TESTING THE VALIDITY OF THE CAPITAL ASSET PRICING MODEL FOR THE MID-CAP STOCKS ON THE BOMBAY STOCK EXCHANGE

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Capital Asset Pricing Model (CAPM) establishes the relationship between risks and returns in the efficient capital markets. The present study examines the validity of the Capital Asset Pricing Model for the medium sized firms using daily returns of 79 companies listed on the Bombay Stock Exchange (BSE Mid-Cap Index) for the period of January 2007 to December 2011.

The research was conducted to test if higher risk (beta) is associated with higher return. According to the CAPM the intercept should be zero and the slope should be equal to the excess return of market portfolio over and above the risk free rate. This study also checks for nonlinearity of the relationship between return and beta and the residual variance of stocks. The results of the study show that CAPM is not valid for mid cap stocks for the period studied.

***Key Words**: CAPM, Mid-Cap Stocks, Bombay Stock Exchange*
JEL Classification: G10, G12

INTRODUCTION

Capital market plays an important role in the development of an economy and is an integral part of financial system wherein medium sized firms provide crucial benefits to the economic development and strengthen economic vitality of a nation. In 2002-2003, the Bombay Stock Exchange introduced a new index called 'BSE Mid-Cap'index that tracks the performance of the companies with relatively less market capitalization and exclusively represents the mid cap companies listed on BSE.

In the capital market, the manner in which securities are priced is a core issue that has

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attracted the attention of researchers. The risk-return relationship performs a central role in pricing of securities consequently helps in judicious investment decision making. If empirically true, the relation given by capital asset pricing model has wide-ranging implications for problems in capital budgeting, cost benefit analysis, portfolio selection etc. CAPM has been tested extensively for over four decades, in various forms primarily in developed capital markets and to some extent in developing markets; however, the debate on the empirical validity of CAPM continues.

The present study aims to test the standard form of CAPM in in the Indian context. An attempt is made to see if systematic risk beta as independent variable can explain the cross-sectional variation in security returns in the mid-cap market.

THE CAPITAL ASSET PRICING MODEL

The simplest form of an equilibrium model is the standard CAPM or the one-factor CAPM. The credit for the CAPM goes to Sharpe (1964), Lintner (1965) and Mossin (1966) who developed the model almost simultaneously.[1] Every investment carries two distinct risks, the risk of being in the market, which is called systematic risk or beta, and the other the unsystematic risk which is company specific and can be diversified through creation of portfolios. Investors hold portfolios comprising of the market portfolio and lend or borrow at the risk free rate depending on individual risk preferences. The capital asset pricing model (CAPM) is used to determine the required rate of return on an asset in a well diversified portfolio. It measures the asset's sensitivity to the systematic risk (beta) and the reward for bearing the risk. CAPM is therefore an equilibrium model that relates the required rate of return for a security or portfolio with the risk for that security as measured by beta. The total required return comprises of the risk free return plus the reward for bearing the syatematic risk.

LIMITATIONS OF THE CAPM:

Although the CAPM allows focus on the market risk the major drawbacks are :

a) CAPM makes many simplifying assumptions. The market is perfect; no investor can influence the market price. All relevant information regarding information is

[1] Fama (1968) showed that the Sharpe and Lintner models lead to the same measure of risk and the same relationship between risk and return. See Litzenberger (1969) for a brief comparison of the three approaches.

freely available to all investors. There are no transaction costs or taxes. All securities are infinitely divisible. All investors can borrow or lend any amount at the risk free rate. All investors have the same single period investment horizon. Investors are rational and risk averse and take decisions using the mean-variance rule. Unlimited short sales are allowed. All assets including human capital are marketable. In spite of all these unrealistic assumptions the model has been found by some to be a good description of the process.

b) Some studies have highlighted the danger of focusing exclusively on mean-beta space as they found that the return generation process also depends on other variables like size, book to market ratio and earnings price ratio.[2]

c) There are also many problems in testing CAPM: CAPM is an ex-ante (forward looking) model and we need to estimate future beta using the world market portfolio. Since there are no figures for future returns, we use ex-post (historical) data.[3] Beta varies considerably with method of computation and the major reason for variation seems to be the interval between data points.[4] Historical betas for individual stocks have not been found to be stationary over time and should not be used for future projection. Since portfolio betas are comparatively more stationary than individual stocks, most studies use portfolios. In the absence of a market portfolio most empirical studies also use the stock market index as a proxy for the market portfolio.

