

Portfolios from BSE 500 using CAPM

Saurabh Agarwal & Neeraj Kumar

Abstract

The study tries to practically use the widely taught Capital Asset Pricing Model (CAPM) for making investment decisions on Bombay Stock Exchange (BSE) – 500 Index. Using CAPM, the study tries to investigate whether securities on BSE 500 are over-valued, properly valued or under-valued. The study also tries to understand that whether undervalued equities belong to a particular industrial sector or diversified sectors enabling creation of a diversified portfolio. A novel way of creating portfolios using systematic risk as weight has been discussed towards the end of the paper. The study is expected to be useful to institutional investors, portfolio managers and retail investors.

Keywords: Valuation, Portfolio, Investment Decision, Wealth Management, Equities, Risk & Return, Diversification, Indian Capital Market

I. Introduction

In the investment field the major advancement was done by the derivation of the portfolio theory. The creation of an optimal portfolio is not just a combination of unique individual securities with desirable risk-return characteristics but to understand the relationship among such securities that help build an optimal portfolio. The basic portfolio model was developed by Harry Markowitz (1952) who derived the expected rate of return for a portfolio of assets and expected risk measure. He is often called the father of modern portfolio theory as he emphasised on not only the importance of diversifying investment to reduce the total risk of the portfolio, but also how to effectively diversify. Markowitz's model can be used to mathematically arrive at a zero and minimum risk portfolio.

Roy (1952) also advised choosing a mean variance efficient portfolio. He advised choosing a single portfolio that maximizes $(\mu_p - d) / \sigma_p^2$ where μ is the return on the portfolio, d is a 'disaster level' return the investor places a high priority on not falling below and σ is the risk on the portfolio. Hence, Roy did not leave it to the investor to choose where along the efficient set he would invest.

One of the most important developments in investment theory is the Capital Asset Pricing Model (CAPM) as developed by Sharpe (1964), Lintner (1965) and Black (1972). The CAPM model is a single factor model explaining the return generation process.

1.1 Plan of the Paper

The paper has been divided into seven parts. Section I gives an introduction to the concepts that will be discussed in detail in the paper. Section II covers the review of literature and analyses the existing gaps. Section III and IV discuss the problem statement and objective of the study. Section V discusses the methodology followed by the paper. Findings and analysis are given in Section VI. Section VII provides the conclusions that can be drawn from current research.

Section II

Review of Literature

Sharpe (1964) said "only the responsiveness of an asset's rate of return to the level of economic activity is relevant in assessing its risk. Prices will adjust until there is a linear relationship between the magnitude of such responsiveness and expected return. Assets which are unaffected by changes in economic activity will return the pure interest rate; those which move with economic activity will promise appropriately higher expected rates of return." This is the basis of the Capital Asset Pricing Model. Sharpe asserted that in equilibrium the expected return on any efficient portfolio will be linearly related to the expected return on the market portfolio. Later, Lintner's CAPM version focused on returns in real terms. Lintner (1965) showed in his empirical analysis that there exist limitations on diversification to reduce risks as the 70 large mutual funds had greater conditional standard errors of estimate than risk free return. Black (1972) created zero beta portfolios. Empirical tests of the two factor model (Black zero beta version of CAPM) suggests that it explains historical returns better than pure CAPM. Black, Jensen and Scholes (1972) demonstrated the linear relationship between return on a security and its beta does not always hold true. Robert C. Merton (1973) developed an inter-temporal capital asset pricing model which was consistent with expected utility maxim and the limited liability of assets. Kraus and Litzenberger's (1976) version, takes into account the third moment of the return distribution. Levy's (1978) version, incorporates transactions costs. Breeden's (1979) version focuses on investor's preferences for consumption. Merton's (1987) version deals with market segmentation and Markowitz's (1990) version considers restrictions on short sales.

