

**THE CAPITAL ASSET PRICING MODEL
VERSUS
THE THREE FACTOR MODEL:
A United Kingdom Perspective**

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ABSTRACT

The Sharpe (1964), Lintner (1965) and Black (1972) Capital Asset Pricing Model (CAPM) is considered one of the foundational contributions to the practice of finance. The model postulates that the equilibrium rates of return on all risky assets are a linear function of their covariance with the market portfolio. Recent work by Fama and French (1996, 2006) introduce a Three Factor Model that questions the “real world application” of the CAPM Theorem and its ability to explain stock returns as well as value premium effects in the United States market.

This thesis provides an out-of-sample perspective to the work of Fama and French (1996, 2006). Multiple regression is used to compare the performance of the CAPM, a split sample CAPM and the Three Factor Model in explaining observed stock returns and value premium effects in the United Kingdom market. The methodology of Fama and French (2006) was used as the framework for this study.

The findings show that the Three Factor Model holds for the United Kingdom Market and is superior to the CAPM and the split sample CAPM in explaining both stock returns and value premium effects. The “real world application” of the CAPM is therefore not supported by the United Kingdom data.

I. INTRODUCTION

One of the fundamental tenants in financial theory is the CAPM as developed by Sharpe (1964), Lintner (1965) and Black (1972). The CAPM's impact over the decades on the financial community has led several authors inclusive of Fama and French (2004) to suggest that the development of the CAPM marks "the birth of Asset Pricing models".

The CAPM is an ex-ante, static (one period) model. The model's main prediction is that a market portfolio of invested wealth is mean-variance efficient resulting in a linear cross-sectional relationship between mean excess returns and exposures to the market factor (Fama and French, 1992). The model draws on the portfolio theory as developed by Harry Markowitz (1959). In its simplest form the CAPM is defined by the following equation:

$$E(R_i) = R_f + \beta_i[E(R_m) - R_f], \quad [1]$$

where

- $E(R_i)$ = The expected return of stock i.
- β_i = $\frac{\text{COV}(R_i, R_m)}{\text{VAR}(R_m)}$
- R_f = The risk free rate of return
- $E(R_m)$ = The expected return of the market

The CAPM model assumes a linear relationship between the expected return in a risky asset and its β and further assumes that β is an applicable and sufficient measure of risks that captures the cross section of average returns, that is, the model assumes that assets can only earn a high average return if they have a high market β . β drives average returns because β measures how much the inclusion of additional stock to a well diversified portfolio increases the inherent risk and volatility of the portfolio.

While relationships described by the CAPM have been the context of numerous empirical studies by many academics, its use in many present day applications by fund managers and in

finance based course curricula, provides an insight on the significance of this finance model. Fama and French (2000) summarize the popularity of the CAPM by their statement:

The attraction of the CAPM is that it offers powerful and intuitively pleasing predictions about how to measure risk and the relation between expected return and risk.

Fama and French (2000) also offer their opinion on its relevance:

Unfortunately the empirical record of the model is poor – poor enough to invalidate the way it is used in applications.

During the 1980's several studies resulted in the identification of additional factors that provide explanatory power other than β for average stock returns. Variables that have no special standing in asset pricing theory were shown to have reliable power in explaining the cross section of returns (these variables are referred to as anomalies by Fama and French (1993, 1996)). Banz (1981) finds that Market Equity (ME) adds to the cross section of expected returns provided by the market β . Basu (1983) finds that low earnings-price ratios (E/P) stocks help explain the cross section of US stocks returns while high (E/P) stocks experiencing lower returns could be explained by the CAPM. DeBondt and Thaler (1985) find that stocks with abnormally low long term returns (average returns in three years) experience abnormally high long term future returns (average returns in the next three years) and vice versa. Bhandari (1988) finds a positive relationship between leverage and the cross section of average return. Rosenberg, Reid and Lanstein (1985) find a positive relationship between the average return and the ratio of a firm's book value to market equity (BE/ME). Lakonishok, Sheifer and Vishny (1994) find a strong positive relationship between average returns and BE/ME and cashflow/price ratio (C/P). These relationships could not be explained by the CAPM.