OBJECTIVES OF THE STUDY

The objective of this paper is to examine whether the CAPM holds true in Indian Mid Cap market i.e.:

a) Whether higher beta stocks give higher return.

b) Whether risk and return are linearly related.

c) Whether unsystematic risk is a determinant of portfolios returns.

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[2] Banz (1981), Reinganum (1981), Gibbons (1982), Shanken (1985) and Fama and French (1992)

[3] Regression of return on the stock with return on the market index yields the characteristic line with intercept alpha and slope beta. The betas are calculated for all the stocks/portfolios being studied, then their returns are regressed with the betas to find the slope and intercept of the security market line.

[4] Singh Rohini, (2008).

LITERATURE REVIEW

Early work in this area in USA supported the CAPM[5] though the intercept was generally found to be higher which was interpreted as support for the zero beta model, however it was not found to be applicable in later periods. Some further studies have highlighted the danger of focusing exclusively on mean-beta space as they found that the return generation process also depends on other variables like size, book to market ratio and earnings price ratio.[6] Studies in India in the past have reported mixed results.[7]

Some of the recent studies in the developing world including India have also reported mixed results:

Trifan (2009) tested CAPM for the Romanian capital market, both for individual assets and for portfolios, using a sample of daily data for 24 companies listed on Bucharest Stock Exchange, during the period January 2003 – July 2009. The tests did not provide evidence against CAPM; the data sample included the time period in which the Romanian capital market was affected by the global financial crisis.

Choudhary and Choudhary (2010) examined the CAPM for the Indian stock market using monthly stock returns of 278 companies of BSE 500 Index listed on the Bombay stock exchange for the period of January 1996 - December 2009. The authors concluded the model does not hold good in the Indian context for the specified period.

Gürsoy and Rejepova (2007) tested the validity of CAPM in Turkey by regressing the weekly risk premiums (rj – rf) against the beta coefficients of 20 portfolios, each including 10 stocks, over the period 1995-2004. The author made use of ISE-100 index and UST-Bill rate, adjusted for the difference between Turkish and US inflation rates as the proxies to the market portfolio, and the risk-free rate respectively. They tested the model using two alternative methods-Fama and MacBeth (1973), and Pettengil et. al. (1995). Research findings based on Fama & MacBeth approach indicated no meaningful relationship between beta coefficients and ex-post risk premiums of the selected portfolios. With Pettengill et al. methodology, on the other hand, strong beta-risk premium relationships were discovered.

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[5] Black, Jensen and Scholes (1972), Fama and McBeth (1973) and Blume and Friend (1973)

[6] Banz(1981), Reinganum (1981), Gibbons(1982), Shanken (1985) and Fama and French (1992)

[7] Obaidullah and Mohanty (1994) and Dhankar (1996), Sehgal (1997), Vipul (1998) and Dhankar & Singh (2005)

Mohammad Hasmat Ali Serajul Islam Mustafa Monir Chowdhury (2010) - tested the validity of the capital asset pricing model in the Dhaka Stock Exchange of Bangladesh. The study comprised of 160 companies listed at Dhaka Stock Exchange from July 1998 to June 2008. The authors investigate the relation between risk (beta) and return by using the Fama and Macbeth (1973) approach. The results indicate that there is a relation between risk and return but the relation is not linear and beta cannot be considered as the main and only source of risk.

