# Beta and returns revisited. Evidence from international stock markets

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## Abstract

*Traditional tests of the CAPM following the Fama and MacBeth procedure are tests of the joint hypotheses that there is a relationship between beta and realized return and that the market risk premium is positive. Using the approach of Pettengill et al. (1995), we analyze the unconditional versus conditional CAPM relationship between risk and return for 26 international stock markets. We develop extensions to the original model to control for extra risk factors like skewness and kurtosis of stock market returns. Taking into account the difference between positive and negative market excess returns yields, significant conditional relationships between return and beta is found to be in general better fit when the market excess return is negative than positive.*

Keywords: CAPM, market risk premium, beta, return, international markets

JEL classification: G12; G15

## Introduction

The capital asset pricing model (CAPM) developed by Sharpe (1964), Lintner (1965) and Mossin (1966) has been one of the premier models in finance over the last decades. One of the main drawbacks of the CAPM studies based on the unconditional relationship between return and beta risk is the lack of an appropriate statistical methodology to evaluate this relation. There is still considerable controversy about the validity of the CAPM following the study of Fama and French (1992). Fama and French (1992) found a flat relationship between return and beta using 50 years of US stock return data.

The impact of this study is quite large on both academics and practitioners, causing them to reinvestigate the relevance of beta. A number of empirical studies have provided evidence supporting the CAPM or more appropriately the relevance of beta. One body of these studies investigates the market excess return, defined by market return minus risk free rate, taking into account whether the market excess return is positive or negative, or more simply stated, whether the market is up or down. They are, among others, Chan and Lakonishok (1993), Grundy and Malkiel (1996), Fletcher (1997, 2000), and Pettengill et al. (1995). Similar findings of an insignificant relationship between beta and return have been observed in UK stock returns by Strong and Xu (1997).

A number of studies have examined the implications of the CAPM within an international context. Cumby and Glen (1990), Harvey and Zhou (1993) and Ferson and Harvey (1993) all were unable to reject the unconditional mean-variance efficiency of the Morgan Stanley Capital International (MSCI) world equity index. Korajczyk and Viallet (1989) reject the mean-variance efficiency of a market index constructed from the securities of four countries. Ferson and Harvey (1993) point out that the mean-variance efficiency tests may lack power and document a weak cross-sectional relationship between beta and return. Heston et al. (1999) explore the cross-sectional relationship between return and beta and size in European stock returns using individual securities.

An appropriate methodology, however, requires adjustment to take into account that realized returns and not expected (ex-ante) returns should be used in the tests. A recent study by Pettengill et al (1995) proposes a potential explanation of the observed weak relationship between beta and return in US stock returns. They argue that it is necessary to adjust the statistical methodology, to evaluate the relationship between beta and return because of the fact that realized returns and not expected returns are used in the tests. They develop a conditional relationship between return and beta that depends on whether the excess return on the market index is positive or negative. In periods where the excess market return is positive (up market) there should be a positive relationship between beta and return. In periods where the excess market return is negative (down market) there should be a negative relationship between beta and return. This is because high beta stocks will be more sensitive to the negative market excess return and have a lower return than low beta stocks.

The evidence in Pettengill et al. (1995) shows that for the period 1936 to 1990, there is strong support for beta in US stock returns when the sample period is split into up market and down market months. Fletcher (1997, 2000) and Hodoshima et al (2000) find that there is support for a significant positive relationship between beta and return in up month and a significant negative relationship between betas and return in down market months in UK, international stock markets and Japan, respectively.

This paper examines the conditional relationship between beta and return in international stock returns between January 1997 and December 2006 using the model of Pettengill et al. (1995). Our study differs from previous research in controlling for empirical extra risk factors that have been identified in the literature as anomalies of the markets. In this study, in addition to examine the conditional versus unconditional relationship between portfolio beta and return, we control for risk factors such as: skewness and kurtosis of excess market returns.

The paper is outlined as follows. Section 2 contains the regression methodology used in the tests. Section 3 refers to the positive and negative excess market returns while in section 4 the data and the descriptive statistics are presented. Section 4 includes the main empirical results. Section 5 reports the results of the study. The final section contains the concluding remarks.

