

“Conditional relation between return and co-moments – an empirical study for emerging Indian stock market”

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CONDITIONAL RELATION BETWEEN RETURN AND CO-MOMENTS – AN EMPIRICAL STUDY FOR EMERGING INDIAN STOCK MARKET

Abstract

Due to many theoretical and practical shortcomings of the traditional CAPM model, this study aims at analyzing the CAPM with possible extensions. The analysis aims to know the empirical soundness of Conditional Higher Moment CAPM in emerging India's capital market. The sample consists of 69 company's daily stock price data from April 2004 to March 2019 from NSE 100. Panel data analysis is used on 21 cross-sections. The overall results show that when both up and down markets are incorporated separately, all three moments, namely, co-variance, co-skewness, and co-kurtosis, are priced during the normal Indian economy phase. Further, this study states that including higher moments (co-skewness and co-kurtosis) in the two-moment model provides symmetry in both the up and down markets. This is one of the first studies in the Indian Stock market explaining the variation in portfolio returns through panel data analysis by extending CAPM with conditional higher-order co-moments. The portfolio managers should consider skewness and kurtosis along with variance in constructing the optimal portfolios.

Keywords

beta, return, variance, co-kurtosis, co-skewness, panel data analysis

JEL Classification

G10, G11, G12, G14

INTRODUCTION

Sharpe (1964), Lintner (1965), and Mossin (1966) proposed Capital Asset Pricing Model (CAPM), which is based on the assumption that expected market risk premium can never be negative and returns on security always have a normal distribution. Accordingly, the CAPM model considers only the first two moments, which are mean and variance of security returns to explain the expected return variation. Traditional CAPM is based on many unrealistic assumptions that are not prevailing in the current scenario. Academicians and practitioners of finance have gone ahead to do a thought-provoking examination of the traditional CAPM and its possible extensions. This has been done to find rational explanations for empirical failures.

Most of the empirical research states that returns on security do not map normal distribution. Rubinstein (1973) pointed out that for non-quadratic utility function of investors and non-normal security return distribution, the quantification of risk requires higher moments like skewness and kurtosis besides variance. Also, in reality, the model's empirical soundness is examined on the actual realized returns and never on expected return. One may assume that in the long run, the expected return on the market is positive, and so the tradi-

tional CAPM can hold, but this model cannot be accepted in the short run as the market return can be negative in the short run. Zhang and Wihlborg (2010) have further stressed that in emerging economies, the stock markets are highly volatile, which calls for a separate study in the up and down market to find the relation, if any, between co-moments and return. A fresh strategy for testing the conditional correlation between risk and return was suggested by Pettengill, Sundaram, and Mathur (1995). They stated that the studies testing the systematic correlation between return and beta was weak and inter-temporally inconsistent due to the conditioning nature of the relation between beta and realized return. They found that the correlation between return and beta to be direct (inverse) if the anticipated risk premium for the market is positive (negative). This is what is referred to as “conditional relationship” between realized return and risk. Furthermore, Nguyen and Puri (2009) discovered that higher-order systematic co-moments could explain high minus low (HML) and small minus big (SMB) factors given by Fama and French, thus, lending support to the framework based on conventional covariance risk without having to depend on the assumptions of behavioral factors as mentioned by Fama and French.

Based on the traditional CAPM model and its practical shortcomings, this work attempts to develop several asset pricing models to find the relation between return and co-moments, i.e., covariance, co-skewness, and co-kurtosis which describe both short-run and long-run relationship.

The rest of the paper is organized as follows: literature review, including gap and purpose of the study; methods, empirical models and hypotheses; results and discussion; and conclusion covering theoretical and practical implications of the study.

1. LITERATURE REVIEW

1.1. CAPM model

The CAPM theory (Sharpe, 1964; Lintner, 1965; Mossin, 1966) is one of the highest studied and discussed asset pricing theories. In the CAPM model, the return is projected based on the assumed basis that the anticipated return is a positive function of beta, the risk-free return, and the the expected return rate from the the market. Beta is a measure of market risk and covariance between the return on assets and market return.

The use of CAPM is misleading when it comes to emerging markets. Ansari (2000), Basu and Chawla (2010), Sehgal and Balakrishnan (2013), Saji (2014), Balakrishnan (2014) and Singh and Yadav (2015) have found the traditional CAPM to be not working in India’s emerging economy as the stock market is highly volatile. Singh and Yadav (2015) examined three asset pricing models in the context of India. The models tested in the study were the CAPM, Fama and French three-factor, and Fama and French five-factor from October 1999 to September 2014. They found the Fama and French three-factor model

to be superior to all other models in all the cases taken into consideration. Chung, Johnson, and Schill (2006) and Nguyen and Puri (2009) mentioned that the Fama and French factors could be explained by co-skewness and co-kurtosis, thus lending support to the covariance risk-based approach.

