A Review of Capital Asset Pricing Models

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Abstract

This paper provides a review of the main features of asset pricing models. The review includes single-factor and multifactor models, extended forms of the Capital Asset Pricing Model (CAPM) with higher order co-moments, and asset pricing models conditional on time-varying volatility.

Key words: Asset pricing, CAPM, single-factor and multifactor models

1. Introduction

The foundations for the development of asset pricing models were laid by Markowitz (1952) and Tobin (1958). Early theories suggested that the risk of an individual security is the standard deviation of its returns – a measure of return volatility. Thus, the larger the standard deviation of security returns the greater the risk. An investor's main concern, however, is the risk of his/her total wealth made up of a collection of securities, the portfolio. Markowitz observed that (i) when two risky assets are combined their standard deviations are not additive, provided the returns from the two assets are not perfectly positively correlated and (ii) when a portfolio of risky assets is formed, the standard deviation risk of the portfolio is less than the sum of standard deviations of its constituents. Markowitz was the first to develop a specific measure of portfolio risk and to derive the expected return and risk of a portfolio. The Markowitz model generates the efficient frontier of portfolios and the investors are

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expected to select a portfolio, which is most appropriate for them, from the efficient set of portfolios available to them.

The computation of risk reduction as proposed by Markowitz is tedious. Sharpe (1964) developed a computationally efficient method, the single index model, where return on an individual security is related to the return on a common index. The common index may be any variable thought to be the dominant influence on stock returns and need not be a stock index (Jones, 1991). The single index model can be extended to portfolios as well. This is possible because the expected return on a portfolio is a weighted average of the expected returns on individual securities.

When analysing the risk of an individual security, however, the individual security risk must be considered in relation to other securities in the portfolio. In particular, the risk of an individual security must be measured in terms of the extent to which it adds risk to the investor's portfolio. Thus, a security's contribution to portfolio risk is different from the risk of the individual security.

Investors face two kinds of risks, namely, diversifiable (unsystematic) and non-diversifiable (systematic). Unsystematic risk is the component of the portfolio risk that can be eliminated by increasing the portfolio size, the reason being that risks that are specific to an individual security such as business or financial risk can be eliminated by constructing a well-diversified portfolio. Systematic risk is associated with overall movements in the general market or economy and therefore is often referred to as the market risk. The market risk is the component of the total risk that cannot be eliminated through portfolio diversification.

The CAPM developed by Sharpe (1964) and Lintner (1965), discussed in the following section, relates the expected rate of return of an individual security to a measure of its systematic risk. Since then, a variety of models have been developed to predict asset returns. These are discussed in Section 3. A brief summary is given in Section 4.

2 The capital asset pricing model

The CAPM conveys the notion that securities are priced so that the expected returns will compensate investors for the expected risks. There are two fundamental relationships: the capital market line and the security market line. These two models are the building blocks for deriving the CAPM. Even though they are not new, it is illustrative to discuss them here briefly. Further, since one of the aims of this thesis is to investigate various forms of CAPM, these models deserve some attention in this paper.

2.1 Capital market line

The capital market line (CML) specifies the return an individual investor expects to receive on a portfolio. This is a linear relationship between risk and return on efficient portfolios that can be written as:

$$E(R_p) = R_f + \sigma_p \left[\frac{E(R_m) - R_f}{\sigma_m} \right] \tag{1}$$

where,

R_p = portfolio return,

R_f = risk-free asset return,

R_m = market portfolio return,

σ_p = standard deviation of portfolio returns, and

σ_m = standard deviation of market portfolio returns.

According to (3.2.1), the expected return on a portfolio can be thought of as a sum of the return for delaying consumption and a premium for bearing risk inherent in the portfolio. The CML is valid only for efficient portfolios and expresses investors' behaviour regarding the market portfolio and their own investment portfolios.

