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AN EMPIRICAL INVESTIGATION INTO UNDERSTANDING WHETHER THE PORTFOLIO PERFORM BETTER IN BUBBLE PERIOD IN INDIAN STOCK MARKET

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ABSTRACT

This paper tries to understand the effect of the steady bubble and bubble bust scenario by constructing optimal portfolio through application of Sharpe's Single Index Model. The study uses data from National stock exchange of India has been taken through a period of March 2008 to March 2012. The end of 2008 saw a rise in price bubble in Indian stock markets. BSE went up by 12000 and NSE gained 300 points in a period of ten days. Post October 2009, the bubble had bust which lead to a dip in the stock indices. Thus two period that is data from March 2005 to 2008 has been taken for the rise in price bubble and the subsequent period of March 2009 to October 2012 has been taken as the post price Bubble bust period. This period also saw a dip in the international economy with the subprime crisis in September 2008. Using NSE as the market index and daily indices from the period mentioned above, the study formulates a cut-off point and selects stocks having excess return of their expected return over the risk free rate of return surpassing this cut-off point. The study uses the average repo rate of 7.25 during the period of the study as the risk free return. Percentage of an investment in each of the selected stock is decided on the weights assigned to each stock depending on the respective beta value. The stock movement variable represent unsystematic risk, return on stocks and risk free return vis-à-vis the cut –off rate of return. Pre bubble and post bubble single index model for the same stocks that entered the optimum portfolio were judged. It was found that the stocks failed to pass the single index criteria during the post bubble period.

KEYWORDS: *Sharpe's Single index model, price bubble, optimal portfolio selection.*

1.1 Introduction

The modern portfolio theory (MPT) traces it origin to the pioneering work of Markowitz (1952), where he identified the optimal rule of allocation of wealth across risky asset using a weighted class in a static setting. Popularly known as the "Portfolio Selection", Markowitz explained in this paper the concept of diversification based on overall risk-reward classification.

The modern portfolio theory is based on a standard process where assets are selected on the basis of risk-reward. They are grouped in such a way that the entire risk is not tilted towards one group of assets. This is known a portfolio creation and portfolio balancing respectively. The portfolios are then managed and revised from time to time.

In managing portfolio, one essential ingredient is assessing the risk of individual asset. The answer to this was provided by capital asset pricing model (CAPM) in a coherent manner. The concept of systematic and unsystematic risk which is associated with the assets help in identifying and minimizing the risk associated with investment. This propagated the idea that without increasing the risk of the portfolio, the investors cannot increase return on the same [Sharpe (1964), Lintner (1965) and Markowitz(1952)].

It was identified that when there is a price bubble, the portfolio outperform the market and hence gives a good result to the investor [Bondit (2002), Ashraf and Noor (2010)].

1.2 Literature review

Markowitz (1952) propounded the MPT. Sharpe (1964) and Lintner (1965) helped in deriving the CAPM assuming expected utility maximization in the face of risk aversion. However, it was later found that multi-indexed model proposed by Markowitz faces problem of difficulty in input data and managing the portfolio (as several quadratic equations have to be solved simultaneously). Thus a Single index model generating mean variance structure proposed by Sharpe became popular (Elton, Grubber and Padberg 1976). Fama and French (2004) argued that the single

index model suggested by Sharpe was based on oversimplified assumption and need to be examined in its components.