METHODOLOGY

The study uses daily stock returns for 79 companies listed on the BSE Mid Cap Index for the period of January 2007 to December 2011. The companies listed on the BSE Mid Cap Index belong to 21 industries. From a representative pool of companies, after excluding stocks that were traded irregularly or had small trading volumes, 79 of them were selected. The adjusted closing prices of stocks were obtained from the Bombay Stock Exchange database. The daily closing values of the BSE Mid Cap Index was used as a proxy for the market portfolio. The 91day Treasury Bill rate was taken as the return on the risk free asset.

Beta was first derived for each security from historical (ex-post) data using a time series regression for the period of January 2007 to December 2011.

$$Rit-Rft=ai+\beta i.(Rmt-Rft)+eit \quad (1)$$

Rit is the return on stock i (i=1…79),
Rft is the risk free rate of return
Rmt is the return on the market index,
βi is the estimate of beta for the stock i , and
eit is the residual risk
ai is the intercept which should be zero if CAPM can explain returns

Based on the estimated betas, the 79 stocks were divided into 9 portfolios in descending order of beta.

The betas and returns for portfolios were calculated assuming equal weightage of each security in the portfolio.

$$Rpt-Rft=ap+\beta p.(Rmt-Rft)+ept \quad (2)$$

The ex-post Security Market Line (SML) was estimated by regressing the portfolio returns against the portfolio betas as follows:

$$rp=\gamma 0+\gamma 1.\beta p+ep \quad (3)$$

rp is the average excess return on a portfolio p (portfolio return-risk-free return),

βp is the beta of the portfolio,

$\gamma 1$ is the market price of risk, or the risk premium for beta=1,

$\gamma 0$ is the expected risk free return

ep is random error

If the CAPM is true, $\gamma 0$ should be zero and the slope of the SML, $\gamma 1$ should be equal to (Rp-Rf) the risk premium of the market portfolio.

Nonlinearity of portfolio returns and betas was tested by adding a square term as follows:

$$rp=\gamma 0+\gamma 1.\beta p+\gamma 2.\beta p2+ep \quad (4)$$

If CAPM is true portfolio returns and betas should be linearly related and $\gamma 2$ should be equal to zero.

CAPM also states that only the systematic risk represented by beta is priced, this was tested by adding residual variance in the equation as follows.

$$rp=\gamma 0+\gamma 1.\beta p+\gamma 2.\beta p2+\gamma 3.RV+ep \quad (5)$$

where RV is the residual variance of portfolio returns.

If CAPM is true, $\gamma 3$ should be equal to zero.

EMPIRICAL ANALYSIS

Betas for individual stocks were calculated using daily stock returns. As can be seen from Table 1 beta ranged from 0.3022 to 1.8126 and had standard deviation of 0.3414697 (Table 1).

Table 1: Individual Stock Betas (Equation 1)

NAME	BETA	NAME	BETA	NAME	BETA
UNITECH LTD.	1.8126	TVS MOTOR L	1.1646	FEDERAL BANK	0.8897
LANCO INFRATECH LTD.	1.8004	GUJARAT STATE PETRONET LTD.	1.1406	E.I.D. PARRY (INDIA) LTD.	0.88923