3.2.2 Security market line

The security market line (SML) expresses the return an individual investor can expect in terms of a risk-free rate and the relative risk of a security or portfolio. The SML with respect to security *i* can be written as:

$$E(R_i) = R_f + \beta_i \left\{E(R_m) - R_f\right\} \qquad (2)$$

where,

$$\beta_i = \frac{\sigma_i r_{im}}{\sigma_m} = \frac{\operatorname{cov}(R_i, R_m)}{\sigma_m^2}, \qquad (3)$$

and r_{im} = the correlation between security return, R_i and market portfolio return. The β_i can be interpreted as the amount of non-diversifiable risk inherent in the security relative to the risk of the market portfolio. Equation (2) is a version of the CAPM. The set of assumptions[1] sufficient to derive the CAPM version of (2) are the following:

(i) the investor's utility functions are either quadratic or normal,

(ii) all diversifiable risks are eliminated and

(iii) the market portfolio and the risk-free asset dominates the opportunity set of risky assets.

The SML is applicable to portfolios as well. Therefore, SML can be used in portfolio analysis to test whether securities are fairly priced, or not.

[1] See Sinclair (1987) for a description of these assumptions.

3 Asset pricing models

3.1 Single-factor CAPM

In order to test the validity of the CAPM researchers always test the SML given in (2). The CAPM is a single-period *ex ante* model. However, since the *ex ante* returns are unobservable, researchers rely on realised returns. So the empirical question arises: Do the past security returns conform to the CAPM?

The beta in such an investigation is usually obtained by estimating the security characteristic line (SCL) that relates the excess return on security i to the excess return on some efficient market index at time *t*. The *ex post* SCL can be written as:

$$R_{it} - R_{ft} = \eta_i + b_i\left(R_{mt} - R_{ft}\right) + \varepsilon_{it} \qquad (4)$$

where, η_i is the constant return earned in each period and b_i is an estimate of β_i in the SML. The estimated β_i is then used as the explanatory variable in the following cross-sectional equation:

$$R_{it} = \gamma_0 + \gamma_1 b_i + u_{it} \qquad (5)$$

to test for a positive risk return trade-off. The coefficient γ_0 is the expected return of a zero beta portfolio, expected to be the same as the risk-free rate and γ_1 is the market price of risk (market risk premium), which is significantly different from zero and positive in order to support the validity of the CAPM. When testing the CAPM using (4) and (5), we are actually testing the following issues: (i) b_i s are true estimates of historical β_i s, (ii) the market portfolio used in empirical studies is the appropriate proxy for the efficient market portfolio for measuring historical risk premium and (iii) the CAPM specification is correct (Radcliffe, 1987).

Early studies (Lintner, 1965; Douglas, 1969) on CAPM were primarily based on individual security returns. Their empirical results were discouraging. Miller and Scholes (1972) highlighted some statistical problems encountered when using individual securities in testing the validity of the CAPM. Most studies subsequently overcame this problem by using portfolio returns. Black, Jensen and Scholes (1972), in their study of all the stocks of the New York Stock Exchange over the period 1931-1965, formed portfolios and reported a linear relationship between the average excess portfolio return and the beta, and for beta >1 (<1) the intercept tends to be negative (positive). Therefore, they developed a zero-beta version of the CAPM model where the intercept term is allowed to change in each period. Extending the Black, Jensen and Scholes (1972) study, Fama and MacBeth (1973) provided evidence (i) of a larger intercept term than the risk-free rate, (ii) that the linear relationship between the average return and the beta holds and (iii) that the linear relationship holds well when the data covers a long time period. Subsequent studies, however, provide weak empirical evidence on these relationships. See, for example, Fama and French (1992), He and Ng (1994), Davis (1994) and Miles and Timmermann (1996).

The mixed empirical findings on the return-beta relationship prompted a number of responses:
(i) The single-factor CAPM is rejected when the portfolio used as a market proxy is inefficient. See[2], for example, Roll (1977) and Ross (1977). Even very small deviations from efficiency can produce an insignificant relationship between risk and expected returns (Roll and Ross, 1994; Kandel and Stambaugh, 1995).
(ii) Kothari, Shanken and Sloan (1995) highlighted the survivorship bias in the data used to test the validity of the asset pricing model specifications.

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[2] Also see Fama and MacBeth (1973), Black (1993) and Chan and Lakonishok (1993) and the references therein.

(iii) Beta is unstable over time. See, for example, Bos and Newbold (1984), Faff, Lee and Fry (1992), Brooks, Faff and Lee (1994) and Faff and Brooks (1998).