1.2. Higher moment CAPM

Stock return is spread non-normal and includes skewness and additional kurtosis (Richardson & Smith, 1993). This extended CAPM is now common in finance literature as the first extended CAPM was given by Kraus and Litzenberger (1976), where the third moment of distribution of returns, i.e., skewness was involved. Literature available these days on three moment CAPM as well as on four moment CAPM seems to be highly progressive.

Kraus and Litzenberger (1976) confirmed skewness to be priced in the market. Harvey and Siddique (2000) found a non-negligible inverse relation between co-skewness measures and mean returns; to be more specific, investors were ready to forego some returns to get positive skewness. A significant enhancement in de-

scriptive power of four moments CAPM in comparison to traditional CAPM or three moment CAPM was found by Fang and Lai (1997), and they suggested that investors get rewarded for systematic variance and systematic kurtosis and were ready to forego few anticipated returns for assets which enhances the systematic skewness. Hwang and Satchell (1999) developed the unconditional CAPM model, including four moments and that too mainly for emerging economies that depict interesting study as their allocation of returns displays skewness and kurtosis. Their study concluded that better explanation was given by higher moments for the returns in developing markets but not in a similar manner as expected returns were explained appropriately by beta and co-kurtosis for some of the countries. For others, expected return was explained more precisely by beta and co-skewness.

1.3. Conditional CAPM

Returns of the market cannot be below the risk-free rate in *ex-ante* based CAPM. In *ex-post* CAPM, however, the market returns may be below risk-free level, which invalidates theoretically projected risk-return relation. Pettengill et al. (1995) mentioned that periods of negative returns could offset the period of favorable returns, which results in a weaker correlation between systemic risk and return. To overcome the problem of negative coefficients of beta, they estimated separate coefficients of beta for up and down markets, which showed a significant positive correlation between return and beta during the up market and negative relation between return and beta during the down market. They used the NYSE data and adopted the same methodology used by Fama and Macbeth (1973). Salazar and Lambert (2010) critically studied the Fama and Macbeth (1973) approach and observed that the projected 402 cross-sectional regression equations in their study are neither independent nor identically distributed. Thus, the model suggested by Pettengill et al. (1995) also has one limitation; they also assumed that the estimated coefficients of beta during the upward and downward market are independent. Nimal and Fernando (2013) studied Japan and the Sri Lanka market and supported the conditional beta-return relation to be significant.

1.4. Conditional higher moment CAPM

Conditional higher moment CAPM was examined by Dittmar (2002), Harvey and Siddique (2000), and Fletcher and Kihanda (2005), among many others. This particular area of study has got high importance in recent times because of the use of derivatives, the prevalent dissemination of value-at-risk, FIIs investment in emerging markets, availability of technology, etc.

Galagedera, Henry, and Silvapulle (2003) found that the unconditional models were not in place to clarify cross-sectional variations in the *ex-post* returns. After segmenting the Australian market into upside and downside, they establish that only co-variance and co-skewness were priced. Fletcher and Kihanda (2005) for the UK stock market and Teplova and Shutova (2011) for the Russian stock market mentioned the use of expanded conditional models to involve higher-order moments.

1.5. Which model for the emerging Indian economy?

Hwang and Satchell (1999) suggested that few emerging markets are better justified with co-skewness and/or co-kurtosis than mean-variance traditional CAPM. For India's capital market, there are mixed opinions for beta as the determining factor of expected returns. Mostly the studies before 1990 reinforced the traditional CAPM and found the beta to be a significant determining factor of return (Yalwar, 1988). On the contrary, Gupta and Sehgal (1993), Madhusoodan (1997), Sehgal (1997), and Basu and Chawla (2010) opined that beta is an insignificant factor for stock return in the Indian market. Recently Chaudhary, Mishra, and Srivastava (2018a) discovered that traditional CAPM does not hold in the Indian setting. Chaudhary, Mishra, and Srivastava (2018b) also studied conditional higher moment models for BSE 500 companies taking monthly data using pooled OLS regression and found skewness to be priced in the Indian market but not co-kurtosis. The OLS model can be easily questioned for heteroscedasticity, and the use of monthly data i.e., lower frequency in place of daily data, can be a hurdle in the correct assessment. The easy access to high-frequency daily data creates a better pos-

sibility of correct analysis of volatile time series (Zhou, 1996).

