Asset Pricing Behavior with Higher Moments at Karachi Stock Exchange

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Introduction

- The CAPM of Sharpe (1964), Lintner (1965) and Black (1972) is the major analytical tool for explaining relationship between expected return and risk used in financial economics.
- The CAPM model measures the risk of an asset by covariance of asset's return with the return of all invested wealth, known as market return.
- The principle of risk compensation is that higher beta risk is associated with higher return.

Standard CAPM

- The standard CAPM is inadequate for Pakistan equity market in explaining economically and statistically significant role of market risk for the determination of expected return.

Higher-Moment-CAPM

- The framework of mean-variance based CAPM requires normality condition. since assets show asymmetry and fat tails in the return distribution the preference over higher moments become relevant
- The most common observation of stock return in emerging markets is leptokurtosis, skewness and volatility clustering. Hussain and Uppal (1998) has confirmed this fact for Karachi Stock Exchange.
- First, the standard model is extended by taking higher moments into account.

- When the returns are non-normal and investors have non-quadratic utility, implying that investors are concerned about all moments of the return, not just the mean and variance.
- Furthermore, a quadratic utility function for an investor implies an increasing risk aversion; instead it is more reasonable to assume that risk aversion decreases with an increase in wealth.

Higher Moments

- The skewness characterizes the degree of asymmetry of a distribution among the mean. Positive (negative) skewness indicates a distribution with asymmetric tail extending towards more positive (negative values.
- The kurtosis of a probability distribution refers to the extent to which the distribution tends to have relatively large frequencies around the center and in the tail of distribution.

- The theoretical justification for including higher moments, coskewness and cokurtosis in the asset pricing framework can be read from shape of return distribution.
- The positively skewed distribution tends to offer small probabilities of windfall gains while limit large downside losses. Thus all else equal, investors prefer positively skewed portfolio to negatively skewed portfolio. And they would be willing to deduct a premium for assets that have positive coskewness with the market if the market portfolio is negatively skewed.
- The excess kurtosis reflects either large frequency around the centre (low probabilities of moderate loss) or in the tails of distribution (small probabilities of large losses). Thus kurtosis could be either risk reducing or risk enhancing depending on the trade-off between the fatness at the center and tail of the return distribution.
- The skewness and kurtosis can not be diversified by increasing the size of portfolio thus the non-diversified skewness and kurtosis become important considerations in asset valuation.

Time Conditionality

- The standard CAPM is based on constant risk parameters which is oversimplified.
- Second, the risk factors are allowed to vary over time.
- This study attempt to incorporate the need of higher moments into account in unconditional and conditional context.

Two-Moment CAPM

- Mean-Variance Model

$$E(r_{it}) = \beta_i E(r_{mt})$$

$$\beta_i = Cov\left(R_i - R_f, R_i - R_f\right) / Var\left(R_i - R_f\right)$$

$$r_{it} = \lambda_0 + \lambda_1 \beta_i + \varepsilon_{it}$$

$$\lambda_0 = 0 \qquad \lambda_1 > 0$$

- Cubic Model

$$E(r_{it}) = \beta_i E(r_{mt}) + \gamma_i E(r_{mt})^2 + \kappa_i E(r_{mt})^3$$

$$\gamma_i = \mathrm{cov}(r_{it}, r_{mt}^2) / E(r_{mt} - E(r_{mt}))^3 = \cos kew(r_{it}, r_{mt}) / skew(r_{mt})$$

$$\kappa_i = \mathrm{cov}(r_{it}, r_{mt}^3) / E(r_{mt} - E(r_{mt}))^4 = cokurt\ (r_{it}, r_{mt}) / kurt\ (r_{mt})$$

- The three and four-moments models tested

$$r_{it} = \lambda_0 + \lambda_1 \beta_i + \lambda_4 \gamma_i + \varepsilon_{it}$$

$$r_{it} = \lambda_0 + \lambda_1 \beta_i + \lambda_5 \kappa_i + \varepsilon_{it}$$

$$r_{it} = \lambda_0 + \lambda_1 \beta_i + \lambda_4 \gamma_i + \lambda_5 \kappa_i + \varepsilon_{it}$$

Covariance, Coskewness , Cokutosis Risk

- Out of model calculation

$$\beta_{it} = \frac{\operatorname{cov}ar(r_{it}, r_{mt})}{\operatorname{var}(r_{mt})} = \frac{E(r_{it} - E(r_{it}))(r_{mt} - E(r_{mt}))}{E(r_{mt} - E(r_{mt}))^2}$$

$$\gamma_{it} = \frac{\cos kew(r_{it}, r_{mt})}{skew(r_{mt})} = \frac{E(r_{it} - E(r_{it}))(r_{mt} - E(r_{mt}))^2}{E(r_{mt} - E(r_{mt}))^3}$$

$$\kappa_{it} = \frac{cokurt(r_{it}, r_{mt})}{kurt(r_{mt})} = \frac{E((r_{it} - E(r_{it}))((r_{mt} - E(r_{mt}))^3}{E(r_{mt} - E(r_{mt}))^4}$$

- Investors have positive prefrence for expected return and skewness, they have aversion towards high variance and high kurtosis.

$$\lambda_0 = 0 \qquad \lambda_1 > 0$$

$$\lambda_3 > 0 \quad \lambda_3 < 0$$

$$\lambda_4 > 0$$

- Higher the market risk higher the premium
- Premium of skewness is opposite of market skewness, a negative market skewness is considired as risk and investor expects positive premium.
- High kurtosis fat tails is negative investment incentive and risk premium is positive.