(iv) There are several model specification issues: For example, (a) Kim (1995) and Amihud, Christensen and Mendelson (1993) argued that errors in variables impact on the empirical research, (b) Kan and Zhang (1999) focused on a time-varying risk premium, (c) Jagannathan and Wang (1996) showed that specifying a broader market portfolio can affect the results and (d) Clare, Priestley and Thomas (1998) argued that failing to take into account possible correlations between idiosyncratic returns may have an impact on the results.

3.2 Multifactor models

A growing number of studies found that the cross-sectional variation in average security returns cannot be explained by the market beta alone and showed that fundamental variables such as size (Banz, 1981), ratio of book-to-market value (Rosenberg, Reid and Lanstein, 1985; Chan, Hamao and Lakonishok, 1991), macroeconomic variables and the price to earnings ratio (Basu, 1983) account for a sizeable portion of the cross-sectional variation in expected returns.

Fama and French (1995) observed that the two non-market risk factors SMB (the difference between the return on a portfolio of small stocks and the return on a portfolio of large stocks) and HML (the difference between the return on a portfolio of high-book-to-market stocks and the return on a portfolio of low-book-to-market stocks) are useful factors when explaining a cross-section of equity returns. Chung, Johnson and Schill (2001) observed that as higher-order systematic co-moments are included in the cross-sectional regressions for portfolio returns, the SMB and HML generally become insignificant. Therefore, they argued that SMB and HML are good proxies for higher-order co-moments. Ferson and Harvey (1999) claimed that many multifactor model specifications are rejected because they ignore conditioning information.

Another possibility is to construct multifactor arbitrage pricing theory (APT) models introduced by Ross (1976). APT models allow for priced factors that are orthogonal to the market return and do not require that all investors are mean-variance optimisers, as in the CAPM. Groenewold and Fraser (1997) examined the validity of these models for Australian data and compared the performance of the empirical version of APT and the CAPM. They concluded that APT outperforms the CAPM in terms of within-sample explanatory power.

3.3 CAPM with higher-order co-moments

It is clear from well-established stylised facts that the unconditional security return distribution is not normal (see, for example, Ané and Geman, 2000 and Chung, Johnson and Schill, 2001) and the mean and variance of returns alone are insufficient to characterise the return distribution completely. This has led researchers to pay attention to the third moment – skewness[3] – and the fourth moment – kurtosis.

Many researchers investigated the validity of the CAPM in the presence of higher-order co-moments and their effects on asset prices. In particular, the effect of skewness on asset pricing models was investigated extensively. For example, Kraus and Litzenberger (1976), Friend and Westerfield (1980), Sears and Wei (1985) and Faff, Ho and Zhang (1998), among others,

[3] Early studies examined the empirical relation of *ex post* returns to total skewness (see, for example, Arditti, 1967). Subsequent studies argued that systematic skewness is more relevant to market valuation rather than total skewness (see, for example, Kraus and Litzenberger, 1976) refuting the usefulness of quadratic utility as a basis for positive valuation theory. The experimental evidence that most individuals have concave utility displaying absolute risk aversion also supports inclusion of higher-order co-moments in risk-return analysis (see, for example Gordon, Paradis and Rorke, 1972).

extended the CAPM to incorporate skewness in asset valuation models and provided mixed results.

Harvey and Siddique (2000) examined an extended CAPM, including systematic co-skewness. Their model incorporates conditional skewness. The extended form of CAPM is preferred as the conditional skewness captures asymmetry in risk, in particular downside risk[4], which has recently become considerably important in measuring value at risk. Harvey and Siddique reported that conditional skewness explains the cross-sectional variation of expected returns across assets and is significant even when factors based on size and book-to-market are included.

A few studies have shown that non-diversified skewness and kurtosis play an important role in determining security valuations. Fang and Lai (1997) derived a four-moment CAPM and it was shown that systematic variance, systematic skewness and systematic kurtosis contribute to the risk premium of an asset. See, also, Christie-David and Chaudhry (2001) who show that the third and fourth moments explain the return-generating process in futures markets well.