The volatility of stock returns in emerging markets and mature markets is quite different; therefore, the models created in developed economies cannot be used as they are in the Indian context. Further, very limited empirical research is done for emerging markets like India, so there is a need to develop the models in the Indian context.

The main purpose of this study is to develop models that can find conditional relation between return and co-moments, i.e., covariance, co-skewness, and co-kurtosis, and be used for short and long period using panel data analysis.

2. METHOD

2.1. Empirical models

To achieve the purpose of this study, models are suggested which describe the direction and intensity of beta, co-skewness, and co-kurtosis on security return when the expectation about the market is positive (expected market risk premium is positive), and describes what kind of correlation between return and beta; co-skewness and return; co-kurtosis and return are expected when expectation about the market is negative (expected risk premium for the market is negative). The models behave differently by the number as well as by the type of co-moments involved in it.

The approach adopted in the current study is the modified version of Pettengill et al. (1995), as mentioned earlier. Fabozzi and Francis (1977) elaborated three methods to find the bull and bear market. The months in which market returns surpass the mean market return or the average risk-free return or zero were considered a bull market or otherwise bear market. The current study estimates the panel data analysis (instead of each month/over the day's cross-sectional regression for up and down markets and then reporting mean values of coefficient) and includes periods of crisis and non-crisis. As per the literature reviewed, there is no study in the Indian Stock market explaining the variation in returns on security through panel data analysis by extending CAPM with higher-order co-mo-

ments using the conditional approach with daily return data. The modified methodology of the study additionally gives an alternative facet.

To estimate the conditional relation between co-moments and return, the following testing model has been used:

$$R_{it} - R_{ft} = \alpha_{0i} + \alpha_1 \beta_{im,t} + \alpha_2 D_t \beta_{im,t} + \alpha_3 \lambda_{im,t} + \alpha_4 D_t \lambda_{im,t} + \alpha_5 \eta_{im,t} + \alpha_6 D_t \eta_{im,t} + e'_{it},$$

$$i = 1, 2, \dots, n \text{ (cross sectional observation unit);}$$

$$t = 1 \dots T \text{ (time period or day),} \quad (1)$$

where R_{it} and R_{ft} are returns on the risky asset and risk free asset, respectively during the day t , α_{0i} is the Intercept term for the risky asset i , $D_t = 1$, if risk free rate of return is higher than realized market returns during the day t , $D_t = 0$, if risk free rate of return is lower than realized market return during the day t ,

and

$$\beta_{im} = \frac{\sum_{t=1}^T (R_{it} - \bar{R}_i)(R_{mt} - \bar{R}_m)}{\sum_{t=1}^T (R_{mt} - \bar{R}_m)^2}, \quad (2)$$

$$\lambda_{im} = \frac{\sum_{t=1}^T (R_{it} - \bar{R}_i)(R_{mt} - \bar{R}_m)^2}{\sum_{t=1}^T (R_{mt} - \bar{R}_m)^3}, \quad (3)$$

$$\eta_{im} = \frac{\sum_{t=1}^T (R_{it} - \bar{R}_i)(R_{mt} - \bar{R}_m)^3}{\sum_{t=1}^T (R_{mt} - \bar{R}_m)^4}, \quad (4)$$

Beta (β_{im}), co-skewness (λ_{im}), and co-kurtosis (η_{im}) of the risky asset are estimated from expressions (2), (3), and (4), respectively. These estimates of co-kurtosis, co-skewness, and beta are calculated in the same manner as done by Kraus and Litzenberger (1976) and further done in the same manner by Galagedera, Henry, and Sivapulle (2003).

There exist a (an) direct (inverse) correlation between beta and return during up (down) market; an (a) inverse (direct) correlation between co-skewness and return during up (down) market, and a (an) direct (inverse) relation between co-kurtosis and return during up (down) market. Thus, there are anticipated positive sign of the projected coefficient of α_1 , the negative sign of the projected coefficient of $\alpha_1 + \alpha_2$, negative sign of projected coefficient of α_3 , positive sign coefficient of $\alpha_3 + \alpha_4$, positive sign of projected coefficient of α_5 , and negative sign of projected coefficient of $\alpha_5 + \alpha_6$. That is, we expect a negative sign of projected coefficient of α_2 , a positive sign of projected coefficient of α_4 , and negative sign of the projected coefficient of α_6 . It is further expected that the absolute values of coefficients of α_2 , α_4 , and α_6 are higher than the absolute value of projected coefficient of α_1 , α_3 , and α_5 , respectively.