## Model specification and econometric methodology

The zero-beta CAPM of Black (1972) predicts that:

$$E(R_i) = \gamma_0 + \gamma_1 \beta_1 \quad (0.1)$$

for all i = 1,...,N where $E(R_i)$ is the expected return on asset i, $\beta_\iota$ is the beta of asset i where $\beta_\iota$ is the $\frac{\mathrm{cov}(R_i, R_m)}{\mathrm{var}(R_m)}$, $\gamma_0$ is the expected return on the portfolio which has a zero covariance with the market portfolio, $\gamma_1$ is the expected risk premium of the market portfolio. The CAPM predicts that there should be a positive risk premium on beta.

Extending the CAPM to an international setting requires additional assumptions. The main one is that capital markets are integrated and purchasing power parity holds. Most empirical studies use the two-pass regression methodology of Fama and MacBeth (1973). In the first step, $\beta_\iota$ is estimated from the regression model:

$$Rit = \alpha_\iota + \beta_\iota R_{mt} + e_{it} \quad (0.2)$$

where $R_{it}$ is the return on asset i in period t, $R_{mt}$ is the return on the market proxy portfolio in period t, $e_{it}$ is a random error term and $\beta_\iota$ is the beta of asset i. It is assumed that the error terms are independently and identically distributed with mean zero and stationary covariance matrix and $R_{mt}$ is drawn from a stationary distribution.
In the second stage, a cross-sectional regression equation is estimated:

$$Rit = \gamma_{ot} + \gamma_{1t} \beta_\iota + u_{it} \quad (0.3)$$

where $\beta_\iota$ is estimated from equation 2 and $u_{it}$ is the random error term. The above equation is estimated by the method of ordinary least squares (OLS) The values of $\gamma_0$ and $\gamma_1$ are calculated and can be tested to see if it is significantly different from zero using the t test of Fama and MacBeth (1973).

The two-stage methodology of Fama and MacBeth (1973) ignores the estimation error in beta from the first stage. Shanken (1992) points out that the Fama and MacBeth (1973) standard errors will tend to overstate the precision of the parameters. However, Jagannathan and Wang (1998) argue that if the assumptions of Shanken (1992) do not hold, the standard errors may not be too high.

Pettengill et al. (1995) adjust the Fama and MacBeth (1973) approach to examine the conditional relationship between beta and return. They argue that studies focusing on the relationship between return and beta should take account of the fact that ex post returns are used in the tests and not ex ante returns. When realized returns are used, a conditional relationship between beta and return should exist. This occurs since there must be some probability where investors expect that the realized return on a low beta portfolio is greater than the return on a high beta portfolio. This is because no investor would hold the low beta portfolio if this were not the case. Pettengill et al. (1995) assume that this occurs when the market return is lower than the risk-free return, which they suggest is implied by the excess returns market model. The implication of this is that there should be a positive relationship between beta and return when the excess market return is positive and a negative relationship when the excess market return is negative.

Pettengill et al. (1995) propose the following specification of the conditional relationship between beta and return:

$$R_{it} = \gamma_{0t} + \gamma_{2t} D\beta_i + \gamma_{3t}(1-D)\beta_i + e_{it} \quad (0.4)$$

where $D=1$ if $(R_{mt} - R_{ft}) >$ or equal to $0$ and $D=0$ if $(R_{mt} - R_{ft}) < 0$. $R_{ft}$ is the risk free rate and $R_{mt}$ is the market portfolio return. The predicted hypotheses in this case are: $H_0 : \gamma_2 = 0$ versus $H_A : \gamma_2 > 0$ and $H_0 : \gamma_3 = 0$ versus $H_A : \gamma_3 < 0$. Using standard t-tests, the statistical significance of these coefficients can be tested.

Pettengill et al. (1995) point out that the conditional relationship does not imply a positive relationship between risk and return. According to them, in order to test a positive relationship between risk and return, two conditions are necessary. Collectively, these are that (1) the excess market return should be positive on average and (2) the beta risk premium in up markets and down markets should be symmetrical.