King (1966) explained the share price movement of individual stocks in line with the market and also quantified the extent to which their variability was attributable to industry membership. Black, Jensen and Scholes (1972) using monthly return data and portfolios found that cross-section of expected returns was linear in beta. Fama and McBeth (1973) found a positive linear relation between average returns and beta. Limmack and Ward (1990) concluded that beta has a significant influence on price movement of individual stocks and portfolios in the U.K. Capital Market. Sauer and Murphy (1992) found that the CAPM is a good indicator of Asset Pricing in German stock market except certain deviations. Major re-examination of the CAPM model was done after the empirical work of Fama and French (1992). Fama and French found that three variables - market equity, the ratio of book equity to market equity and leverage variables capture much of the cross section of average stock returns. The three variables were found to have more explaining power as

compared to market beta. Dash and Sumanjeet (2008) support Fama and French Hypotheses for Indian Capital markets on the basis of their study from January 1997 to January 2007 on BSE 500. Market Beta was found to have insignificant explanatory power.

Bansal (1988) using 200 firms' portfolio returns for the period of 1972-84 and Reserve Bank of India Index as market proxy found CAPM to be applicable to Indian capital market. Yalwar (1988) using 20 years' data for 122 firms found that CAPM is operative in Indian Capital Markets for active equities. Vipul (1998) found CAPM of limited applicability for earning supernormal returns. However, he found clear evidence supporting applicability of CAPM for Indian Capital Markets. Sehgal (1991) based on an analysis of 100 securities for a period from April 1984-March 1993 found that CAPM does not hold for Indian capital markets. Hence, studies done by Bansal (1988), Varma (1988), Yalwar (1988), Srinivasan (1988) and Vipul (1998) support the CAPM model. However, studies of Barua and Raghunathan (1990), Obaidullah (1994), Sehgal (1991), Madhusoodanan (1997), Ansari (2000) and Dash and Sumanjeet (2008) question the validity of the CAPM in the Indian markets. The existing studies do suffer from the limitations of the model and data used for the analysis. The present study is an effort not to test CAPM but how we can use the model for searching undervalued securities and creating meaningful portfolios.

Brandt and Clara (2006) in their article on Dynamic Portfolio selection by augmenting the Asset Space have used Markowitz approach in a novel manner. They expanded the set of assets to include mechanically managed portfolios and optimize statistically the extended asset space. They have created conditional portfolios. Their study suffers from finite size of the sample returns. Their study relied on the intuition that the static choice in mechanically managed portfolios is equivalent to a dynamic strategy in the basis assets. This paper paves the easy way to undertake dynamic portfolio selection.

Section III

Problem Statement

The International Financial Sub-prime mortgage crisis of 2008 has led to plummeting of the prices of majority of scripts on Indian bourses. The lower valuation of the stocks is compelling the investors to invest in undervalued scripts. The current research tries to solve the problem of the investors by finding those stocks which are undervalued and have a possibility of yielding good returns.

Section IV

Objective

The main objective of this study is to maximize wealth for an individual investor in period t by suggesting alternate investment options in period $t-1$.

$$\Delta W = \frac{W_t - W_{t-1}}{W_{t-1}}$$

where, ΔW = change in wealth;
 W_t = Wealth at Period t;
 W_{t-1} = Wealth at Period t-1;

Section V

Methodology

5.1 CAPM Model

The paper has used first asset pricing model derived from economic theory by Sharpe (1964). The Capital Asset Pricing Model (CAPM) is represented by the following equation

$$R_i = R_F + (R_M - R_F) \beta_i \tag{1}$$

where R_i = expected return on the security
 β_i = measure of systematic risk of asset i relative to the "market portfolio"
 R_F = return on the riskless asset
 $(R_M - R_F)$ = Risk premium

CAPM is an equilibrium asset pricing model derived from a set of assumptions. This equation shows that the expected return on an individual asset is a positive linear function of its index of systematic risk as measured by beta. An investor, pursuing active strategy, will try to search for underpriced securities or try to sell overpriced securities. If an investor believes in CAPM, then by comparing the expected rate of return (equation 1) with the estimated rate of return (equation 2) one can identify mispriced securities. Overvaluation and undervaluation of scrips is done by comparing the values of expected rate of return (CAPM return) and estimated rate of return. Those stocks where estimated rate of return is higher than the CAPM return are undervalued stocks. The stocks with higher CAPM return as compared to estimated rate of return are overvalued stocks. While those with approximately same expected return and estimated return are properly valued stocks.

$$R_i = \frac{P_2 - P_1 + D_1}{P_1} \tag{2}$$

where R_i = estimated return on the security
 P_1 = price of the security at time period t
 P_2 = price of the security at time period t+1
 D_1 = dividend declared in February or March.