By restricting $\alpha_3 \dots \alpha_6$ equal to zero in equation (1), the conditional correlation between return and beta has been tested in the Indian stock market (two moment model):

Model 1 – Two moment model

$$R_{it} - R_{ft} = \alpha_{0i} + \alpha_1 \beta_{im,t} + \alpha_2 D_t \beta_{im,t} + e'_{it} \quad (5)$$

By restricting α_5 and α_6 equal to zero in equation (1), the conditional impact of beta and co-skewness on realized return has been tested in the Indian stock market (three moment model):

Model 2 – Three moment model

$$R_{it} - R_{ft} = \alpha_{0i} + \alpha_1 \beta_{im,t} + \alpha_2 D_t \beta_{im,t} + \alpha_3 \lambda_{im,t} + \alpha_4 D_t \lambda_{im,t} + e'_{it} \quad (6)$$

By estimating the complete equation (1) the conditional impact of beta, co-kurtosis, and co-skewness on realized return has been tested in the Indian stock market (four moment model):

Model 3 – Four moment model

$$R_{it} - R_{ft} = \alpha_{0i} + \alpha_1 \beta_{im,t} + \alpha_2 D_t \beta_{im,t} + \alpha_3 \lambda_{im,t} + \alpha_4 D_t \lambda_{im,t} + \alpha_5 \eta_{im,t} + \alpha_6 D_t \eta_{im,t} + e'_{it} \quad (7)$$

2.2. Hypothesis testing

In the regression models (1), (2), and (3), if the estimated value of the coefficient of α_1 comes out to be positive and significant, and the estimated value of $\alpha_1 + \alpha_2$ comes out to be negative and significant. The hypothesis that there exists a significant relationship between beta and returns with predicted signs is accepted.

Similarly, in the regression models (1), (2), and (3), if the estimated value of the coefficient of α_3 comes out to be negative and significant, and estimated value of $\alpha_3 + \alpha_4$ comes out to be positive and significant. The hypothesis that there exists a significant relationship between co-skewness and returns with predicted signs is accepted.

In the regression models (1), (2), and (3), if the estimated value of the coefficient of α_5 comes out to be the positive and significant and estimated value of $\alpha_5 + \alpha_6$ comes out to be negative and significant. The hypothesis that there exists a significant relationship between co-kurtosis and returns with predicted signs is accepted.

This study also tests for symmetric correlation between return and beta; co-skewness and return; and co-kurtosis and return during up and down markets. This test will help us assess whether the impact of co-kurtosis, co-skewness, and beta on the realized return during up market is more or less than the impact of co-kurtosis, co-skewness, and beta on realized return during the down market.

If the estimated value of $2\alpha_1 + \alpha_2$ comes out to be insignificant, it means the hypothesis that there exists a symmetric correlation between return and beta during the up and down markets is accepted. If the estimated value of $2\alpha_3 + \alpha_4$ comes out to be insignificant, it means the hypothesis that there exists a symmetric correlation between return and co-skewness during the up and down markets is accepted. Similarly, if the estimated value of $2\alpha_5 + \alpha_6$ comes out to be insignificant, it means the hypothesis that there exists a symmetric correlation between return and co-kurtosis during the up and down markets is accepted.

2.3. Data and methodology

The study presented herein is representative from April 2004 to March 2019 (3,725 days). The sample consists of 69 company's daily share price data from NSE 100 Index because of the higher volume and higher market capitalization companies.

The following formula is used for calculating the stock price returns:

$$R_{it} = \ln \left(\frac{S_{it}}{S_{i,t-1}} \right), \quad (8)$$

where R_{it} is daily return on stock i , S_{it} is per share stock price i at the end of the day t , $S_{i,t-1}$ is per share stock price i at the end of the day $t-1$.

A value-weighted index, i.e., the NSE 500 index, has been used as a dummy for the market portfolio. It represents the overall Indian economy by covering all major industries. It represents close to 92+% of the total market capitalization out of the total number of stocks traded on NSE.

The following formula is used to calculate the market return:

$$R_{mt} = \ln \left(\frac{S_{mt}}{S_{m,t-1}} \right), \quad (9)$$

where R_{mt} is daily return on the market portfolio S_{mt} is value of the NSE 500 Index at the end of the day t , $S_{m,t-1}$ is value of the NSE 500 Index at the end of the day $t-1$.