The importance of additional risk factors (like skewness and kurtosis) can be studied by adding additional risk factors to equations (0.3) and (0.4). The inclusion of higher moments (skewness and kurtosis) of stock returns is justified when stock returns are not normally distributed. The study of Scott and Horvath (1980) shows that rational investors prefer positive skewness but dislike kurtosis. Following the unconditional and conditional relationship between realized returns and risk incorporating higher moments (skewness and kurtosis) the equations are constructed as follows:

$$Rit = \gamma_{ot} + \gamma_{1t}\beta_\iota + \gamma_{2t} SKEW_{it} + u_{it} \quad (0.5)$$

$$R_{it} = \gamma_{0t} + \gamma_{2t} D\beta_i + \gamma_{3t}(1-D)\beta_i + \gamma_{4t} DSKEW_{it} + \gamma_{5t}(1-D)SKEW_{it} + e_{it} \quad (0.6)$$

and

$$Rit = \gamma_{ot} + \gamma_{1t}\beta_\iota + \gamma_{2t} KURT_{it} + u_{it} \quad (0.7)$$

$$R_{it} = \gamma_{0t} + \gamma_{2t} D\beta_i + \gamma_{3t}(1-D)\beta_i + \gamma_{4t} DKURT_{it} + \gamma_{5t}(1-D)KURT_{it} + e_{it} \quad (0.8)$$

where $SKEW_{it}$ and $KURT_{it}$ are, respectively, country $i$'s relative skewness and kurtosis coefficients risk factors.

## Positive and Negative Market Excess Return

According to the model a systematic relationship must exist between beta risk and return for beta to be a useful measure of risk. The CAPM model shows an unconditional systematic and positive relationship between beta and expected return. However, the CAPM model also implies a conditional relationship between realized returns and beta (i.e., a positive relationship during positive market excess return periods and a negative relationship during negative market excess return periods). If realized market returns were barely less than the risk-free rate, this conditional relationship would have no significant impact on tests of the relationship between beta and returns. This condition, however, occurs frequently. A month-by-month comparison of the MSCI index (as the proxy for the market portfolio return) and the monthly equivalent 90-day Treasury-bill rate (as the measure for the risk-free return) over the period 1997 through 2006 indicates that the Treasury Bill rate exceeds the market return in 48% of the cases.

As Pettengill et al. state, the presence of a large number of negative market excess return periods suggests that those studies that test for an unconditional positive association between beta risk and realized returns are biased against finding a systematic relationship.

## Data and Descriptive statistics

This study examines the conditional relationship between beta and return in monthly international stock market returns between January 1997 and December 2006.

The data consists of monthly closing prices on 26 international stock markets indexes and the Morgan Stanley Capital International (MSCI) World index. The return on the MSCI world index is used as a proxy for the market portfolio. The monthly return on a 3 month US Treasury Bill (obtained from the Federal Reserve Bank of Chicago internet site) is used as a proxy for the risk-free asset that better depicts short term chnages in the financial environment.

The countries included in the study are, Argentina (ARG), Austria (AUS), Belgium (BELG), Brazil (BRA), China (CHI), Denmark (DEN), Egypt (EGY), France (FRA), Germany (GER), Greece (GRE), Hong Kong (HOK), India (IND), Indonesia (IDN), Israel (ISR), Italy (ITA), Japan (JAP), Korea (KOR), Mexico (MEX), Netherlands (NETH), Norway (NOR), Russia (RUS), Switzerland (SWITZ), Taiwan (TAI), Turkey (TURK), United Kingdom (UK) and finally USA (US). The selection of these countries was based on their importance from financial point of view according to their geographical position.

{Insert Table 1 from appendix here}

Table 1 includes summary statistics of the 26 equity markets and the world index. The table reports the mean return, standard deviation, minimum and maximum returns and the beta of each country with respect to the World index. The results are reported for the whole sample period. Table 1 also reports the additional sources of risk that will be examined such as the skewness and the kurtosis, higher moments of stock returns.

The mean returns range between -1.00% (Taiwan) and 6.00% (Turkey). Although Turkey has the highest mean return, it also has the highest standard deviation. The standard deviations range between 7.70% (MSCI) and 19.10% (Turkey). Thirteen of the twenty six countries have negative average returns. It is important to realize that the period of time under study, January 1997 to December 2006, was a very volatile period for the world stock markets (Asian financial crises in 1997 and 1998, Russia, Brazil and Long Term Capital Management close to default in 1998, the bursting of the technology stock bubble in the spring of 2000, and the September 11 2001 terrorist attacks on the World Trade Centre).

The world index has the second smaller deviation across the markets. This reflects the benefits of risk reduction due to diversification. The MSCI is calculated by the individual indices of all the major stock markets taking the average weighting factor of their market share. The MSCI index is calculated using the Laspeyres' concept of a weighted arithmetic average.