5.2 Data

The closing prices of the scrips forming part of BSE 500 for the months of February and March 2009 have been used for calculating expected and estimated return. BSE 500 has been taken as the proxy for the market index. The risk free rate is taken as the 90 days Treasury bill rate of Reserve bank of India (R_f).

5.3 Hypotheses

In this paper we have tested two hypotheses. Our first Hypothesis is as follows

H_0 : Most of the stocks of BSE 500 are overvalued

H_A : Most of the stocks of BSE 500 are properly valued or undervalued

The second hypothesis of the study is

H_0 : Majority of undervalued stocks belong to a particular sector.

H_A : Majority of undervalued stocks do not belong to a particular sector.

5.4 Construction of Portfolios

The difference between closing prices of shares is used to calculate the percentage change in price. The percentage change in market index is also calculated in the same manner. The beta is calculated with the help of regression between percentage change in price (R_i) and percentage change in market index (R_m). The expected rate of return has been determined using equation 1. The estimated rate of return is calculated using equation 2. CAPM return is compared with the estimated return to find overvalued, undervalued and properly-valued. Out of the 500 stocks under study, the portfolios are constructed by taking ten stocks in each portfolio. The construction of portfolio is done on the following basis:

Table 1: Construction of alternate portfolios from BSE 500

Portfolio	Basis	Reason
1	Only those securities with beta between 0.5 to 1 are randomly picked from BSE 500	The selected equities represent moderate sensitivity to the index and hence moderate risk
2	Randomly picked equities with negative Beta	With BSE 500 going down such stocks should provide good returns as they are negatively related with the index
3	Randomly picked overvalued equities	To trace the performance of a portfolio consisting of overvalued equities
4	Randomly picked undervalued equities	To find whether by creating a portfolio of undervalued securities as per CAPM can an investor expect supernormal returns

Source: Self Constructed

Note: Equities have been randomly picked in the portfolios to generalise the results obtained.

5.5 Assignment of Weight and Return Formulae

The weight to each stock in the portfolio is given on the basis of equation 3. Beta has been used because it represents the systematic risk of the stock.

$$w_i = \beta_i / \sum_{i=1}^n \beta_i \quad (3)$$

Return on each portfolio is calculated by multiplying the weights (equation 3) and return on each equity included in the portfolio.

$$R_p = \sum_{i=1}^n w_i R_i \tag{4}$$

Section VI

Findings and Analysis

6.1 Results of Hypothesis Testing

Using equations 1 and 2, it was found that most of the stocks for the months of February and March 2009 were overvalued. Nine scripts were found to be properly valued and 11 scripts were undervalued (Table 2). By investment in undervalued stocks, investors can expect to earn returns in the long run. If one has already invested in properly valued stocks then he should hold on to the investment for some time. All other scripts which are part of BSE 500 were found to be overvalued and hence must be sold. Hence, for our Hypothesis 1 we can accept the Null Hypothesis.