The concepts of bubbles are indicative of rise in stock prices and the continuance of the trend. Hence, ***"Bubbles"*** are a persistent economic phenomenon which occurs because of information asymmetry. These bubbles are there until a certain rally or change in information occurs. They then burst open and a crash happened. Once a crash opens a bubble occurs and this is a continuous process. Since Kindleburger (1978) article on Manias, Crashes and Bubbles, a lot many studies have followed to explain the cause, nature and duration of a bubble and a crash. With the advent of rational expectation to economic models, bubbles got precisely defined. The rational expectation model provides infinite solution for asset price. One of them is "Fundamental solution" and the others are "Bubble" solutions. The latter is an explosive path of asset price and constantly deviates from the fundamentals but continues to satisfy the non-arbitrage conditions. This certainly cannot occur in a perfect foresight environment, leading to the insight by the efficient market theorem that Bubbles cannot occur. Blanchard (1979), Blanchard and Watson (1982) came forward with the explanation that a bubble can be predicted through a stochastic model but its time of occurrence cannot be ascertained with certainty by rational expectation. This approach has been referred to as 'bounded rationality'. Abren and Brunnereir (2003) commented that the distinction between rational and non-rational agents may be may be useful by creates epistemological that are not fully resolved and difficult to address. Lux (1998), Lux and Sornettee (2002) objectively defined a rational bubble as a condition of asymmetric information in a speculative market and a condition of fat-tail. Grauwe and Grimaldi (2004), developed a model to give a simple model of exchange where agents optimize their portfolio by using different rules. They used the bubble solution to reach the equilibrium. They were able to discriminate between behavioural bubbles and rational bubbles. It has been observed by Bondit (2002) that portfolio which has a higher mean variance of return tend to perform well during bubbles. Rosser (2000), explained that a speculative bubble exists when the price of something does not equal its market fundamentals for some period of time for reasons other than random shock.

1.2.1 Gap in research:

It was observed that there are no studies on Indian context which tried to understand the pre and post ante effect on portfolio of price bubbles in Indian context. Hence this study was taken to fill the gap.

This paper uses single index model to understand the effect bubble on portfolio. The use of single index model has been found quite popular amongst academic studies. Dutt (1998), Chitnis (2010), Rahaman (2010) are few of the most important ones in this regard. A study by Kamal (2010) is interesting as well as phenomenal. In this study the Dhaka Stock exchange data has been studied for a period of pre and post stock price bubble in 2005 and 2010. The study find that during and after the bubble bust no stock made an optimal portfolio due to not surpassing the single index model criteria.

1.3 Methodology

1.3.1 Objective of the study

The study aims at the following objectives.

i. To construct optimal portfolio using Sharpe's single index model.

ii. To allocate assets to portfolio in ex ante price bubble and bubble scenario.

1.3.1 Scope of the study

The scope of the study is limited to Indian stock market and only to data available on National Stock Exchange of India.

1.3.3 Model specification

The study uses Sharpe (1963) model which was an improvement of Markowitz model. The model stands as follows:

$$R_i = \alpha_i + \beta R_m \quad \text{.....}$$

Equation (1)

Where;

R_i = return on the i^{th} stock.

α = Component of the security 'i' and is independent of market performance.

β = Coefficient that measures expected change in R_m given a change and

R_m = Rate of return on market index.

Since this model is a deterministic model, α_i consist of both the constant and the error or the random part of the equation. The term α_i is therefore divided into two parts, α_i and ε_i. Which is the random element of α[1].

Construction of the optimal portfolio.

The construction of optimal portfolio using Sharpe's single index model is to select securities on the basis of the following criteria.

i. The return on the investment is greater than the risk free return.

ii. The beta value for that security is positive.

Thereafter, for each security selected in the portfolio, expected return is then calculated using equation 1. Then selecting these securities to the portfolio, the next step is to construct an optimal portfolio.

The desirability of inclusion of a security in a portfolio using Sharpe's model is based on excess return to beta as given below:

$$(R_i - R_f)/\beta \quad \text{..... Equation (2)}$$

Where R_i is expected return of stock I, R_f is the risk free return and β is beta of stock i

This is repeated for all the securities and then ranked in descending order of magnitude of the excess return to beta. (for the study average repo rate of 7.5 has been used as R_f)

[1] For detail discussion please refer Fisher D.E and Jordan R.J (2009), "Security Analysis and Portfolio Management" Pearson, 6th ed, pp. 589-590.

The number of stock selected in the optimal portfolio depends on an unique cut off rate C*, such that all the stocks with the excess return to beta ratio is greater than this unique cut off C* are included and all stocks with the lower ratios are excluded.