The data used in the study for stocks and indexes were obtained from CMIE – Prowess. The 91-days treasury bill rates (is used as a proxy for the risk-free return) have been taken from the authentic website of Reserve Bank of India (www.rbi.org.in). Since in the RBI database the Treasury Bill Rates are quoted annually, these rates are converted into daily equivalents.

The period from April 2004 to March 2019 reveals that 91-days T-Bill Rate is greater than the market returns in 1683 out of 3,725 total observations (45.18%). The presence of a high number of negative market excess return periods may cause non-existence of relation between risk and return

as estimated by traditional CAPM. Thus the study aims to test for the conditional relation between the co-moments and realized returns.

For the NSE 500, i.e., market index and each share, daily returns have been computed using the natural logarithm of price relatives. Further, the excess returns from share and excess returns from the market have been calculated. This is followed by estimating beta, co-skewness, and co-kurtosis for every security based on equation (2), (3), and (4), respectively. Beta, co-skewness, and co-kurtosis have been estimated on the period of 5 years rolling data. From April 2009 onwards, every year, the portfolio formation is done based on beta, co-skewness, and co-kurtosis of securities estimated from an earlier five-year period. The portfolios are created based on beta, co-skewness, and co-kurtosis. For beta sorted portfolios, the stocks are arranged in descending order of beta to form 7 portfolios (first six portfolios of 10 stock each and the last portfolio of 9 stocks). Each portfolio is constructed so that the first portfolio consists of stocks representing the highest beta values, and the last portfolio consists of the lowest beta values. Similarly, the stocks are arranged separately in descending order of co-skewness, and co-kurtosis and a similar approach have been followed for the construction of co-skewness and co-kurtosis sorted portfolios. Thus, in total, 21 (7 each for beta sorted portfolios, co-skewness sorted portfolios, and co-kurtosis portfolios) portfolios are constructed. A portfolio's beta, co-skewness, and co-kurtosis are obtained by averaging the beta, co-skewness, and co-kurtosis of the individual securities assigned to that portfolio. The current study adopts almost the same methodology for portfolio formation, as was adopted by Kraus and Litzenberger (1976). Since the study by Kraus and Litzenberger (1976) analyzed the impact of systematic covariance and systematic skewness on portfolio return, they constructed the portfolio from stocks sorted based on beta and co-skewness. However, the current study, in addition to beta and co-skewness, also analyzes the impact of co-kurtosis on portfolio returns, and thus in this study, the portfolio is constructed based on beta, co-skewness, and co-kurtosis. This mechanism aimed to achieve diversification and, in turn, to reduce any error that might occur because of the presence of unsystematic risk. (Amanullah & Kamaiah, 1998). In this study, two testing periods have been taken, one from

April 2009 to March 2014 and the second one from April 2014 to March 2019, respectively. This has been done to analyze the results in two phases, one testing period, i.e., April 2009 to March 2014 being the later stage of the 2008 financial crisis and the second testing period, i.e., April 2014 to March 2019, being the normal phase of the Indian economy. The testing of systematic, conditional relation between co-moments and realized returns was carried using panel data analysis on the portfolios formed.

3. RESULTS AND DISCUSSION

The portfolio summary statistics and market return distributions over the two testing periods are shown in Tables 1 and 2. The Jarque-Bera test is executed to verify the normality of returns of beta, skewness, and kurtosis sorted portfolios for both the testing period. The results of both the tables show that returns from all the portfolios are asymmetric and leptokurtic. The Jarque-Bera test of normality for the portfolios and market shows that the returns of all the portfolios and market during both the testing period shows significant non-normality at the level of 1%. The first testing period being the later stage of the 2008 financial crisis, the descrip-

tive statistics of the first testing period show that the skewness of all the portfolios during this period is positive. These results are consistent with the results of Chaudhary (2014) who observed that the skewness of returns of US stocks became positive during the later stage of the financial crisis. The descriptive statistics show that the standard deviation and kurtosis of returns for the first testing period are greater than the second testing period. The descriptive statistics further show that skewness of returns become negative in the second testing period (second testing period: 2014–2019). All these results of descriptive statistics are consistent with the results of Chaudhary (2014).

The models are estimated using the panel data on EViews, and results are reported in Table 3 and Table 4. The fixed-effects model and the random-effects model are estimated. Further, the Hausman test shows that the random effect model is suitable and should be chosen over the fixed-effects model. This conclusion holds for both the testing periods.