Table 2: Valuation Analysis for BSE 500 scripts

<i>Company Name</i>	<i>Beta</i>	<i>Estimated rate of Return</i>	<i>CAPM Return</i>	<i>Nature</i>
Aban Offshore	0.986	10.07367313	10.16	Properly Valued
Ambuja Cements	0.934	11.42631994	9.96	Undervalued
Amtek India	0.635	8.23117338	8.85	Properly Valued
Ansal Prop. & Infra	0.853	8.713692946	9.67	Properly Valued
Apollo Tyres	1.677	17.12374582	12.72	Undervalued
Asahi India Glass	0.788	11.42857143	9.43	Undervalued
Bharti Shipyard	1.101	11.23853211	10.58	Undervalued
Elder Pharmaceuticals	82.968	847.2616633	314.31	Undervalued
Fresenius Kabi Oncology	1.04	10.6189968	10.36	Properly Valued
Geojit Financial Services	0.888	9.069212411	9.79	Properly Valued
Hindustan Petroleum Corp.	7.737	79.01094753	35.2	Undervalued
Jain Irrigation Systems	1.785	18.22490306	13.12	Undervalued
Kotak Mahindra Bank	72.153	736.8232891	274.19	Undervalued
Nagarjuna Fertilz. & Chem.	0.971	9.917355372	10.1	Properly Valued
Rajesh Exports	1.06	10.82352941	10.43	Properly Valued
Rashtriya Chem & Fert.	1.507	15.38461538	12.09	Undervalued
Sobha Developers	1.404	14.34058899	11.71	Undervalued
Spice Communications	1.041	10.63122924	10.36	Properly Valued
Sun TV Network	1.413	14.43298969	11.74	Undervalued
TVS Motors	0.886	9.051724138	9.79	Properly Valued

Source: *Self Constructed*

For our Hypothesis 2 we found that Null Hypothesis is rejected and Alternate Hypothesis that undervalued stocks belong to different sectors is accepted (Table 3). Hence, this finding provides a way of creating a diversified portfolio of undervalued equities.

Table 3: Unvalued stocks and Sector Analysis

<i>Company Name</i>	<i>Nature</i>	<i>Sector</i>
Ambuja Cements	Undervalued	Cement
Apollo Tyres	Undervalued	Automobile
Asahi India Glass	Undervalued	Glass
Bharti Shipyard	Undervalued	Shipping
Elder Pharmaceuticals	Undervalued	Pharmaceutical
Hindustan Petroleum Corp	Undervalued	Oil
Jain Irrigation Systems	Undervalued	Agriculture
Kotak Mahindra Bank	Undervalued	Banking
Rashtriya Chem & Fert.	Undervalued	Chemical
Sobha Developers	Undervalued	Real Estate
Sun TV Network	Undervalued	Media

Source: *Self Constructed*

6.2 Alternate Portfolios from BSE – 500

6.2.a Portfolio 1: Randomly picked equities with beta between 0.5 to 1

The first portfolio is constructed on the basis of beta. Beta has been used as it is a measure of systematic risk and represents the sensitivity of the script to the index. Only those stocks whose beta is between 0.5 to 1 have been randomly picked for making the portfolio. Using equations 1, 3 and 4 the expected return on portfolio 1 is 9.57 per cent. Whereas while calculating the return on portfolio 1 using equation 2, 3 and 4 we got 8.66 per cent return on the portfolio (Table 4). Hence, this portfolio is an overvalued portfolio.

Table 4: Portfolio 1: Randomly picked equities with beta between 0.5 to 1

<i>Sl.No.</i>	<i>Company</i>	<i>Beta</i>	<i>Estimated rate of Return</i>	<i>CAPM Return</i>	<i>Weighted</i>	<i>Nature</i>
1	Aban Offshore	0.986	10.074	10.16	0.123188406	Properly Valued
2	Ambuja Cements	0.934	11.43	9.96	0.116691654	Undervalued
3	Ansal Prop. & Infra.	0.853	8.714	9.67	0.106571714	Over Valued
4	GVK Power & Infra.	0.667	6.81	8.97	0.083333333	Over Valued
5	IDFC	0.617	6.304	8.79	0.077086457	Over Valued