The betas on the national equity markets with respect to the world index show a reasonably wide spread. Most stock markets have a beta above 0.6534. It is interesting to note that Turkey has significant low beta but the highest standard deviation.

## Empirical Evidence

The unconditional relationship between beta and return in equation 3 is examined over the whole sample period. Table 2 presents the mean of the monthly coefficients $\gamma_{ot}$ and $\gamma_{1t}$.

{Insert Table 2 from appendix here}

The evidence in Table 2 shows that there is no significant relationship between beta and return in international stock returns between January 1997 and December 2006. This is consistent with Fama and French (1992) and a number of other studies that document a flat relationship between beta and return in the US and in other countries. Ferson and Harvey (1994) also find a weak relationship between beta and return in international stock returns.

Pettengill et al. (1995) argue that the flat relationship between beta and return can be explained by the failure to take account of the fact that realized returns are used in the test rather than expected returns. The conditional beta and return relationship implies that high beta countries like Turkey will have higher returns than low beta countries in up market months and poorer returns in down market months.

{Insert Table 3 from appendix here}

Table 3 reports the results of the tests of the hypotheses in equation 4. The table includes the $\gamma_2$ and $\gamma_3$ coefficients and the corresponding Fama and MacBeth (1973) t statistics. The table also reports the symmetrical relationship between up market and down market months. The results are reported for the whole sample period.

The evidence in Table 3 for the overall sample period is not consistent with the predictions of the Pettengill et al. (1995) model. There is a significant negative relationship between return and beta in up market months and a significant negative relationship in down market months. Furthermore, the hypothesis of a symmetric relationship between up market and down market months is very small almost zero. The evidence is not consistent with the results in US stock returns by Pettengill et al. (1995). This cannot suggest that beta is a useful tool in terms of asset allocation in identifying aggressive and defensive countries. In general it can be said that the evidence is less favourable but generally there is some support for the relationship between beta and return. In the conditional beta and return relationship there is a significant negative relationship between beta and return in up market months but there is also a significant relationship in down market months. This implies that the relationship in down market months is much stronger than in up market months during the sample period.

The results of skewness and kurtosis to the unconditional risk-return relationship of the international markets are presented in Table 4.

{Insert Table 4a and 4b from appendix here}

The unconditional model of skewness shows that skewness is positively related to returns, but the relationship is insignificant at the 5% (Table 4a). The results of the unconditional model of kurtosis and returns show a negative relation (Table 4b).

The conditional model of the relation between risk, kurtosis, skewness and return for international stock markets is presented in Table 5.

{Insert Table 5a and 5b from appendix here}

The conditional model echoes the unconditional model which shows that there exist an insignificant positive relationship, at the 5% level, between skewness and returns in both up and down markets. In contrast, the results of the conditional model show that kurtosis is negatively related to realised returns in up markets and positively related to realised returns in down markets.

The results seem not to support the predictions of Pettengill et al. (1995). There is a significant no positive relationship between beta and return in up market months and a significant negative relationship in down market months. In down markets, there is a significantly negative relationship between the world market beta and returns, suggesting that high-beta markets incur higher losses than low-beta markets. These results are consistent with the Sharpe-Lintner hypothesis. The evidence in the paper tends to support the conditional beta and return relationship of Pettengill et al. (1995). It also give partial support the usefulness of beta to the international investor only in down market months. Grundy and Malkiel (1996) argue that investors require a risk measure that captures the exposure of an investment to a market fall. The evidence in the paper suggests that beta does capture this in that high beta countries have poorer returns on average in down market months.

## Conclusions

In this paper, we study both the conditional and unconditional CAPM versions as applied to the most important stock markets for the period January 1997 to December 2006. As extensions of these CAPM versions, we control for extra risk factors, which might also explain the conditional return variation on each of the above stock markets. This study provides a framework for a better understanding about how securities are priced across different stock markets and may also help investors to improve their results in terms of portfolio performance.

Consistent with previous research, there is no evidence of a positive unconditional relationship between beta and return. These findings suggest that the unconditional CAPM model might be either misspecified or additional risk factors other than beta might be required to explain the trade-off between risk and return.