To determine C^* it is necessary to calculate its value as if different numbers of securities were in the optimal portfolio. For a portfolio of I stocks, C_i is given by:

The formula for Cut off rate is given in equation 4 below.

$$C_i = \frac{\sigma_{ei}^2 \sum_{j=1}^{i} \frac{(R_i - R_f)\beta_i}{\sigma_{ei}^2}}{1 + \sigma_m^2 \sum_{j=1}^{i} \frac{\beta_i^2}{\sigma_{ei}^2}} \quad \text{..... equation (3)}$$

Where;

σ_m^2 = Variance in the market index

σ_{ei}^2 = Variance of a stock's movement that is not associated with the movement of the market index; this is the stock's unsystematic risk [2]

Once the optimum portfolio is constructed, the next step is calculated the percentage invested in each security in the optimal portfolio.

For this we calculate the percentage invested in each security. The percentage invested in each security is:

$$X_i = \frac{Z_i}{N} \quad \text{..... Equation (4)}$$

[2] Please refer for calculation Fisher D.E and Jordan R.J (2009), "Security Analysis and Portfolio Management" Pearson, 6th ed, pp. 611-13.

$$\sum_{j=1} Z_j$$

Where ;

$$Z_i = \frac{\beta_i}{\sigma_{ei}^2} \left[\frac{(R_i - R_f)}{\beta_i} - C \right] \quad \text{Equation (5)}$$

All other notation remaining unchanged, σ_{ei}^2 is the unsystematic risk of stock i.

1.3.4 Data specification

For this purpose, data from National stock exchange of India has been taken through a period of March 2008 to March 2012. The end of 2008 saw a rise in price bubble in Indian stock markets. BSE went up by 12000 and NSE gained 300 points in a period of ten days. Post October 2009, the bubble had bust which lead to a dip in the stock indices. Thus two period that is data from March 2005 to 2008 has been taken for the rise in price bubble and the subsequent period of March 2009 to October 2012 has been taken as the post price Bubble bust period. This period also saw a dip in the international economy with the subprime crisis in September 2008. During the period of 2008-09, the foreign exchange reserve depleted to USD 57 billion and the indices fell by average value of 600 to 900 points [Bhatt (2012]. The study uses the average repo rate of 7.25 during the period of the study as the risk free return.

1.4 Analysis of the study

Table 1.1 shows the stock choice for the construction of the portfolio. A total of 14 stocks were chosen across the pharmaceutical, metal, cement, banks, lifestyle and personal care and paints have been identified for the study. All these stocks were included in the Index at some point of time during the period of study.

Table 1.1 Portfolios

Sector	Stock
Pharmaceuticals	- Dr. Reddy Lab
Metal	- SAIL - Hindlco
Bank	- ICICI Bank - YES Bank - HDFC Bank - SBI Bank
Cement	- ACC Cement - Ambuja Cement - Grasim industry
Lifestyle and Personal care	- ITC Ltd - Hindustan Unilever Ltd. - Titan industry
Paints	- Asian paint

Source: ***Author's selection***

As the criteria for selection mentioned in the tab. 1 ignores stocks with negative β. The Sharpe modal will automatically exclude such stocks as its ranking is based on excess return over β.

Table 1.2 shows that almost all stocks have mean returns higher than the risk free rate of return except SAIL in ex ante bubble scenario. However excess return is more than market return in ICICI bank, Yes Bank, Dr. Reddy's Lab, Asian Paints and Titan Industry. For determining which of these stocks will be include in the optimal portfolio, it necessary to rank the stocks from highest to lowest based on excess return to beta ratio.

Table 1.3 shows that in the ex-ante bubble, it can be seen the cut off rate C^* is HUL at 3.042 and only ten securities make it to the optimal portfolio. Where as in the bubble bust allowed situation, C is 2.975 (i.e; of Grashim).