Investors are generally compensated for taking high risk as measured by high systematic variance and systematic kurtosis. Investors also forego the expected returns for taking the benefit of a positively skewed market. It also has been documented that skewness and kurtosis cannot be diversified away by increasing the size of portfolios (Arditti, 1971).

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[4] Downside risk is the risk of loss or underperformance that is considered as the appropriate measure of risk. Variance, as a measure of risk, includes returns above and below the average return, in the same vein. This has led to criticism of variance as a measure of risk.

3.4 Conditional asset pricing models

Testing for the instability of beta and the validity of the return-beta relationship is not new. Following the suggestion made by Levy (1974) to compute separate betas for bull and bear markets, Fabozzi and Francis (1977) were the first to formally estimate and test the stability of betas over the bull and bear markets. They found no evidence supporting beta instability. However, in an empirical analysis of the cross-sectional relationship between the expected returns and beta, Fabozzi and Francis (1978) concluded that investors like to receive a positive premium for accepting downside risk, while a negative premium was associated with the up market beta, suggesting that downside risk – as measured by the beta corresponding to the bear market – may be a more appropriate measure of portfolio risk than the conventional single beta.

Prompted by Fabozzi and Francis (1978), several studies tested for randomness of beta. Kim and Zumwalt (1979) extended the Fabozzi-Francis design to analyse the variation of returns on security and portfolios in up and down markets. They used three alternative measures to determine what constituted an up and down market. Up market constituted those months in which the market return exceeded (i) the mean market return, (ii) the mean risk-free rate or (iii) zero. Kim and Zumwalt concluded that downside risk might be a more appropriate measure of portfolio risk than the conventional single beta. Chen (1982) allowed beta to be nonstationary in an examination of the risk-return relationship in the up and down markets and concluded that (i) under the condition of either constant or changing beta, investors seek compensation for assuming downside risk and (ii) as in the Kim and Zumwalt (1979) study, the down market beta is a more appropriate measure of portfolio risk than the single beta. Bhardwaj and Brooks (1993) observed that the systematic risks in bull and bear time periods are statistically different. Their classification of bull and bear markets is based on whether the market return exceeds the median market return or not. Studies have considered three-beta models as well. For example, Faff and Brooks (1998), noting that there is no reason to believe that beta is constant, especially over long estimation periods, defined three regimes relating to two major past events.

Ferson and Harvey (1991), on the other hand, in their study of US stocks and bond returns, revealed that the time variation in the premium for beta risk is more important than the changes in the betas themselves. This is because equity risk premiums were found to vary with market conditions and business cycles. Schwert (1989) attributed differential risk premia between up and down markets to varying systematic risk over the business cycle.

Pettengill, Sundaram and Mathur (1995) highlighted that the weak and intertemporally inconsistent results of studies testing for a systematic relation between return and beta is due to the conditional nature of the relation between the beta and the realised return. They argued that when realised returns are used, the relation between the beta and the expected return is conditional on the excess market return. They postulated a positive (negative) relation between the beta and returns during an up (down) market. See Section 6.2.2 for more details. Their study of US stocks sampled over the period 1926-1990 reported the existence of a systematic conditional relation between the beta and the return for the total sample period, as well as across sub-sample periods.

Following Pettengill, Sundaram and Mathur (1995), Crombez and Vander Vennet (2000) analysed the conditional relationship between stock returns and beta on the Brussels Stock Exchange over the period 1990-1996. They observed that the beta factor is a strong and consistent indicator of both upward potential in bull markets and downside risk in bear markets. They found the results to be robust for various definitions[5] of beta and different specifications[6] of up and down markets. Further, they highlighted that investors could improve the performance of their portfolios by using up and down market betas in their asset selection practice. A common feature in the above studies is the use of monthly data.

As far as we are aware only one study has adopted the Pettengill, Sundaram and Mathur approach to investigate an extended CAPM with higher-order co-moments. Postulating that the systematic risks corresponding to variance, skewness and kurtosis are different for up and down markets, Galagedera and Silvapulle (2002) examined the relationship between the returns and higher-order systematic co-moments in the up and down markets. They found strong empirical evidence to suggest that in the pr4esence of skewness in the market returns distribution, the expected excess rate of return is related not only to beta but also to systematic co-skewness.