In addition when the tests are estimated taking account of the conditional relationship between beta and return there is partial support for the model. The paper finds a significant negative relationship in up market months and a significant negative relationship in down market months. However, it is important to realize that the period of time under study, January 1997 to December 2006, was a very volatile period for the world stock markets (Asian financial crises in 1997 and 1998, Russia, Brazil and Long Term Capital Management close to default in 1998, the bursting of the technology stock bubble in the spring of 2000, and the September 11 2001 terrorist attacks on the World Trade Centre).

Overall the paper suggests that beta is a useful tool in explaining cross-sectional differences in country index returns in down market months where investors seek with more agony a risk measure that captures the exposure of an investment to a market fall.

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**Appendix**

**Table 1: Summary statistics**

| Country | Mean Rit | Beta | Median | Max | Min | Std. Dev. | Skew | Kurt | Jarque-Bera |
|---|---|---|---|---|---|---|---|---|---|
| ARG | 0.0011 | 0.6727 | 0.0181 | 0.4229 | -0.6465 | 0.1386 | -0.7619 | 6.9738 | 89.8117 |
| AUS | 0.0030 | 0.8592 | 0.0117 | 0.1814 | -0.3428 | 0.0856 | -1.0163 | 5.1005 | 42.3605 |
| BELG | -0.0032 | 0.8717 | 0.0024 | 0.1684 | -0.3029 | 0.0770 | -1.1190 | 6.0225 | 70.1327 |
| BRA | 0.0063 | 0.8119 | 0.0148 | 0.2574 | -0.6538 | 0.1262 | -1.4636 | 8.4378 | 189.0993 |
| CHI | 0.0017 | 0.7839 | 0.0136 | 0.1642 | -0.3282 | 0.0849 | -1.0095 | 5.1479 | 43.0894 |
| DEN | 0.0002 | 0.5427 | 0.0021 | 0.2327 | -0.3619 | 0.0971 | -0.7979 | 5.1380 | 35.2933 |
| EGY | -0.0051 | 0.9464 | 0.0084 | 0.1959 | -0.2565 | 0.0757 | -0.7018 | 5.0128 | 29.8563 |
| FRA | -0.0016 | 0.8931 | 0.0051 | 0.2028 | -0.2542 | 0.0840 | -0.6370 | 3.9842 | 12.8496 |
| GER | 0.0081 | 0.6534 | 0.0383 | 0.4865 | -0.9749 | 0.1792 | -1.7798 | 10.2270 | 321.7992 |
| GRE | 0.0029 | 0.5259 | 0.0113 | 0.9395 | -0.7107 | 0.1538 | 0.9098 | 17.1117 | 103.8140 |
| HOK | -0.0073 | 0.8016 | 0.0050 | 0.2544 | -0.3434 | 0.0953 | -0.8146 | 5.0303 | 33.5992 |
| IND | 0.0019 | 0.7285 | 0.0156 | 0.1832 | -0.2937 | 0.0947 | -0.9142 | 3.7211 | 19.1550 |
| IDN | 0.0003 | 0.7030 | 0.0185 | 0.2654 | -0.4916 | 0.1198 | -1.0256 | 5.3187 | 47.5208 |
| ISR | 0.0085 | 0.7784 | 0.0148 | 0.2951 | -0.2449 | 0.0806 | -0.4359 | 5.1396 | 26.4690 |
| ITA | -0.0017 | 0.8767 | 0.0089 | 0.2115 | -0.3452 | 0.0964 | -0.8194 | 4.5337 | 24.9776 |
| JAP | -0.0098 | 0.8641 | 0.0054 | 0.1428 | -0.3402 | 0.0847 | -1.3981 | 6.0144 | 83.8193 |
| KOR | -0.0036 | 0.6715 | -0.0031 | 0.3821 | -0.3743 | 0.1158 | -0.2688 | 4.3146 | 10.0021 |
| MEX | 0.0084 | 0.8813 | 0.0230 | 0.2181 | -0.5002 | 0.1046 | -1.5020 | 8.0118 | 169.2865 |
| NETH | 0.0030 | 0.8592 | 0.0117 | 0.1814 | -0.3428 | 0.0856 | -1.0163 | 5.1005 | 42.3605 |
| NOR | -0.0018 | 0.8717 | 0.0120 | 0.1626 | -0.2827 | 0.0793 | -0.9669 | 4.6186 | 31.5323 |
| RUS | 0.0081 | 0.6534 | 0.0383 | 0.4865 | -0.9749 | 0.1792 | -1.7798 | 10.2270 | 321.7992 |
| SWITZ | -0.0042 | 0.8798 | 0.0034 | 0.1873 | -0.2738 | 0.0877 | -0.6606 | 3.9249 | 12.8974 |
| TAI | -0.0100 | 0.7349 | -0.0012 | 0.2637 | -0.3134 | 0.0990 | -0.6144 | 3.9909 | 12.3558 |
| TURK | 0.0569 | 0.0180 | 0.0143 | 0.9727 | -0.3323 | 0.1912 | 1.5151 | 7.0937 | 128.6182 |
| UK | -0.0021 | 0.8940 | 0.0022 | 0.2106 | -0.3603 | 0.0821 | -0.9044 | 6.1736 | 66.1634 |
| USA | -0.0032 | 0.9805 | -0.0011 | 0.1690 | -0.3080 | 0.0773 | -1.0549 | 5.9400 | 64.9279 |
| MSCI | -0.0032 | | 0.0024 | 0.1684 | -0.3029 | 0.0770 | -1.1190 | 6.0225 | 70.1327 |