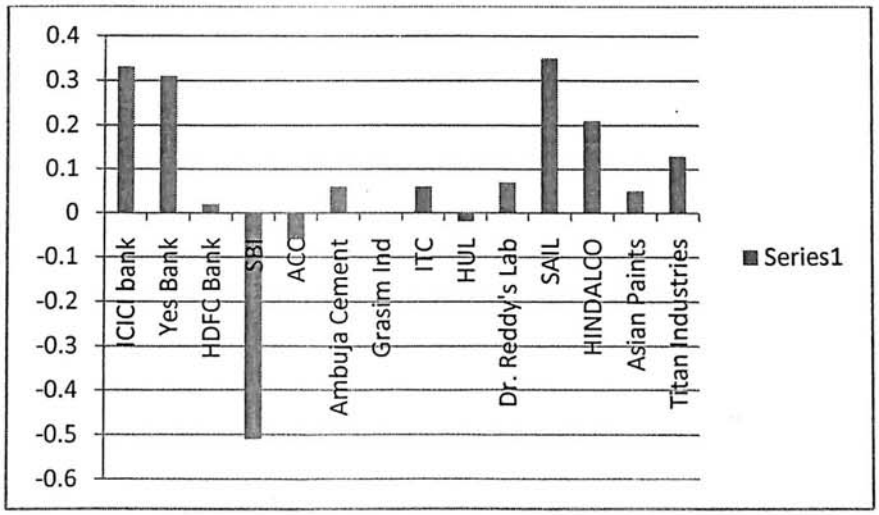
Once the composition of the optimal portfolio is known, the next step is to calculate the percentage to be invested in each security (See Table 1. 5). It is found that during bubble and post bubble only ICICI bank, Tata steel, Hindalco, Asian paint and Titan get same weight and can enter the portfolio. This brings us to the

conclusion that stocks such as Yes Bank, Dr. Reddy's Lab despite having better excess return to beta, fail to improve performance in portfolio. This has been the faith of other stocks too. Thus it may be inferred that portfolios perform remains better than the stocks individually in both bubble and post bubble scenario. Both table 1.5 and 1.6 read together makes us conclude that optimal portfolio construction becomes tougher during post bubble (bubble bust) scenario, but is possible .

Beside during and after the bubble burst no stock made an optimal portfolio due to not surpassing the single index modal criteria (see table1. 6). Here optimal portfolio construction fails to rationalize the post bubble scenario.

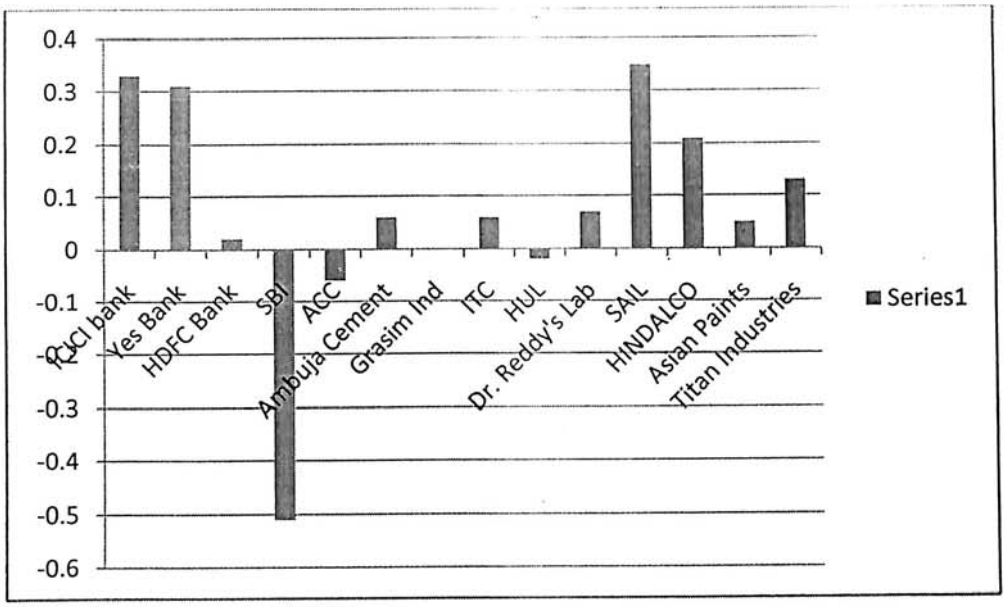
In ex ante stocks price bubble scenario, most of the selected are bank, cement, Pharmaceuticals, Steel, Banks, Aluminum, Paints, Banks, Lifestyle and personal care, when no short sales allowed. Besides in post bubble situation, there is it can be found dominated of stocks of bank, cement, Pharmaceuticals, Metal, Aluminum, Paints, Lifestyle and Personal care and (see Figure 1.1 and Figure1. 2).