One of the major empirical arguments against the CAPM model is presented by Fama and French (1992). They find that the cross section of average equity returns in the US market shows little statistical relation to the β s of the original CAPM model. The authors evaluate the joint roles of the market β , firm Size (ME), (E/P), financial leverage and BE/ME in the cross section of average returns on the New York Stock Exchange (NYSE), American Stock Exchange

(AMEX), and National Association of Securities Dealers Automated Quotations (NASDAQ) stocks. They find that the Size and BE/ME variables capture the cross sectional variation in average stock returns associated and conclude that the CAPM model is violated in its predication of a cross sectional relationship between mean excess returns and exposures to the market factor.

Fama and French (1993) find that five (5) common risk factors explain the returns in both stocks and bonds. In testing the relationship between risk factors and stocks returns, the authors use the Black, Jensen and Scholes (1972) time series regression model to identify these factors. They find that two (2) factors, namely; firm Size and BE/ME portfolios explain the differences in the average cross section returns of stocks. Fama and French (1996) also observe that abnormal patterns of asset returns experienced during the 1980's and 1990's could not be explained by the CAPM but are however due to mis-specification in the expected returns model. They find that two other variables, SMB (Small Minus Big - the Size proxy) and HML (High Minus Low - the BE/ME proxy), inclusive of the market factor, explains significant return patterns on Lakonishok, Shleifer, and Vishny (1994) portfolios¹. The resultant model is being coined the Fama and French Three Factor Model (TFM) in financial literature. Fama and French (1998) further observe that value stocks outperform growth stocks in twelve (12) of thirteen (13) major international markets during the period 1975 – 1995 and also document an international Size effect based on evidence that small stocks outperformed large stocks in eleven (11) out of sixteen (16) markets. Their evidence suggests that the fundamentals of the CAPM are contradicted outside of the US market.

The conclusion(s) of the Fama and French (1993, 1996) TFM has of itself been the subject of much academic contention. Withstanding more than thirty years of intense econometric investigation, there is agreement among academics that a single factor, as defined as market β , is insufficient to describe the cross section of expected returns (Miller 1999).

¹ Lakonishok, Shleifer, and Vishny (1994) portfolios are formed on earnings/price, cash flow/price and sales growth.

Kothari, Shanken and Sloan (1995) re-examine the results presented by Fama and French (1993) by seeking to determine whether β explains the cross sectional variation in average returns and also whether BE/ME capture the cross sectional variation in average returns in the US market. They use an alternative data source (Standard and Poor's industry level data) from 1947 to 1987 to find that BE/ME is weakly related to average stock returns. They identify a significant selection bias introduced for both firm Size and BE/ME sorted portfolios since many stocks with high BE/ME ratios and low ME do not survive and are removed from the primary databases. They conclude that the Fama and French (1993) results are likely influenced by a combination of survivorship bias in the COMPUSTAT database. Additionally, Black (1993) and Mackinlay (1995) suggest that the results presented by Fama and French (1993) may be based on data snooping given the variable construction for the characteristics based portfolios.

Several studies have also empirically validated the results of Fama and French (1993, 1996). Barber and Lyon (1997) suggest that a method to overcome data snooping claims of the Fama and French (1993,1996) model, will be best achieved by using different time periods of observations and different countries or a hold out sample.

Chan, Hamao and Lakonishok (1991) find a strong relationship between BE/ME and average return in Japanese stocks. Connor and Sehgal (2001) empirically examined the application of the TFM in the Indian market. They also find evidence for pervasive Market, Size and BE/ME factors in the Indian market and produce largely consistent results supporting the TFM. Drew, Tony and Veeraragavan (2005) compared the performance of the CAPM with the TFM for equities listed in the Shanghai Stock Exchange as well as simultaneously investigating the explanatory power of idiosyncratic volatility. They find that firm Size, BE/ME, the Market factor as well as idiosyncratic volatility are priced risk factors Their results are consistent with the findings of Fama and French (1996).

A. Three Factor Model in the United Kingdom

Prior research on the cross sectional determinants of the UK stock return show that the BE/ME is the dominant variable in explaining cross sectional variation in the UK stock returns.² Strong and Xu (1997) used simple regressions to find that average returns are significantly positively related to beta, book-to-market equity and market leverage, and significantly negatively related to market value and book leverage.