3.5 CAPM conditional on time-varying volatility

[5] Beta computed using different market indices.

[6] Up market defined as months in which market return is non-negative and other strong criteria: (i) market return exceeds the average value of positive market returns and (ii) market return exceeds the average value of positive market returns plus a factor (0.5 and 0.75) of the standard deviation of positive market returns.

Since the introduction of ARCH/GARCH[7]-type processes by Engle (1982) and others, testing for, and modelling of, time-varying volatility (variance/covariance) of stock market returns (and hence the time-varying beta) have been given considerable attention in the literature. See Bollerslev, Engle and Wooldridge (1988) – the first study to model the beta in terms of time-varying variance/covariance – and the survey paper by Bollerslev, Engle and Nelson (1994). The ARCH-based empirical models appear to provide stronger evidence, though not convincingly, of the risk-return relationship than do the unconditional models.

Using monthly data from the United Kingdom market from 1975 to 1996, Fraser, Hamelink, Hoesli and MacGregor (2000) compared the cross-sectional risk-return relationship obtained with an unconditional specification of the asset's betas with betas obtained through Quantitative Threshold ARCH (QTARCH[8]) and GARCH-M[9] models. In all specifications, they allowed for possible negative return-risk relationships when excess return on the market is negative. Fraser, Hamelink, Hoesli and MacGregor observed that CAPM holds better in downward moving markets than in upward markets and suggested that beta as a risk measure is more appropriate in the bear markets. They observed that the QTARCH specification, in

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[7] The ARCH model allows the current conditional variance to be a function of the past squared error terms. This is consistent with volatility clustering. Bollerslev (1986) later generalised the ARCH (GARCH) model such that the current conditional variance is allowed to be a function of the past conditional variance and past squared error terms. The return-generating process can be written as: ARMA(*m*,*n*) mean: $R_t = \mu + \sum_{i=1}^{m} \alpha_i R_{t-i} + \sum_{j=1}^{n} \beta_j \varepsilon_{t-j} + \varepsilon_t$, where $\varepsilon_t / \Omega_{t-1} \sim \left(0, \sigma_t^2\right)$, Ω_{t-1} is the information set available at time $t-1$, and the conditional variance, σ_t^2 is defined as: GARCH(*p*,*q*): $\sigma_t^2 = \delta_0 + \sum_{i=1}^{p} \delta_1 \varepsilon_{t-i}^2 + \sum_{j=1}^{q} \delta_2 \sigma_{t-j}^2$.

[8] See Gourieroux and Monfort (1992) for details.

[9] Due to Bollerslev, Engle and Wooldridge (1988).

which they allowed for asymmetries in the first and second moments of returns, yields a significant beta without having to account for up and down markets.

Recently, several studies investigated the effect of good and bad news (leverage effects), as measured by positive and negative returns on beta. See, for example, Braun, Nelson and Sunier (1995) (BNS hereafter) and Cho and Engle (1999) (CE hereafter) and the references therein. BNS investigated the variability of beta[10] using bivariate Exponential GARCH (EGARCH[11]) models allowing market volatility, portfolio-specific volatility and beta to respond asymmetrically to positive and negative market and portfolio returns. CE, on the other hand, used a two-beta model with an EGARCH variance specification and daily stock returns of individual firms. CE concluded that news asymmetrically affects the betas while the BNS study that used monthly data on portfolios did not uncover this relationship.

An alternative approach to capture market movements is through various market volatility regimes. Galagedera and Faff (2003) examined the appropriateness of a conditional three-beta model as a security return generating process. Having modelled the market return volatility as a GARCH(1,1) process, they defined three volatility regimes based on the size of the conditional volatilities. Even though their results overwhelmingly suggest that the betas in the low, usual and high volatility regimes are positive and significant, most of the security/ portfolio betas were not found to be significantly different in the three regimes.

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[10] See also Huang (2000) for the use of a Markov regime-switching model to investigate the instability of beta.

[11] Due to Nelson (1991).