Figure 1. 1 Investment weight in asset (Bubble scenario)



Source: - Constructed

Figure 1. 2 Investment weight in asset (Ex ante bubble scenario)



Source: - Constructed

Table 1. 2 Performance of stock based on excess return to beta ie; $(R_i - R_f)/\beta$ (ex ante bubble scenario)

Stock Name	Mean Return (R_i)	Excess Return $(R_i - R_f)$	β	Unsystematic Risk $\sigma_{ei}2$	Excess Return to Beta $\frac{(R_i - R_f)}{\beta_i}$
ICICI Bank	15	7.25	1.50	0.03	4.833
YES Bank	25	17.25	1.35	0.14	12.778
HDFC Bank	14	6.25	1.35	0.32	4.630
SBI Bank	9	1.25	1.39	0.02	0.899
ACC cement	9	1.25	0.75	0.03	1.667
Ambuja cement	12	4.25	0.78	0.06	5.449
Grasim Industry	10	2.25	0.75	0.04	3.000
ITC Ltd	13	5.25	0.61	0.08	8.607
HUL	8	0.25	0.45	0.05	0.556
Dr. Reddy Lab	17	9.25	0.46	0.13	20.108
SAIL	2	-5.57	1.34	-0.09	-4.156
Hindalco	13	5.25	1.45	0.014	3.620
Asian Paint	18	10.25	0.32	0.15	32.031
Titan Industry	21	13.25	0.70	0.15	18.928

Risk free return R_f is 7.25

Source: - Calculated

Table 1.3 Cut-off calculations ex ante bubble scenario.

Stock Name	$(R_i - R_f)$	β	$\sigma_{ei}2$	$\frac{(R_i-R_f)\times\beta_i}{\sigma_a 2}$	$\frac{\beta^2}{\sigma_{ei}2}$	$\frac{\sum(R_i-R_f)\times\beta_i}{\sigma_a 2}$	$\frac{\sum\beta^2}{\sigma_{ei}2}$	C_i
ICICI Bank	7.25	1.50	0.03	362.50	75.00	362.50	75	4.799
YES Bank	17.25	1.35	0.14	166.339	13.018	528.839	88.018	5.972
HDFC Bank	6.25	1.35	0.32	26.367	5.695	555.206	93.713	5.891
SBI Bank	1.25	1.39	0.02	86.875	96.605	642.081	190.318	3.374
ACC cement	1.25	0.75	0.03	31.25	18.75	673.331	209.068	3.214
Ambuja cement	4.25	0.78	0.06	55.25	10.14	728.581	219.208	3.316
Grasim Industry	2.25	0.75	0.04	42.187	9.375	770.768	258.583	2.975
ITC Ltd	5.25	0.61	0.08	40.031	4.651	810.799	263.234	3.074
HUL	0.25	0.45	0.05	2.25	4.05	813.049	267.284	3.042
Dr. Reddy Lab	9.25	0.46	0.13	32.730	1.628	845.779	268.912	3.139
SAIL	-5.57	1.34	-0.09	5.57	-19.95	851.349	248.962	3.412
Hindalco	5.25	1.45	0.01	543.75	150.18	1395.099	399.142	3.495
Asian Paint	10.25	0.32	0.15	21.867	0.683	1416.966	399.825	3.538
Titan Industry	13.25	0.70	0.15	61.833	3.267	1478.799	403.092	3.664

Variance of market =1.88
Source: - Computed

Table 1.4 Cut-off points arranged in ascending order ex-ante bubble scenario

1	5.972 Yes Bank	9	3.316 Abuja cement
2	5.891 HDFC Bank	10	3.214 Acc Cement
3	4.799 ICICI Bank	11	3.139 Dr. Reddy's Lab
4	3.664 Titan Industry	12	3.074 ITC Ltd
5	3.538 Asian Paints	13	3.042 HUL
6	3.495 Hindalco	14	2.975 Grashim Industry
7	3.412 SAIL		
8	3.374 SBI		

Source: Computed and compiled

Table 1.5 Optimum portfolios – Bubble and Post Bubble (bubble bust) scenario.