Dimson, Nagel and Quigley (2003) tested for a value premium effect in the UK market. They used a new defined dataset of accounting information spanning the period 1955 to 2001 to cover the whole population of stocks ever listed on the London Stock Exchange (LSE). They find a strong value premium effect for stocks within the small cap and large cap universe. Horani, Pope and Stark (2003) tested the existing relationship between stock returns and Research and Development Activity (RD) in the UK Market. The authors examined this relationship by using a RD model of the Fama and French (1993, 1996) TFM. They find that there is strong evidence that the Fama and French (1993, 1996) factors capture the variation in returns that are associated with RD activity. Malin and Veeraraghavan (2004) investigated the TFM on three major European markets namely: England, France and Germany over the period 1992 – 2001. They find evidence of a small firm effect in France and Germany and a big firm effect in the UK. Their final results however, contradict value effect as no evidence of a value effect was identified in any of the markets.

The results of the Malin and Veeraraghavan (2004) paper support the conclusions of Al-Horani, Pope and Stark (2003). Al-Horani, Pope and Stark (2003) suggest that the CAPM β does not appear to have significant explanatory power for the cross section of UK stock returns. They comment that while the UK results of Chan and Chui (1996) and Strong and Xu (1997) support and are consistent with the results TFM, the absence of a consistently significant firm Size effect is inconsistent with the US market findings.

² See Chan and Chui (1996)

B. The Value Premium Effect

A prevalent interpretation of the value premium is that it acts as a proxy for a variable associated with relative financial distress. Value stocks are typically aligned with financial distress where, given that, if liquidity constraints arise, these stocks usually perform badly.³ Fama and French (1993, 1996) identify that value stocks are stocks with high ratios of BE/ME while growth stocks are those with low BE/ME ratios. High BE/ME ratios are identified to have a higher than average return (value premium) in US stocks for the period after 1963. Fama and French (2000) document a value premium effect by extending the study from 1926 – 1995.

Ang and Chen (2005) use a conditional version of the CAPM to capture the value premium in US stocks for the period 1926 – 1963. Fama and French (2006) examine the relationship between the value premium and firm size and whether the CAPM can explain value premiums in this market. They also examine if, in general, average returns compensate β as predicted by the CAPM. Fama and French (2006) conclude that for the US, evidence for a weak value premium among large firms is special to US stocks between the period of 1963 – 1995. They further suggest that Ang and Chen's (2005) evidence in US stock value premiums are special to the period 1926 – 1963. They identify that the CAPM's general problem (i.e. the variation in β is unrelated to Size and more specifically value growth) goes unrewarded throughout the 1926 – 2004 sample period.

This paper offers further fuel and impetus to the on-going debate by providing an out-of-sample perspective to the work of Fama and French (1996, 2006). Multiple regression is used to empirically compare the performance of the CAPM, a split sample version of the CAPM and the TFM in explaining (1) the observed stock returns and (2) the value premium effects in the United Kingdom market. The methodology of Fama and French (2006) was used as the framework for this study.

³ See among others, Chan and Chen (1991) and Cochrane (2001)

The remainder of this paper is organized as follows: Section II presents the data and methodology adopted. Section III presents the study's findings as they relate to outlined research objectives. Section IV concludes the paper.

II. Security and Company Data⁴

The behavior of the underlying factors in the UK market were identified by studying the returns of all UK stocks in the FAME database⁵ as developed and maintained by Bureau van Dijk Electronic Publishing (BvDEP). The FAME database is a financial database which provides both accounting and other financial information on companies in both the UK and Irish markets. For this study, data was gathered over the period of April 2000 to June 2007.

Data considerations can be segregated into two (2) main categories:

- Category one (1): Monthly Stock returns.⁶
- Category two (2): Company Accounting data.

Stock and share price data consist of month-end adjusted shares prices of all companies over the sample period. Companies included in the sample are listed on the LSE, specifically the Stock Exchange Electronic Trading Services (SETS) and Stock Exchange Automatic Quotation (SEAQ) trading systems. The LSE⁷ website defines the SETS trading system as the Exchange's electronic order book trading service for UK blue chip securities. Securities traded on SETS include all the Financial Times Stock Exchange (FTSE) 100 constituents' reserves and the most liquid FTSE 250 securities. The LSE's website also defines the SEAQ trading system as the LSE's service for Main Market and Alternative Investment Market (AIM) securities that are not liquid

⁴ See Appendix 1 for summary data on the Number of Firms, Average Firm Size (ME) and Average Firm BE/ME.