4 Conclusions

For the CAPM to hold, normality of returns is a crucial assumption, and if the CAPM holds, then only the beta should be priced. Several studies have shown that security returns are non-normal and this is evident especially in high frequency data. When returns are normal, the mean and the variance are sufficient to describe the return distribution. On the other hand, an adequate description of a non-normal return distribution requires statements on higher-order moments such as skewness and kurtosis. Prompted by the mixed results of the single-factor CAPM studies and the non-normal nature of return distribution, the CAPM with higher-order co-moments was proposed in the literature as an alternative to the single-factor CAPM. These empirical studies, too, reported mixed results.

Because of the failure of market beta alone to explain cross-sectional variation in security returns, multifactor models emerged. These models incorporate fundamental variables such as size and the price-to-earnings ratio in addition to market beta.

Pettengill, Sundaram and Mathur (1995) argued that the studies on the beta and cross-sectional returns relationship that used realised return as a proxy for the expected returns might have produced biased results due to the aggregation of positive and negative market excess returns. They postulated that when the market return in excess of the risk-free return is negative, an inverse relationship between beta and portfolio returns is expected. Their test for a systematic conditional relationship between the realised returns and the beta in an empirical investigation of US data revealed a positive risk premium in the up market and a negative risk premium in the down market. Other studies that adopted Pettengill, Sunderam and Mathur’s conditional model to test the beta risk-return relationship on different data sets reported stronger results than they would obtain otherwise.

References

Amihud, Y., Christensen, B.J. and Mendelson, H. (1993). Further evidence on the risk-return relationship, Working Paper, New York University.

Ané, T. and Geman, H. (2000). Order flow, transaction clock, and normality of asset returns, *Journal of Finance*, 55, 2259-2284.

Arditti, F. (1967). Risk and the required return on equity, *Journal of Finance*, 22, 19-36.

Arditti, F. (1971). Another look at mutual fund performance, *Journal of Financial and Quantitative Analysis*, 6, 909-912.

Banz, R.W. (1981). The relationship between return and market value of common stocks, *Journal of Financial Economics*, 9, 3-18.

Basu, S. (1983). The relationship between earnings yield, market value and the return for NYSE common stocks, *Journal of Financial Economics*, 12, 126-156.

Bhardwaj, R.K. and Brooks, L.D. (1993). Dual betas from bull and bear markets: reversal of the size effect, *The Journal of Financial Research*, 16, 269-283.

Black, F. (1993). Beta and return, *Journal of Portfolio Management*, 20, 8-18.

Black, F., Jensen, M. and Scholes, M. (1972). The capital asset pricing model: some empirical tests, in M.C. Jensen (ed.), *Studies in the Theory of Capital Markets*, Praeger: New York, 79-124.

Bollerslev, T., Engle, R.F. and Nelson, D. (1994) ARCH models, in R.F. Engle and D.L. McFadden (eds.), *Handbook of Econometrics*, Volume IV, North Holland: Amsterdam, 2959-3038.

Bollerslev, T., Engle, R.F. and Wooldridge, J.M. (1988). A capital asset pricing model with time varying covariances, *Journal of Political Economy*, 96, 116-131.

Bos, T. and Newbold, P. (1984). An empirical investigation of the possibility of stochastic systematic risk in the market model, *Journal of Business*, 57, 35-41.

Brooks, R., Faff, R. and Lee, J. (1994). Beta stability and portfolio formation, *Pacific-Basin Finance Journal*, 2, 463-479.

Chan, L.K.C., Hamao, Y. and Lakonishok, J. (1991). Fundamentals and stock returns in Japan, *Journal of Finance*, 46, 1739-1764.

Chan, L.K.C. and Lakonishok, J. (1993). Are the reports of beta's death premature?, *Journal of Portfolio Management*, 19, 51-62.

Charnes, A. and Cooper, W.W. (1980). Auditing and accounting for program efficiency and management efficiency in not-for-profit entities, *Accounting, Organizations and Society*, 5, 87-107.

Chen, S.N. (1982). An examination of risk-return relationship in bull and bear markets using time-varying security betas, *Journal of Financial and Quantitative Analysis*, 17, 265-286.

Christie-David, R. and Chaudhry, M. (2001). Coskewness and cokurtosis in futures markets, *Journal of Empirical Finance*, 8, 55-81.