The random effect results describing the conditional relationship for portfolios show a positive and significant correlation between realized returns and beta of portfolios during the up market

Table 1. Summary statistics of portfolio return distributions (first testing period – from April 2009 to March 2014)

Particulars	Item	Mean	Max	Min.	Std. Dev.	Skew.	Kurt.	J B Test	P-Value
Beta sorted portfolios	Portfolio 1	0.0007	0.1656	-0.0858	0.0187	0.5372	8.7106	1754.39	0.00
	Portfolio 2	0.0006	0.1400	-0.0629	0.0152	0.4934	9.3629	2154.21	0.00
	Portfolio 3	0.0010	0.1369	-0.0517	0.0125	1.1775	15.8402	8854.53	0.00
	Portfolio 4	0.0008	0.1353	-0.0536	0.0120	0.9752	15.5721	8410.07	0.00
	Portfolio 5	0.0009	0.1040	-0.0433	0.0109	0.5779	9.9188	2556.63	0.00
	Portfolio 6	0.0009	0.0677	-0.0367	0.0094	0.3270	5.7216	407.08	0.00
	Portfolio 7	0.0009	0.0704	-0.0364	0.0080	0.5171	8.0382	1374.44	0.00
Skewness sorted portfolios	Portfolio 1	0.0007	0.1513	-0.0744	0.0169	0.4333	8.7444	1753.53	0.00
	Portfolio 2	0.0008	0.1206	-0.0507	0.0128	0.4868	9.9039	2525.81	0.00
	Portfolio 3	0.0010	0.1509	-0.0631	0.0158	0.6295	9.9580	2597.87	0.00
	Portfolio 4	0.0007	0.1215	-0.0430	0.0115	0.8517	12.6850	5024.46	0.00
	Portfolio 5	0.0010	0.0765	-0.0349	0.0094	0.5494	7.6868	1204.07	0.00
	Portfolio 6	0.0008	0.1093	-0.0336	0.0101	1.0054	13.9411	6429.91	0.00
	Portfolio 7	0.0009	0.0919	-0.0347	0.0093	0.7503	10.7451	3233.82	0.00
Kurtosis sorted portfolios	Portfolio 1	0.0005	0.1612	-0.0739	0.0171	0.6091	10.1040	2699.31	0.00
	Portfolio 2	0.0007	0.1362	-0.0658	0.0140	0.6965	10.8798	3326.93	0.00
	Portfolio 3	0.0010	0.1391	-0.0566	0.0149	0.5798	9.5833	2321.74	0.00
	Portfolio 4	0.0010	0.1216	-0.0478	0.0109	0.9579	15.1958	7918.81	0.00
	Portfolio 5	0.0008	0.1016	-0.0345	0.0105	0.7945	10.3286	2921.77	0.00
	Portfolio 6	0.0010	0.0717	-0.0339	0.0093	0.3430	6.3521	608.27	0.00
	Portfolio 7	0.0008	0.0904	-0.0410	0.0087	0.7959	12.7823	5103.74	0.00
NSE 500		0.0005	0.1502	-0.0560	0.0123	1.3099	18.2736	12477.66	0.00

Table 2. Summary statistics of portfolio return distributions (second testing period – from April 2014 to March 2019)