⁵ The Fame Database is part of the Amadeus database group.

⁶ The adjusted share price series have been converted into return series logarithmic returns also know as continuously compounded return. The logarithmic return is defined as

$Return_{log} = \ln\left(\frac{P_{t+1}}{P_t}\right)$, where P_{t+1} is equal to Stock Price in period $t+1$ and where P_t is equal to Stock Price in period t . The return calculations have been done using the capital gain component only, since database information did not have separate data on dividends.

⁷ See <http://www.londonstockexchange.com/>

enough to trade on SETS. The service is based on two-way continuous quotes, offered by at least two competing market makers⁸. Data for both financial and non-financial firms were used in this study as opposed to Fama and French (1992) whose sample only included non-financial firms. Accounting data consists of market value per share and book value per shareholder's equity. For this study the market return variable (R_{Mt}) is the value weighted portfolio⁹ of all stocks under consideration.

A. Risk Free Rate

For this study the UK Three (3) month Treasury Bill rate will be used as the risk free rate proxy. Data on the three (3) month Treasury Bill Rate over the sample period was sourced from the Bank of England's website¹⁰.

B. The Models

B.1. The CAPM Model

As developed by Sharpe (1964), Lintner (1965) and Black (1972), the CAPM model draws on the portfolio theory as developed by Harry Markowitz (1959). In its simplest form, the CAPM is defined by equation [1] in Section I where β is held constant over time and market information is perfect.

⁸ See <http://www.londonstockexchange.com/en-/products/membershiptrading/tradingservices/>

⁹ In a value-weighted portfolio, securities are weighted by their market capitalization. Each period the holdings of each security are adjusted so that the value invested in a security relative to the value invested in the portfolio is the same proportion as the market capitalization of the security relative to the total portfolio market capitalization. Following Fama and French (1993) all stocks inclusive of stocks with negative BE/ME were included in the value-weighted portfolio construction.

¹⁰ Information for the one (1) month Treasury Bill rate was not used in this study due to lack of resources in attaining such data. See <http://www.bankofengland.co.uk/statistics/index.htm>. According to the Bank of England website, Treasury Bills are bearer Government Securities representing a charge on the Consolidated Fund of the UK issued in minimum denominations of £5,000 at a discount to their face value for any period not exceeding one year. Although they are usually issued for 3 month (91 days), on occasion they have been issued for 28 days, 63 days and 182 days. (http://www.bankofengland.co.uk/mfsd/iadb/notesiadb/wholesale_tbs_3months.htm)

B.2. The Split Sample CAPM Models

One of the commonly made assumptions with the CAPM model is that the β 's are constant over time. Jagannathan and Wang (1996) however, are of the view that this is not a particularly reasonable assumption since the relative risk of a firm's cash flow is likely to vary over the business cycle. Some studies (Keim and Stanbough (1986) and Fama and French (1989)) show that β 's can vary. Others (Ferson and Harvey (1991) and Chen (1991)) show that variations in β occur as a result of movement in economic activity. A split sample CAPM can provide further determination on whether β is the only true and valid explanatory variable for excess market returns and also whether the CAPM can explain the value premium in these average returns for the UK market.

In this study, the method of Fama and French (2006) will be followed. The full period dataset will be split into two (2) equal periods to allow for a single break in β in June 2004:

- Sample 1 will look at the CAPM over the period May 2001 – May 2004 (*hereinafter referred as CAPMS1*).
- Sample 2 will look at the CAPM over the period June 2004 – June 2007 (*hereinafter referred as CAPMS2*).

B.3. The Value Premium CAPM and Split Sample Value Premium CAPM Models

To measure the ability of the CAPM to capture the Value Premium effect (*hereinafter referred to as the VCAPM*) in the UK market, equation [1] will be modified. Following Fama and French (2006), the dependent variable of R_m will be replaced by the value proxy, HML ¹¹ (See equation 2 below). The regressions of HML returns on the excess market return test whether the CAPM can explain value premiums (Fama and French, 2006).

$$HML_t = R_f + \beta_i[E(R_m) - R_f], \quad [2]$$

¹¹ The definition of the HML variable is discussed in Section 2.2.4.