Sl.No.	Company	Beta	Estimated rate of Return	CAPM Return	Weighted	Nature
6	Geojit Fin. Services	0.888	9.07	9.79	0.110944528	Properly Valued
7	India Infoline	0.837	8.55	9.61	0.104572714	Over Valued
8	Nagarjuna Fertilz. & Chem.	0.971	9.92	10.1	0.121314343	Properly Valued
9	JSW Steel	0.593	6.06	8.7	0.074087956	Over Valued
10	KEC International	0.658	6.715	8.94	0.082208896	Over Valued
Total		8.004			1	

Source: *Self Constructed*

6.2.b Portfolio 2: Randomly picked equities with negative beta

Portfolio 2 has been constructed with stocks which have negative beta. The current capital market is showing a high volatility in the share prices. In the current scenario with the plummeting of the stock market negative beta equities may become ideal for a portfolio. Hence, as the index value goes down the value of the portfolio is expected to increase. Return on portfolio by taking CAPM return into consideration is 4.08 per cent which is a positive sign whereas the return on portfolio on the basis of estimated rate of return came as -6.63 per cent (Table 5). Hence, this portfolio is also an overvalued portfolio.

Table 5: Portfolio 2: Randomly picked equities with negative beta

Sl.No.	Company	Beta	Estimated rate of Return	CAPM Return	Weighted	Nature
1	Texmaco	-0.545	-5.57	4.48	0.087339744	Over Valued
2	Thomas Cook (India)	-0.436	-4.45	4.88	0.069871795	Over Valued
3	Tamil Nadu Newsprint & Papers	-0.534	-5.45	4.52	0.085576923	Over Valued
4	Suzlon Energy	-0.621	-6.35	4.19	0.099519231	Over Valued
5	Sujana Towers	-0.839	-8.57	3.39	0.134455128	Over Valued
6	EIH	-0.579	-5.91	4.35	0.092788462	Over Valued
7	Dalmia Cements (Bharat)	-0.523	-5.35	4.36	0.083814103	Over Valued
8	Crompton Greaves	-0.621	-6.34	4.2	0.099519231	Over Valued
9	Bhushan Steel	-0.726	-7.4	3.81	0.116346154	Over Valued
10	B L Kashyap and Sons	-0.816	-8.33	3.47	0.130769231	Over Valued
Total		-6.24			1	

Source: *Self Constructed*

6.2.c Portfolio 3: Randomly picked overvalued equities

The third portfolio is constructed by taking overvalued stocks only. It is generally seen that investors are more willing to invest in these kinds of stocks as they show a positive movement and investors make a positive return in short period. The stocks have been picked up randomly from the 480 overvalued stocks of BSE – 500. Over here, we can see that the portfolio return calculated comes out to be 8.81 as per equation 1, 3 and 4 and 6.36 per cent as per equation 2 and equation 2, 3 and 4 (Table 6). Hence, this portfolio is an overvalued portfolio.

Table 6: Portfolio 3: Randomly picked overvalued equities

Sl.No.	Company	Beta	Estimated rate of Return	CAPM Return	Weighted	Nature
1	ABB	0.473	4.83	8.26	0.082938804	Over Valued
2	Abbott India	0.291	2.97	7.58	0.051025776	Over Valued
3	Ahluwalia Contracts	0.27	2.76	7.5	0.047343503	Over Valued
4	Dish TV India	0.776	7.92	9.38	0.136068736	Over Valued
5	Neyveli Lignite Corpn.	0.731	7.47	9.21	0.128178152	Over Valued
6	Television Eighteen India	0.595	6.08	8.71	0.104331054	Over Valued
7	Triveni Engineering & Industries	0.631	6.44	8.84	0.110643521	Over Valued
8	Unitech	0.782	7.98	9.4	0.137120814	Over Valued
9	Vishal Retail	0.509	5.2	8.39	0.089251271	Over Valued
10	Ashok Leyland	0.645	6.57	8.89	0.113098369	Over Valued

Source: *Self Constructed*

6.2.d Portfolio 4: Randomly picked undervalued equities

Portfolio 4 consists of properlyvalued and undervalued scripts picked up randomly from Table 1. The return on portfolio by taking the CAPM return is calculated as 21.22 per cent whereas the return on the basis of estimated rate of return is 40.77 per cent (Table 7). Hence, this portfolio is an undervalued portfolio.