Particulars	Item	Mean	Max	Min.	Std. Dev.	Skew.	Kurt.	J B Test	p-value
Beta sorted portfolios	Portfolio 1	0.0002	0.0662	-0.0935	0.0145	-0.3366	5.0093	230.51	0.00
	Portfolio 2	0.0001	0.0635	-0.0855	0.0124	-0.2250	6.3144	574.31	0.00
	Portfolio 3	0.0005	0.0297	-0.0803	0.0099	-0.6829	6.9192	884.24	0.00
	Portfolio 4	0.0006	0.0408	-0.0713	0.0110	-0.6115	6.2805	629.22	0.00
	Portfolio 5	0.0002	0.0436	-0.0626	0.0091	-0.5185	6.6326	732.61	0.00
	Portfolio 6	0.0005	0.0282	-0.0523	0.0092	-0.3182	4.3423	113.28	0.00
	Portfolio 7	0.0004	0.0306	-0.0597	0.0092	-0.4966	5.1907	297.00	0.00
Skewness sorted portfolios	Portfolio 1	0.0001	0.0343	-0.0667	0.0103	-0.2734	4.6869	161.42	0.00
	Portfolio 2	0.0002	0.0633	-0.0834	0.0129	-0.3099	6.9778	831.97	0.00
	Portfolio 3	0.0003	0.0564	-0.0959	0.0120	-0.5629	7.0211	895.10	0.00
	Portfolio 4	0.0003	0.0459	-0.0593	0.0102	-0.2617	4.8856	196.58	0.00
	Portfolio 5	0.0005	0.0466	-0.0787	0.0104	-0.5843	6.3134	633.69	0.00
	Portfolio 6	0.0005	0.0410	-0.0594	0.0093	-0.4705	5.2254	299.67	0.00
	Portfolio 7	0.0007	0.0326	-0.0622	0.0098	-0.5241	5.4514	364.88	0.00
Kurtosis sorted portfolios	Portfolio 1	0.0002	0.0459	-0.0720	0.0109	-0.2626	4.9830	216.03	0.00
	Portfolio 2	0.0002	0.0815	-0.1034	0.0142	-0.3016	6.6685	709.52	0.00
	Portfolio 3	0.0002	0.0444	-0.0704	0.0116	-0.5077	5.1193	283.49	0.00
	Portfolio 4	0.0003	0.0337	-0.0733	0.0094	-0.5628	6.7027	768.83	0.00
	Portfolio 5	0.0005	0.0388	-0.0712	0.0096	-0.6199	6.3047	639.50	0.00
	Portfolio 6	0.0004	0.0348	-0.0530	0.0087	-0.4161	4.6573	176.54	0.00
	Portfolio 7	0.0007	0.0326	-0.0622	0.0098	-0.5241	5.4514	364.88	0.00
NSE 500	NSE 500	0.0003	0.0319	-0.0697	0.0087	-0.7391	4.0665	170.57	0.00

and negative and significant correlation during the down markets for both the periods (Model 1) (Table 3 and Table 4). Consequently, the utility of beta as a measure of risk is supported.

Model 2 (Table 3 and Table 4) shows the co-moments (beta and co-skewness). The results describing the conditional relationship for portfolios show a significant and direct correlation between realized returns and beta of portfolios during the up market. The significant and inverse correlation between return and beta during the down markets for both periods. Further, there is an inverse correlation between co-skewness and returns during the up market and a direct correlation between co-skewness and returns during the down market for both periods. Overall, the coefficients of beta and co-skewness have become significant in both the time periods for up and down markets. The predicted signs are also present in all coefficients.

Model 3 (Tables 3 and 4) describe the conditional relation between returns and beta; co-skewness and return; and co-kurtosis and returns for the portfolios. The results (Table 3, Model 3) describing the conditional relationship between realized returns and co-moments show that after including

the co-kurtosis (in addition to co-skewness and beta) in the model, the sign of the coefficient and the significance level of skewness have changed. Although significant, both for the up market and the down market, the coefficients of co-kurtosis have signs contrary to the predicted signs. As this testing period (from 1st April 2009 to 31st March 2014 i.e. 1,247 days) has witnessed the financial crisis, due to which investors' degree of risk aversion might have been on the higher side, thus higher moments, especially co-kurtosis might not have played an important role in the explanation of variation in portfolio returns. Further, to verify this, a regression model was run to examine the conditional impact of beta and co-kurtosis (without co-skewness) on realized return in the Indian stock market from 1 April 2009 to 31 March 2014. The result confirmed that co-kurtosis alone without skewness was not able to explain returns for this testing period. The results (Table 4, Model 3) describing the conditional correlation between realized returns and co-moments during the second testing period show that after including the co-kurtosis (in addition to co-skewness and beta) in the model, the explanation power of regression model describing the conditional correlation between realized returns and co-moments has in-

Table 3. Estimates of risk premium in conditional pricing models

Panel EGLS analysis on portfolio data for the period 1st April 2009 to 31st March 2014
(21 cross-sections, period included 1,247 days and total panel observation 26,187)

Model	α_1 (beta)	α_2 ($D^*\beta_i$)	α_3 (skewness)	α_4 ($D^*\lambda_i$)	α_5 (kurtosis)	α_6 ($D^*\eta_i$)	\overline{R}^2
Model 1	0.0083 (32.4916)*	-0.0183 (-130.9136)*	-	-	-	-	0.3956
Model 2	0.0113 (7.7976)*	-0.0247 (-11.8005)*	-0.0029 (-1.9959)***	0.0062 (3.0600)*	-	-	0.3957
Model 3	0.0203 (6.4793)*	-0.0457 (-10.0146)*	0.0011 (0.5488)	-0.0033 (-1.2092)	-0.0131 (-3.1891)*	0.0306 (5.1800)*	0.3963

Note: Figures in () indicate the value of *t*-statistics. Significant at *1% level, **5% level, *** 10% level.