Conditional Higher Momemnet CAPM

$$E_{t-1}(r_{it}) = \beta_{it} E_{t-1}(r_{mt}) + \gamma_{it} E_{t-1}(r_{mt})^2 + \kappa_{it} E_{t-1}(r_{mt})^3$$

$$\beta_{it} = \mathrm{cov}_{t-1}(r_{it}, r_{mt}) / \mathrm{var}_{t-1}(r_{mt})$$

$$\gamma_{it} = \cos kew_{t-1}(r_{it}, r_{mt}) / skew_{t-1}(r_{mt})$$

$$\kappa_{it} = cokurt_{t-1}(r_{it}, r_{mt}) / kurt_{t-1}(r_{mt})$$

- The time-variation in conditional covariance, coskewness and cokurtosis is captured by autoregressive process

$$E(\varepsilon_{it}\varepsilon_{mt}) = \rho_0 + \rho_1\varepsilon_{it-1}\varepsilon_{mt-1} + \rho_2\varepsilon_{it-2}\varepsilon_{mt-2}$$

$$E(\varepsilon_{it}\varepsilon_{mt}^2) = \rho_0 + \rho_1\varepsilon_{it-1}\varepsilon_{mt-1}^2 + \rho_2\varepsilon_{it-2}\varepsilon_{mt-2}^2$$

$$E(\varepsilon_{it}\varepsilon_{mt}^3) = \rho_0 + \rho_1\varepsilon_{it-1}\varepsilon_{mt-1}^3 + \rho_2\varepsilon_{it-2}\varepsilon_{mt-2}^3$$

- The risk premium is estimated by

$$r_{it} = \lambda_{0t} + \lambda_{1t}\beta_i + \lambda_{2t}\gamma_i + \varepsilon_{it}$$

$$r_{it} = \lambda_{0t} + \lambda_{1t}\beta_i + \lambda_{2t}\kappa_i + \varepsilon_{it}$$

$$r_{it} = \lambda_{0t} + \lambda_{1t}\beta_i + \lambda_{2t}\gamma_i + \lambda_{3t}\kappa_i + \varepsilon_{it}$$

Data

- The data include 49 companies which contributed 90% to the total turnover of KSE in the year 2000. The sample period is 1993-2004.
- The overall period is divided into sub-period of three years each , two sub-period of six year and overall sample period.

Data

- Six out of 49 have significant positive mean return. Among these 6 stocks NESTLE has the maximum, positive and significant mean value (0.26%). However, no firm has significantly negative mean return.
- Standard deviation are significant at 1% for all the firms except for the SEMF. The most frequently traded stocks have smaller values of standard deviation for most of the cases.

Data

- The negative value of skewness is not significant for any stock. There are 16 stocks out of 49 with significant positive value of skewness
- The values of excess kurtosis indicate that all the stocks are leptokurtic behavior which is described as fat tails in the literature.
- The J. B. Test are consistent with the results of excess kurtosis that is all stocks deviate from normality.

Empirical Findings

- The risk premium for coskewness is positive for the sub-periods 1993-1995, 1996-1998, 1993-1998, and for overall period 1993-2004, inconclusive and insignificant otherwise in the three-moment CAPM
- When co-kurtosis risk is combined with beta the risk premium for is positive and insignificant for most of the sub periods (only sub-period 1993-1995 the compensation is rewarded.
- When the beta risk is supplemented by both, the results are improved to some extent as coefficient of determination increases

Empirical Findings

- The premium for beta risk is also positive and significant for the period 1993-1995
- The price of conditional co-skewness risk is significantly different from zero in sub periods 1996-1998 and 1993-98 and the overall sample period. 1993-2004.
- The risk premium for conditional co-kurtosis is positive and significant in period 1993-1995, 1993-1998 and 1993-2004.
- The results remain the same for four-moment-CAPM.
- The covariance and co-kurtosis risk is not compensated the, but investors get reward for conditional co-skewness-risk

Conclusion

- The inadequacy of CAPM at KSE leads us to test non-linear generalization of the model in unconditional and conditional context.
- We find that coskewness is important determinant of returns to equity and pricing relationship varies over time.