SUZLON ENERGY LTD.	1.7909	ASHOK LEYLND	1.1351	ING VYSYA BK	0.8527
ISPAT INDUSTRIES LTD	1.6485	HOTEL LEELA VENTURE LTD.	1.1322	BAJAJ ELECTRICALS LTD.	0.8311
STERLITE TECHNOLOGIES LIMITED.	1.6478	BATA INDI LT	1.1261	RALLIS INDIA LTD	0.8123
PUNJ LLOYD LTD	1.6043	SYNDICATE BANK	1.1188	EIH LTD	0.8085
BAJAJ HINDUSTAN LTD.	1.6022	SINTEX INDUSTRIES LTD	1.1156	MAX INDIA LTD.	0.7957
BOMBAY DYEING & MFG. CO. LTD.	1.5659	PTC INDIA LTD	1.1125	HT MEDIA LTD	0.7916
CENTURY TEXT	1.5558	JAI CORP LIMITED	1.1071	EICHER MOTORS LTD.	0.783
ARVIND LTD	1.5373	SRF LTD.	1.0909	TULIP TELCOM LTD	0.7672
ABAN OFFSHO	1.487	BHUSHAN STEEL LIMITED	1.0903	AIA ENGINEERING LTD.	0.7479
DENA BANK	1.4271	MAHANAG TELE	1.0618	SUPREME INDUSTRIES LTD.	0.7464
POLARIS LAB	1.4261	APOLLO TYRES LTD	1.0329	JAIN IRRIGATION SYSTEMS LTD.	0.73207
INDIABULLS FINANCIAL SERVICES LTD.	1.4064	TATA CHEMICA	1.0312	BLUE STAR LTD	0.7239
GVK POWER & INFRASTRUCTURE LTD	1.3951	BOMBAY RAYON FASHIONS LTD.	1.0229	JAGRAN PRAKASHAN LIMITED	0.6745
CORE EDUCATION & TECHNOLOGIES LTD	1.3431	HAVELL INDIA	1.014	BOC INDIA LT	0.5808
NATIONAL FER	1.3397	BHARAT FORGE LTD	1.0089I	NDRAPRASHTA GAS LTD.	0.5716
VOLTAS LTD.	1.3145	WHIRLPOOL OF INDIA LTD	1.002	MARICO LIMITED	0.5213
GODREJ INDUSTRIES LTD.	1.3067	V.I.P. INDUSTRIES LTD.	0.995	GUJARAT GAS CO. LTD.	0.5006
TATA TELESERVICES (MAHARASHTRA) LTD.	1.2913	HIMADRI CHEMICALS & INDUSTRIES LTD.	0.9938	GILLETTE IND	0.4645
JSL	1.2717	INDIAN HOTELS CO. LTD	0.9659	NOVARTIS IND	0.4109
JET AIRWAYS (INDIA) LTD	1.2716	CMC LTD	0.95106	PFIZER LTD.	0.3846

ABG SHIPYARD LTD.	1.222	M.R.F LTD	0.9459	PROCTER & GAMBLE HYGIENE & HEALTH CARE L	0.3022
HMT LTD	1.1942	RAYMOND LTD	0.9423		
GREAT EASTERN SHIPPING CO. LTD.	1.1932	GRAPHITE INDIA LTD.	0.9417		
VIDEOCON IND	1.192	BIOCON LTD.	0.9111		
INDIA CEMENT	1.1864	TATA COMM	0.905		
PANTALOON RETAIL (INDIA) LTD	1.1779	MAHARASHTRA SEAMLESS LTD.	0.9033		

According to CAPM higher risk ie higher beta should be associated with higher return. Portfolio returns and beta are given in Table 2. As can be seen from the table this is not so. For example, Portfolio-1 has the highest beta value (β=1.67) but has negative returns (rp=-0.156), similarly Portfolio-9 has the lowest beta (β=0.467) and yet has positive returns (rp=0.151). This could be due to the turmoil in markets following the sub prime crisis.

Table 2: Average Excess Portfolio Returns And Betas

Portfolio	Portfolio Return	Portfolio Beta	Standard Error	R2	F Stat	P Value
P1	-0.156	1.670	0.013	0.832	6098.602	0.058
P2	0.098	1.409	0.010	0.851	7035.787	0.247
P3	0.029	1.237	0.009	0.841	6522.593	0.805
P4	0.063	1.136	0.009	0.822	5701.490	0.429
P5	0.054	1.051	0.010	0.754	3781.101	0.553
P6	0.149	0.961	0.010	0.717	3126.317	0.059
P7	0.097	0.836	0.009	0.705	2952.322	0.179
P8	0.069	0.746	0.012	0.556	1545.432	0.446
P9	0.151	0.467	0.009	0.451	1012.596	0.020

The results of the test of the SML equation are presented in Table 3. As can be seen the results are not consistent with the CAPM. According to CAPM that the value of $\gamma 0$ should be zero, whereas we are getting a value of 0.262 which is statistically significant (t stat=3.74). Also if CAPM is true, the slope of the SML i.e. $\gamma 1$ should be equal to the difference between return on market and the risk free rate. The average market risk premium estimated from the BSE mid cap index and the t-bill rate was -6.39592 while the calculated value of $\gamma 1$ is -0.19 and was found to be statistically significant (t stat =-3.01).