Note: The table reports summary statistics of the Morgan Stanley Capital International (MSCI) equity index for the period 1997 to 2006. The table includes the mean return, median, standard deviation, minimum and maximum return, skewness and kurtosis of the 26 stock market indexes. The betas of each country are estimated with respect to the MSCI index. The final column reports the Jarque Bera statistic.

**Table 2: Tests of unconditional beta and return relationship**

| $\gamma_{0t}$ | 0.0410 | $\gamma_{1t}$ | -0.0510 |
|---|---|---|---|
| t-statistics | (6.5451) | t-statistics | (-6.3827) |
| Std. Error | 0.0063 | Std. Error | 0.0080 |
| | | | |
| R-squared | 0.6293 | Mean dependent var | 0.0022 |
| Adjusted R-squared | 0.6138 | S.D. dependent var | 0.0123 |
| S.E. of regression | 0.0077 | Akaike info criterion | -6.8312 |
| Sum squared resid | 0.0014 | Schwarz criterion | -6.7344 |
| Log likelihood | 90.8054 | F-statistic | 40.7397 |
| Durbin-Watson stat | 2.1354 | Prob(F-statistic) | 0.0000 |

**Table 3: Tests of the conditional relationship between beta & return**

| $\gamma$0t | 0.0410 | $\gamma$2t | -0.0511 | $\gamma$3t | -0.0510 |
|---|---|---|---|---|---|
| t-Statistic | (6.3718) | t-Statistic | (-5.9920) | t-Statistic | (-6.1281) |
| Std. Error | 0.0064 | Std. Error | 0.0085 | Std. Error | 0.0083 |
| | | | | | |
| R-squared | 0.6293 | Mean dependent var | 0.0022 | | |
| Adjusted R-squared | 0.5971 | S.D. dependent var | 0.0123 | | |
| S.E. of regression | 0.0078 | Akaike info criterion | -6.7543 | | |
| Sum squared resid | 0.0014 | Schwarz criterion | -6.6091 | | |
| Log likelihood | 90.8055 | F-statistic | 19.5215 | | |
| Durbin-Watson stat | 2.1332 | Prob(F-statistic) | 0.0000 | | |
| $\gamma_2 - \gamma_3$ = 0. | -0.0001 | | | | |

Note: The conditional beta and return relationship of Pettengill et al. (1995) is estimated between January 1997 and December 2006. The betas of each country are estimated over the whole sample period relative to the MSCI World index. The table includes the mean risk premiums in up market months (positive excess market returns) $\gamma_2$ and down market months (negative excess market returns) $\gamma_3$. The *t* statistics (in parentheses) are the Fama and MacBeth (1973) *t* statistics (one-tail) and test whether the mean values of $\gamma_2$ and $\gamma_3$ are significantly positive and negative, respectively. The last row is a *t* test of whether $\gamma_2 - \gamma_3 = 0$. The results are reported for the overall sample period