Chung, Y.P., Johnson, H. and Schill, M.J. (2001). Asset pricing when returns are nonnormal: Fama-French factors vs higher-order systematic co-moments, Working Paper, A. Gary Anderson Graduate School of Management, University of California, Riverside.

Clare, A.D., Priestley, R. and Thomas, S.H. (1998). Reports of beta's death are premature: Evidence from the UK, *Journal of Banking and Finance*, 22, 1207-1229.

Crombez, J. and Vander Vennet, R. (2000). Risk/return relationship conditional on market movements on the Brussels stock exchange, *Tijdschrift voor Economie en Management*, 45, 163-188.

Davis, J. (1994). The cross-section of realised stock returns: the pre-COMPUSTAT evidence, *Journal of Finance*, 49, 1579-1593.

Douglas, G.W. (1969). Risk in the equity markets: an empirical appraisal of market efficiency, *Yale Economic Essays*, 9, 3-45.

Engle, R.F. (1982). Autoregressive conditional heteroscedasticity with estimates of the variance of U.K. inflation, *Econometrica*, 50, 122-150.

Fabozzi, F.J. and Francis, J.C. (1977). Stability tests for alphas and betas over bull and bear market conditions, *Journal of Finance*, 32, 1093-1099.

Fabozzi, F.J. and Francis, J.C. (1978). Beta as a random coefficient, *Journal of Financial and Quantitative Analysis*, 13, 101-116.

Faff, R. and Brooks, R.D. (1998). Time-varying beta risk for Australian industry portfolios: an exploratory analysis, *Journal of Business Finance and Accounting*, 25, 721-745.

Faff, R., Ho, Y.K. and Zhang, L. (1998). A generalised method of moments test of the three-moment capital asset pricing model in the Australian equity market, *Asia Pacific Journal of Finance*, 1, 45-60.

Faff, R., Lee, J. and Fry, T. (1992). Time stationarity of systematic risk: some Australian evidence, *Journal of Business Finance and Accounting*, 19, 253-70.

Fama, E.F. and French, K.R. (1992). The cross-section of expected stock returns, *Journal of Finance*, 47, 427-465.

Fama, E. and French, K. (1995). Size and book-to-market factors in earnings and returns, *Journal of Finance*, 50, 131-156.

Fama, E.F. and MacBeth, J.D. (1973). Risk, return and equilibrium: empirical tests, *The Journal of Political Economy*, 81, 607-636.

Fang, H. and Lai T-Y. (1997). Co-kurtosis and capital asset pricing, *The Financial Review*, 32, 293-307.

Ferson, W.E. and Harvey, C.R. (1991). The variation of economic risk premiums, *Journal of Political Economy*, 99, 385-415.

Ferson, W.E. and Harvey, C.R. (1999). Conditioning variables and the cross-section of stock returns, *Journal of Finance*, 54, 1325-1360.

Fraser, P., Hamelink, F., Hoesli, M. and MacGregor, B. (2000). Time-varying betas and cross-sectional return-risk relation: evidence from the UK, in *Ecole des Hautes Etudes Commerciales*, University of Geneva, Switzerland.

Friend, I and Westerfield, R. (1980). Co-skewness and capital asset pricing, *Journal of Finance*, 35, 897-913.

Galagedera, D.U.A. and Faff, R. (2003). Modelling the risk and return relationship conditional on market volatility: evidence from Australian data. *Proceedings of the Sixteenth Australasian Finance and Banking Conference*, University of New South Wales, Sydney, Australia.

Galagedera, D.U.A. and Silvapulle, P. (2002). Conditional relation between higher-order co-moments and stock return: evidence from Australian data. *Proceedings of the Econometric Society Australasian Meeting*, CD Rom, Queensland University of Technology, Brisbane, Australia.

Gordon, M.J., Paradis, G.E. and Rorke, C.H. (1972). Experimental evidence on alternative portfolio decision rules, *American Economic Review*, 62, 107-118.

Gourieroux, C. and Monfort, A. (1992). Qualitative threshold ARCH models, *Journal of Econometrics*, 52, 159-199.

Groenewold, N. and Fraser, P. (1997). Share prices and macroeconomic factors, *Journal of Business Finance and Accounting*, 24, 1367-1383.

Harvey, C. and Siddique, A. (2000). Conditional skewness in asset pricing tests, *Journal of Finance*, 55, 1263-1295.