Where

HML = High Minus Low (proxy for BE/ME)

The methodology applied for the split sample of the CAPM will also be applied for the split sample of the VCAPM where the full period dataset will be split into two (2) equal periods to allow for a single break in β in June 2004.

- Sample 1 will look at the VCAPM over the period May 2001 – May 2004 (*hereinafter referred as VCAPMS1*).
- Sample 2 will look at the VCAPM over the period June 2004 – June 2007 (*hereinafter referred as VCAPMS2*).

B.4. The Fama and French Three Factor Model (TFM)

The TFM of Fama and French (1996) uses the standard multiple regression approach. It is expressed via equation three (3) below:

$$R_{it} - R_{ft} = \alpha_{it} + \beta_{iM}(R_{Mt} - R_{ft}) + \beta_{is}SMB_t + \beta_{ih}HML_t + \varepsilon_{it} \quad [3]$$

where

R_{it} = Average monthly return of portfolio i

R_{ft} = Risk free rate observed at the end of each month

β_{iM} = $\frac{\text{COV}(R_i, R_M)}{\text{VAR}(R_M)}$

R_{Mt} = Expected Market Return

SMB = Small Minus Big (proxy for company Size)

HML = High Minus Low (proxy for BE/ME)

β_{is} & β_{ih} = Factor loadings (other than market β). These loadings also represent the slope(s) in the time series regression.

α_{it} & ε_{it} = These represent the intercept of the regression and the error term respectively.

Equation [3] can be used to estimate the CAPM by imposing the restriction $\beta_{is} = \beta_{ih} = 0$ for all i.

C. Portfolio Formation

Following the Fama and French (1993, 1996) procedure, all LSE stocks were ranked as listed in the FAME database on Size (market price times number of outstanding shares or ME) in May of each year “t” from 2001 – 2007. The median LSE Size is then used to split the data into two specific portfolios: stocks with an ME below the median shall be considered Small, while stocks with an ME above the median shall be considered Big.

Subsequent to this initial classification of data, the LSE stocks were further broken into three BE/ME groups for the bottom 30% (Low), middle 40% (Medium) and the upper 30% (High). Malin and Veeraraghavan (2004) use March 31st as the fiscal year end for stocks listed on the LSE. The initial sample of 983 stocks, however, showed that there exists significant dispersion of fiscal year ends throughout the market. The highest percentage of year ends (39%) within the dataset is recorded in December, while the second highest percentage (22%) is recorded in March. The remaining fiscal year ends are spread among the remaining months of the year where none have percentages exceeding 10% of the sample. In consideration of both the data and the significant spread of fiscal year ends for companies listed on the LSE, the Fama and French (1992) and Dimson, Nagel and Quigley (2003) approaches were adopted where BE/ME is measured as the book common equity for the firm’s fiscal year ending t-1, divided by market equity at the end of December of t-1. Negative BE/ME firms were also not included when calculating the breakpoints for BE/ME.

As a result of these portfolios, six (6) Size and BE/ME portfolios were constructed based on the intersections of the two Size and three BE/ME portfolios. The six (6) portfolios formed were S/L, S/M, S/H, B/L, B/M and B/H. The S/L portfolio consisted of firms both small in Size and low in BE/ME. The S/M portfolio consisted of firms both small in Size and medium in BE/ME. The S/H portfolio consisted of firms both small in Size and high in BE/ME. The B/L portfolio consisted of firms both big in Size and low in BE/ME. The B/M portfolio consisted of firms big in Size and medium in BE/ME. The B/H portfolio consisted of firms big in Size and high in BE/ME.

For each portfolio there was a total of six (6) years of 12 monthly returns, generating seventy two (72) returns.

The monthly value weighted returns on the six portfolios were calculated from the June of year “t” to May of year “t+1” and the portfolios were re-formed in June of year “t+1”. The returns were calculated from June of year “t” to ensure that book equity (BE) for year “t-1” is known by investors by the time of the portfolio formation.