**Table 4a Unconditional relationship between beta, skewness & return**

| $\Gamma_{0t}$ | 0.0456 | $\gamma_{1t}$ | -0.0531 | $\gamma$2t(SKEW) | 0.0037 |
|---|---|---|---|---|---|
| t-Statistic | (6.9619) | t-Statistic | (-6.8477) | t-Statistic | (1.7608) |
| Std. Error | 0.0065 | Std. Error | 0.0078 | Std. Error | 0.0021 |
| | | | | | |
| R-squared | 0.6733 | Mean dependent var | 0.0022 | | |
| Adjusted R-squared | 0.6449 | S.D. dependent var | 0.0123 | | |
| S.E. of regression | 0.0073 | Akaike info criterion | -6.8807 | | |
| Sum squared resid | 0.0012 | Schwarz criterion | -6.7355 | | |
| Log likelihood | 92.4492 | F-statistic | 23.7026 | | |
| Durbin-Watson stat | 2.4580 | Prob(F-statistic) | 0.0000 | | |

**Table 4b Cunconditional relationship between beta, kurtosis & return**

| $\Gamma$0t | 0.0411 | $\gamma_{1t}$ | -0.0509 | $\gamma$2t(KURT) | -0.0001 |
|---|---|---|---|---|---|
| t-Statistic | (6.3736) | t-Statistic | (-6.1571) | t-Statistic | (-0.1444) |
| Std. Error | 0.0064 | Std. Error | 0.0083 | Std. Error | 0.0005 |
| | | | | | |
| R-squared | 0.6296 | Mean dependent var | 0.0022 | | |
| Adjusted R-squared | 0.5974 | S.D. dependent Var | 0.0123 | | |
| S.E. of regression | 0.0078 | Akaike info crit. | -6.7552 | | |
| Sum squared resid | 0.0014 | Schwarz criterion | -6.6100 | | |
| Log likelihood | 90.8171 | F-statistic | 19.5492 | | |
| Durbin-Watson stat | 2.1557 | Prob(F-statistic) | 0.0000 | | |

**Table 5a Conditional relationship between beta, skewness and return**

| | | | | | |
|---|---|---|---|---|---|
| $\gamma_{0t}$ | 0.0456 | $\gamma_{2t}$ | -0.0537 | $\gamma_{3t}$ | -0.0522 |
| t-Statistic | 6.3905 | t-Statistic | -6.2997 | t-Statistic | -5.4877 |
| Std. Error | 0.0071 | Std. Error | 0.0085 | Std. Error | 0.0095 |
| $\gamma_{4t}$(SKEW, up markets) | 0.0035 | $\gamma_{5t}$(SKEW, down markets) | 0.0041 | | |
| t-Statistic | 1.2349 | t-Statistic | 1.2274 | | |
| Std. Error | 0.0029 | Std. Error | 0.0033 | | |
| | | | | | |
| R-squared | 0.6746 | Mean dependent var | 0.0022 | | |
| Adjusted R-squared | 0.6126 | S.D. dependent var | 0.0123 | | |
| S.E. of regression | 0.0077 | Akaike info criterion | -6.7307 | | |
| Sum squared resid | 0.0012 | Schwarz criterion | -6.4887 | | |
| Log likelihood | 92.4988 | F-statistic | 10.8821 | | |
| Durbin-Watson stat | 2.4193 | Prob(F-statistic) | 0.0001 | | |

**Table 5b Unconditional relationship between beta, kurtosis & return**

| | | | | | |
|---|---|---|---|---|---|
| $\gamma_{0t}$ | 0.0435 | $\gamma_{2t}$ | -0.0504 | $\gamma_{3t}$ | -0.0560 |
| t-Statistic | 6.2873 | t-Statistic | -5.8102 | t-Statistic | -5.7384 |
| Std. Error | 0.0069 | Std. Error | 0.0087 | Std. Error | 0.0098 |
| $\gamma_{4t}$(KURT, up markets) | -0.0012 | $\gamma_{5t}$(KURT, down markets) | 0.0003 | | |
| t-Statistic | -1.0725 | t-Statistic | 0.4944 | | |
| Std. Error | 0.0011 | Std. Error | 0.0007 | | |
| | | | | | |
| R-squared | 0.6523 | Mean dependent var | 0.0022 | | |
| Adjusted R-squared | 0.5861 | S.D. dependent var | 0.0123 | | |
| S.E. of regression | 0.0079 | Akaike info criterion | -6.6645 | | |
| Sum squared resid | 0.0013 | Schwarz criterion | -6.4225 | | |
| Log likelihood | 91.6379 | F-statistic | 9.8484 | | |
| Durbin-Watson stat | 2.1434 | Prob(F-statistic) | 0.0001 | | |