Table 7: Portfolio 4: Randomly picked undervalued equities

Sl.No.	Company	Beta	Estimated rate of Return	CAPM Return	Weighted	Nature
1	Aban Offshore	0.986	10.074	10.16	0.052516644	Properly Valued
2	Ambuja Cements	0.934	11.43	9.96	0.049747004	Undervalued
3	Sobha Developers	1.404	14.34	11.71	0.074780293	Undervalued
4	Rashtriya Chem & Fert.	1.507	15.38	12.09	0.080266312	Undervalued

Sl.No.	Company	Beta	Estimated rate of Return	CAPM Return	Weighted	Nature
5	Ansal Prop. & Infra.	0.853	8.72	9.67	0.045432756	Properly Valued
6	Apollo Tyres	1.677	17.12	12.72	0.089320905	Undervalued
7	Asahi India Glass	0.788	11.43	9.43	0.041970706	Undervalued
8	Bharti Shipyard	1.101	11.24	10.58	0.058641811	Undervalued
9	Jain Irrigation Systems	1.785	18.22	13.12	0.095073236	Undervalued
10	Hindustan Petroleum Corp	7.74	79.01	35.2	0.412250333	Undervalued
Total		18.775			1	

Source: *Self Constructed*

6.3 Return on Portfolios

On the basis of return portfolio 4 gives the highest expected and estimated rate of return. Portfolio 1 and Portfolio 3 also give high returns. In case, an investor has to select between Portfolio 1 and Portfolio 3 then Portfolio 1 which consists of moderate risk securities would be recommended as both the weighted expected return and weighted estimated return for Portfolio 1 is higher than on Portfolio 3. Portfolio 2 is not recommended as it has negative weighted estimated return (Table 8). Portfolio 1, 2 and 3 are overvalued portfolios and Portfolio 4 is undervalued portfolio. All the four portfolios which we have constructed explain the importance of CAPM model in the portfolio analysis. The capital asset pricing model not only helps us to determine the appropriate expected rate of return but also helps us to determine the level of risk of an asset. Looking at the current scenario of the capital market whereby due to the financial crisis most of the investors are running away from capital markets, this model gives them a way to still make positive return.

Table 8 : Weighted Expected return and Weighted Estimated Return on the 4 portfolios

Sl. No.	Name of portfolio	Basis of construction	Weighted Expected/CAPM Return (%)	Weighted Estimated Return (%)
1	Portfolio no.1	Beta value (0.5 to 1)	9.57	8.66
2	Portfolio no.2	Negative beta	4.08	-6.63
3	Portfolio no.3	Overvalued stocks	8.81	6.36
4	Portfolio no.4	Undervalued and properly valued stocks	21.22	40.77

Source: *Self Constructed*

Section VII

Conclusion

Most of the stocks for the months of February and March 2009 on BSE - 500 were overvalued. Nine scripts were found to be properly valued and 11 scripts were undervalued (Table 2). Undervalued stocks belonged to different sectors in the economy supporting proper diversification. Portfolio 1 is constructed using equities with beta 0.5 to 1. Portfolio 2 has been constructed with stocks which have negative beta value. Portfolio 3 is constructed by taking the overvalued stocks. Portfolio 4 consists of properly valued and undervalued scripts. On the basis of return, portfolio 4 gives the highest expected and estimated rate of return. Portfolio 1 and Portfolio 3 also give high returns but are overvalued portfolios. Portfolio 2 is not recommended for purchase as it has negative weighted estimated return (Table 8). Hence, CAPM can be used for Indian Capital market for identifying undervalued equities and creating undervalued portfolios yielding supernormal returns.

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Mr Saurabh Agarwal is a Vice-Chairman, Indian Institute of Finance, Delhi and Managing Director, Edge India Publishing (P) Ltd., Delhi.

Mr Neeraj Kumar is an MBF student, Indian Institute of Finance, Delhi.