He, J. and Ng, L.K. (1994). Economic forces, fundamental variables and equity returns, *Journal of Business,* 67, 5999-639.

Huang, H.R. (2000). Tests of regimes-switching CAPM, *Applied Financial Economics*, 10, 573-578.

Jagannathan, R and Wang, Z. (1996). The conditional CAPM and the cross-section of expected returns, *Journal of Finance*, 51, 3-53.

Jones, P. (1991). *Investments Analysis and Management*, 3rd edition, John Wiley and Sons: New York.

Kan, R. and Zhang, C. (1999). Two-pass tests of asset pricing models with useless factors, *Journal of Finance*, 54, 203-235.

Kandel, S. and Stambaugh, R.F. (1995). Portfolio inefficiency and the cross-section of expected returns, *Journal of Finance*, 50, 157-184.

Kim, D. (1995). The errors in the variables problem in the cross-section of expected stock returns, *Journal of Finance*, 50, 1605-1634.

Kim, M.K. and Zumwalt, J.K. (1979). An analysis of risk in bull and bear markets, *Journal of Financial and Quantitative Analysis,* 14, 1015-1025.

Kothari, S.P., Shanken, J. and Sloan, R.G. (1995). Another look at the cross-section of expected stock returns, *Journal of Finance*, 50, 185-224.

Kraus, A. and Litzenberger, R.H. (1976). Skewness preference and the valuation of risk assets, *Journal of Finance*, 31, 1085-1100.

Levy, R.A. (1974). Beta coefficients as predictors of returns, *Financial Analysts Journal*, 30, 61-69.

Lintner, J. (1965). The valuation of risk assets and selection of risky investments in stock portfolios and capital budgets, *Review of Economics and Statistics*, 47, 13-37.

Markowitz, H. (1952). Portfolio selection, *The Journal of Finance*, 7, 77-91.

Miles, D. and Timmermann, A. (1996). Variation in expected stock returns: evidence on the pricing of equities from a cross-section of UK companies, *Economica*, 63, 369-382.

Miller, M. and Scholes, M. (1972). Rates of return in relation to risk: a re-examination of some recent findings, in M. Jensen (ed.), *Studies in the Theory of Capital Markets*, Praeger: New York, 47-78.

Nelson, D.B. (1991). Conditional heteroscedasticity in asset returns: a new approach, *Econometrica*, 59, 347-370.

Pettengill, G.N., Sundaram, S. and Mathur, L. (1995). The conditional relation between beta and returns, *Journal of Financial and Quantitative Analysis*, 30, 101-116.

Radcliffe, R.C. (1987). *Investment*, Second edition, Scott, Foresman and Company: London.

Roll, R. (1977). A critique of the asset pricing theory's tests; part I: on past and potential testability of the theory, *Journal of Financial Economics*, 4, 129-176.

Roll, R. and Ross, S.A. (1994). On the cross-sectional relation between expected returns and betas, *Journal of Finance*, 49, 101-121.

Rosenberg, B., Reid, K. and Lanstein, R. (1985). Persuasive evidence of market inefficiency, *Journal of Portfolio Management*, 11, 9-17.

Ross, S.A. (1976). The arbitrage theory of capital asset pricing, *Journal of Economic Theory*, 13, 341-360.

Ross, S.A. (1977). Return, risk and arbitage, in I. Friend and J.I. Bicksler (eds.), *Risk and Return in Finance*, Massachusetts: Ballinger, 189-218.

Schwert, G.W. (1989). Why does stock market volatility change over time?, *Journal of Finance*, 44, 1115-1153.

Sears, R.S. and Wei, K.C.J. (1985). Asset pricing, higher moments, and the market risk premium: a note, *Journal of Finance,* 40, 1251-1253.

Sharpe, W.F. (1964). Capital asset prices: a theory of market equilibrium under conditions of risk, *Journal of Finance*, 19, 425-442.

Sinclair, N.A. (1987). Multifactor asset pricing models, *Accounting and Finance*, 27, 17-36.

Tobin, J. (1958). Liquidity preference as behaviour towards risk, *Review of Economic Studies*, 26, 65-86.