Table 3: Statistics of the Estimation of SML (Equation 3)

COEFFICIENTS	γ0	γ1
VALUE	0.262419591	-0.190123563
T STAT	3.743207631	-3.010884691
P-VALUE	0.00723227	0.019637569
CORRELATION COEFFICIENT	0.564282	
STANDARD ERROR	0.064418	
F STAT	9.065427	
R SQUARE	0.564282	

Results of the test for non-linearity (Equation 4) are presented in Table 4. As can be seen γ0 was 0.03, γ1 the beta coefficient, was positive but not statistically significant (0.28 and t value=0.91) and γ2 was negative and not ststistically significant(-0.22 andt-value=-1.54).

Table 4: Testing For Non-Linearity (Equation 4)

COEFFICIENTS	γ0	γ1	γ2
VALUE	0.033092191	0.285264323	-0.22156
T STAT	0.205125538	0.913298147	-1.5486
P-VALUE	0.844256054	0.396300631	0.172448
CORRELATION COEFFICIENT	0.688705		
STANDARD ERROR	0.058812		
F STAT	6.637151		
R SQUARE	0.688705		

The results including the test for residual variance are presented in Table 5. The coefficient of the residual variance γ3 was very high (-1194.02) indicating that residual risk appears to be important even when portfolios are used.

Table 5: Testing For Non-Systematic Risk (Equation 5)

Coefficients	γ0	γ1	γ2	γ2
Value	0.2026516	0.137686827	-0.1295	-1194.02
t Stat	1.01717303	0.436790644	-0.85219	-1.31907
P-value	0.355736992	0.680482096	0.433019	0.244323
CORRELATION COEFFICIENT	0.769067			
STANDARD ERROR	0.05549			
F STAT	5.550431			
R SQUARE	0.769067			

Thr correlation between the portfolio beta and residual variance was also calculated and a high degree of positive correlation was found as can be seen from Table 6. This problem of multicolinearity makes it difficult for us to interpret the results of the earlier tables.

Table 6: Correlation Between Variables

VARIABLES	PORTFOLIO BETA	BETA2	RESIDUAL VARIANCE
PORTFOLIO BETA	1		
BETA2	0.982819161	1	
RESIDUAL VARIANCE	0.525937438	0.588996548	1

Our results are similar to other studies in emerging economies; *Choudhary and Choudhary (2010)* concluded the model does not hold good in the Indian context for 278 companies of BSE 500 Index for the period of January 1996 - December 2009. *Gürsoy and Rejepova (2007)* studied 200 stocks from 1995-2004 and found no relationship between beta and return with the Fama and MacBeth (1973) method while the Pettengil et. al. (1995) methodology supported the CAPM. *Serajul et al (2010)* studied 160 companies in Dhaka from July 1998 to June 2008 using the Fama and Macbeth (1973) approach and found a relation between risk and return but it was not linear and beta was not the only source of risk.

CONCLUSION

The article tested the validity of the Capital Asset Pricing Model for the medium sized firms listed on BSE Mid-Cap index. The study used daily stock returns of 79 companies listed on the Bombay Stock exchange from January 2007 to December 2011. We found that higher beta does not give higher return, the intercept was not zero and slope was not equal to excess returns on market portfolio. The relationship was found to be linear, but residual risk appears to be important. We therefore conclude that CAPM cannot explain returns for the mid cap companies studied during this period.

It is possible that results were influenced by the worldwide turmoil in markets following the sub prime crisis. Further research can be conducted to test if other macroeconomic factors or firms specific factors are able to explain returns during the same period.

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