				Bubble			*Post Bubble*		
	Stock name	$\frac{\beta^2}{\sigma_{ei}2}$	$\frac{(R_i - R_f)}{\beta_i}$	C	Z	*% invested*	C	Z	*% Invested*
1	ICICI Bank	75.00	4.833	3.042	134.325	0.33	2.975	139.35	0.32
2	YES Bank	13.018	12.778	3.042	126.743	0.31	2.975	127.615	0.3
3	HDFC Bank	5.695	4.630	3.042	9.044	0.02	2.975	9.425	0.02
4	SBI Bank	96.605	0.899	3.042	-207.03	-0.51	2.975	-200.55	-0.46
5	ACC	18.75	1.667	3.042	-25.78	-0.06	2.975	-24.525	-0.06
6	Ambuja cement	10.14	5.449	3.042	24.407	0.06	2.975	25.086	0.06
7	Grasim Industry	9.375	3.000	3.042	-0.394	-0	2.975	0.234	0
8	ITC Ltd	4.651	8.607	3.042	25.883	0.06	2.975	26.194	0.06
9	HUL	4.05	0.556	3.042	-10.068	-0.02	2.975	-9.779	-0.02
10	Dr. Reddy Lab	1.628	20.108	3.042	27.783	0.07	2.975	27.892	0.06
11	SAIL	-19.95	-4.156	3.042	143.600	0.35	2.975	142.236	0.33
12	Hindalco	150.18	3.620	3.042	86.804	0.21	2.975	96.886	0.22
13	Asian Paint	0.683	32.031	3.042	19.799	0.05	2.975	19.845	0.05
14	Titan	3.267	18.928	3.042	51.90	0.13	2.975	52.118	0.12
				Total	407.016	1	Total	432.027	1

Source: Computed

Table.1 .6 Single index Criteria: Excess return over beta > risk free rate

	Stock name	Beta using single index for single period (post bubble)	Criteria:- *excess return over beta > risk free rate (risk free return 7.25)*
1	ICICI Bank	0.818	0.88
2	YES Bank	0.690	0.69
3	HDFC Bank	0.731	.85
4	SBI Bank	0.747	0.17
5	ACC cement	0.552	0.23
6	Ambuja cement	0.491	0.87
7	Grasim Industry	0.557	0.40
8	ITC Ltd	0.508	1.033
9	HUL	0.346	0.072
10	Dr. Reddy Lab	0.377	2.45
11	SAIL	0.722	-0.72
12	Hindalco	0.698	0.75
13	Asian Paint	0.282	3.63
14	Titan Industry	0.419	3.16

Note: criteria- Excess Return over beta > rick free rate; β>0. Risk free rate for the period from 2th March 2009 to 4th April 2013 is considered 7.25% (Treasury bill rate). Criteria are not met, because excess return over beta is less than risk free rate.

Source: ***Computed***

1.5. Inferences

The following are some of the major inferences drawn.

i. The stocks do not perform well when the bubble busts. But the portfolio performance beats the market risk. Hence, the inventor would do better to invest in a selected portfolio rather than invest in a single stock. Banks, metals and lifestyle stocks show better result.

ii. The paper identifies single index model as a source of easy portfolio construction and finds that in pre ante and post bubble scenario the portfolio outperform the market.

iii. The paper also infers that in case of well selected stocks, the portfolio will show uniform result, whether in bubble or post bubble scenario. It identifies that no short sale condition yield better result than short sale condition in post bubble market.

iv. It was found that stocks fail to pass the single index criteria during the post bubble period.

1.6 Conclusions

This paper was developed to verify the bubble and post bubble effect on portfolio in Indian stock market. For the purpose, data from NSE for a bubble and post bubble was identified and subjected to Sharpe's Single index model. Portfolio was constructed in short and no short sale condition. It was observed that Banks, lifestyle and metal industry outperform the other industry. The excess return to beta of the stocks beat the market return in many cases but not in all cases. However, the portfolio outperforms the market. It is also observed that Sharpe's

single index model is a good estimator for portfolio creation and that no short sale condition yield better result than short sale condition in post bubble market.

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