	EWI	LV
Mean	0.001074	0.011872
Variance	0.009219	0.003777
Observations	78	78
Df	77	77
F	2.440563	
P(F<=f) one-tail	0.000061	
F Critical one-tail	1.458228	

Tables 2 and 3 show that the superior return delivered by the LV portfolio compared to the market portfolio is mainly contributed by the lower risk associated with the former rather than higher returns.

Table 4: Relationship between Sign of Market Returns and Return on Low Volatility Portfolio

EWI	LV	
	Positive	Negative
Positive	37	3
Negative	13	25

Table 4 shows the relationship between the positive and negative returns delivered by the market in a given month and the corresponding return sign for the LV portfolio. It is generally believed that the LV portfolio tends to deliver superior returns during bad times only. The results of Table 4 do not indicate anything like that. Out of total 78 months of the test period, market has delivered positive returns for 40 periods; The LV portfolio has delivered positive returns for 46 periods. It is not that the LV portfolio delivers positive returns even when the market delivers negative returns but the intensity of negative return for the LV portfolio is much less and that delivers the superior risk adjusted returns.

Possible Explanations

Some possible explanations are given below.

Borrowing restriction: Leverage is needed to take full advantage of attractive absolute returns of low-risk stocks. But in practice there are several restrictions on short selling and leverage allowed for investment purposes. Borrowing restrictions have been well documented by Black (1972). This is true both for individual and most institutional investors. Black (1993) suggested that one should look at asset allocation between bonds and low risk equity rather than bond and market portfolio of equity. However, for that one has to recognize low risk equity as a separate asset class.

Limits to Arbitrage: The other explanation for persistence of low risk anomaly is limits to arbitrage as explained by Baker, Bradley, and Wurgler (2011). Most institutional investors work for beating some benchmarks and, in order to do so, they tend to go for high beta stocks. They can achieve the same result by investing in low beta stocks using leverage but

restrictions on borrowing including long only mandate leads to elimination of possibility of exploiting arbitrage opportunity between low beta-high alpha and high beta-low alpha stocks.

Decentralized Investment Approach: In professional investment the practice is that the chief investment officer makes the asset allocation decision and in the second stage capital is allocated to managers who buy securities within the different assets classes. Binsbergen, Brandt, and Koijen (2008) attributed inefficiencies to decentralized investment management approach that causes profit maximizing asset managers looking for outperformance in the up market rather than in the down market.

Behavioural Biases: Investors may behave like classic risk averse investors in asset allocation decision making but, within the asset class, when it comes to security selection, they suddenly change preference and start chasing small and risky growth stocks; may be driven by behavioural biases such preference for lottery as suggested by Kahneman and Tversky (1979) or representativeness. Mitton and Vorkink (2007) have shown that high volatility individual stocks with limited liability are positively skewed. Kumar (2009) shows that individual investors show clear preference for stocks with lottery-like payoff. Boyer, Mitton, and Vorkink (2010) argued that volatility is a proxy for expected skewness.

Representativeness: Hazards of ignoring representativeness bias were explained by Kahneman and Tversky (1983). Owing to this behavioural bias, a layman and quant look at characteristics of “a great investment” from two completely different perspectives.

Overconfidence: Overconfidence leads to a tendency to precisely forecast uncertain outcomes and sticks to that. Miller (1977) reports that market is dominated by optimistic investors as generally pessimistic individuals or even institutional investors are averse to short selling and therefore markets are dominated by optimistic overconfident investors who push the price of highly volatile stocks upwards and make them overvalued leading to lower returns.

Conclusion

The findings of the study are consistent with those found elsewhere. There is evidence for presence of low risk anomaly and low volatility portfolio outperforms both high volatility portfolio and market portfolio on risk adjusted basis. While the LV portfolio delivers higher absolute return over both HV and market portfolios, it is statistically not significant.

However, when it comes to variance of returns, the LV portfolio has much lower variance than both HV and market portfolios and it is highly statistically significant. In addition, the LV portfolio suffers much smaller drawdown compared to the HV counterpart. This can be taken as a very good strategy when the markets do not have any specific direction and volatility in general is very high. In such situations it ensures minimum erosion of wealth but ensures that an investor does not miss out on the upside returns totally. Finally, this study confirms that the behaviour of emerging markets like the Indian stock market is similar to a mature US market and that similar anomalies exist in both markets. This opens new doors for investment strategies which have been successful in developed markets.

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