Table 4. Estimates of risk premium in conditional pricing models

Panel EGLS analysis on portfolio data for the period 1st April 2014 to 31st March 2019
(21 cross-sections, period included 1,232 days and total panel observation 25,872)

Model	α_1 (beta)	α_2 ($D^*\beta_i$)	α_3 (skewness)	α_4 ($D^*\lambda_i$)	α_5 (kurtosis)	α_6 ($D^*\eta_i$)	\overline{R}^2
Model 1	0.0063 (33.2255)*	-0.0148 (-123.3210)*	-	-	-	-	0.3703
Model 2	0.0088 (19.7550)*	-0.0193 (-36.5847)*	-0.0026 (-6.7461)*	0.0049 (8.7988)*	-	-	0.3722
Model 3	0.0022 (1.7147)	-0.0055 (-2.9068)*	-0.0152 (-6.0624)*	0.0313 (8.9271)*	0.0194 (5.1416)*	-0.0406 (-7.6283)*	0.3735

Note: Figures in () indicate the value of *t*-statistics. Significant at *1% level, **5% level.

Table 5. Test for symmetry between co-moments and returns in up and down markets

Time period	Testing period (from April 2009 to March 2014)	Testing period (from April 2009 to March 2014)	Testing period (from April 2009 to March 2014)	Testing period (from April 2014 to March 2019)	Testing period (from April 2014 to March 2019)	Testing period (from April 2014 to March 2019)
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
(<i>t</i> -statistics) $2\alpha_1 + \alpha_2$	-3.2277*	-0.5807	-0.6564	-5.6183*	-1.7278	-0.3453
(<i>t</i> -statistics) $2\alpha_3 + \alpha_4$	-	0.0994	-0.2311	-	-3417	0.1368
(<i>t</i> -statistics) $2\alpha_5 + \alpha_6$	-	-	0.4402	-	-	-0.1975

Note: * significant at 1% level.

creased in this period (from 1st April 2014 to 31st March 2019, i.e., 1,232 days). The coefficients of beta, co-skewness, and co-kurtosis have become significant for upward and downward markets. All coefficients have the predicted sign during the second testing period. Thus, one can infer that during the normal phase of the Indian economy, all three moments, namely, co-variance, co-skewness, and co-kurtosis are priced in the Indian stock market. These study results are in line with Dittmar (2002), Galagedera et al. (2003), Fletcher and Kihanda (2005), Teplova and Shutova (2011).

Table 5 shows the test for symmetry between co-moments and returns in up market and down market for both the testing periods. The *t*-test

has been applied to judge the symmetry of beta, co-skewness, and co-kurtosis during the upward and downward market. The results given in Table 5 state that the total value of the coefficient of beta in absolute terms during the down market is significantly higher than the total value of the coefficient of beta in absolute terms during the up market in case of Model 1 for both the testing periods. In Model 2, beta and co-skewness, and in Model 3 beta, co-skewness, and co-kurtosis are found to be symmetric during the up market as well as the down market. Thus, the analysis depicts that when higher moments (co-skewness and/or co-kurtosis) are involved in the model. The coefficient of all three moments provides symmetry in both the up and down market.

CONCLUSION

In this study, some modifications in the traditional CAPM are done to measure the relationship between risk and returns which includes incorporating higher moments (co-skewness and co-kurtosis) and segmenting the market in two, the rising market (realized return is greater in comparison to risk-free rate of return) and the declining market (realized rate of return is lower compared to risk-free return). This is called a conditional correlation between return and co-moments. The analysis aims to know the empirical soundness of Conditional Higher Moment (CAPM) in India's developing capital market for the sample period from April 2004 to March 2019 using panel data analysis. The overall results show that when both up and down markets are incorporated separately all three moments, namely, co-variance, co-skewness and co-kurtosis are priced during the normal phase of the Indian economy. Further, this study states that including higher moments (co-skewness and/or co-kurtosis) in the two-moment model provide symmetry in both the up and down market. Also, the developed models in this study can be used for short- and long-term period and are applicable for non-volatile, as well as for volatile market like India.

The equilibrium asset pricing models such as higher moment CAPM or traditional models should not be naively used by investors while making a decision for diversification.

Precisely, the portfolio managers should understand that beta play an important role. Those investors who are concerned with the downside risk can opt for low beta stock when the market falls below the risk-free rate. Furthermore, the portfolio managers should also consider skewness and kurtosis in addition to variance while constructing the optimal risky portfolios in the Indian stock market.

AUTHOR CONTRIBUTIONS

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