III. Findings

This section is presented in conjunction with Table I and Figures I and II. Inspection of the return characteristics assisted in determining whether size and value premium effects in the UK market are consistent with findings of authors such as Fama and French (1993, 1996). Table I shows the summary statistics for the monthly excess returns ($R_{mt}-R_{ft}$), the SMB portfolio returns and the HML portfolio returns over the period 2001 – 2007. Figure 1 depicts a bar chart presentation for the mean returns of the Small Cap versus Large Cap Portfolios while Figure 2 depicts a bar chart presentation of the mean returns of Low BE/ME portfolios versus Medium BE/ME portfolios versus High BE/ME portfolios.

Table I
Summary Statistics for Monthly Returns on Size and Value Factors and the Size-*B/M* Portfolios Used to Construct Them

At the end of each May from 2001 to 2007, six value-weight portfolios are formed, *S/L*, *S/M*, *S/H*, *B/L*, *B/M*, and *B/H*. The portfolios comprise of LSE stocks into two size groups, *S* (small, firms with the June market cap below the LSE median) and *B* (big, market cap above the LSE median), and three book-to-market equity (*B/M*) groups, *L* (low, firms in the bottom 30% of LSE *B/M*), *M* (Medium, middle 40% of LSE *B/M*), and *H* (high, firms in the top 30% of LSE *B/M*). Book equity is Fame Database's Book Value per Share for the specific period multiplied by the Shares Outstanding for the specific period. In the *B/M* sorts in June of year *t*, book equity is for the fiscal year ending in the preceding calendar year, *t* - 1, and market equity is market cap at the end of December of that calendar year. Only firms with positive book equity are used. The size premium, *SMB* (small minus big), is the simple average of the returns on the three small stock portfolios minus the average of the returns on the three big stock portfolios. The value premium, *HML* (high minus low), is the simple average of the returns on the two high portfolios minus the average of the returns on the two low portfolios. $RM_t - Rft$ is the difference between the value-weight market return (LSE) and the Bank of England three (3) month Treasury Bill Rate. The table shows means, standard deviations (*SD*).

	<u>Average/Mean Returns</u>	<u>Standard Deviation</u>
<i>S/L</i>	-1.52%	6.19%
<i>S/M</i>	-0.11%	4.87%
<i>S/H</i>	0.77%	3.99%
<i>B/L</i>	-0.04%	5.59%
<i>B/M</i>	0.68%	4.78%
<i>B/H</i>	1.07%	4.81%
<i>SMB</i>	-2.57%	5.66%
<i>HML</i>	3.40%	4.80%
$RM_t - Rft$	-0.23%	4.76%

Figure 1

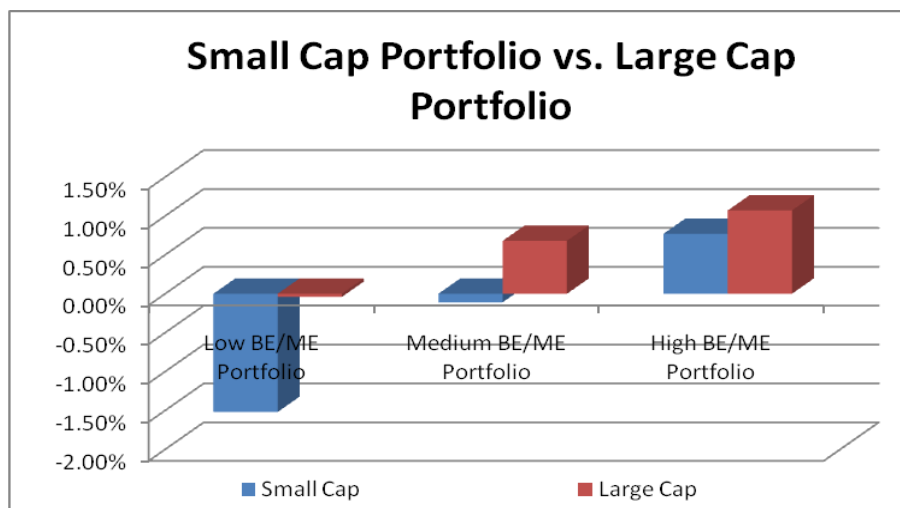
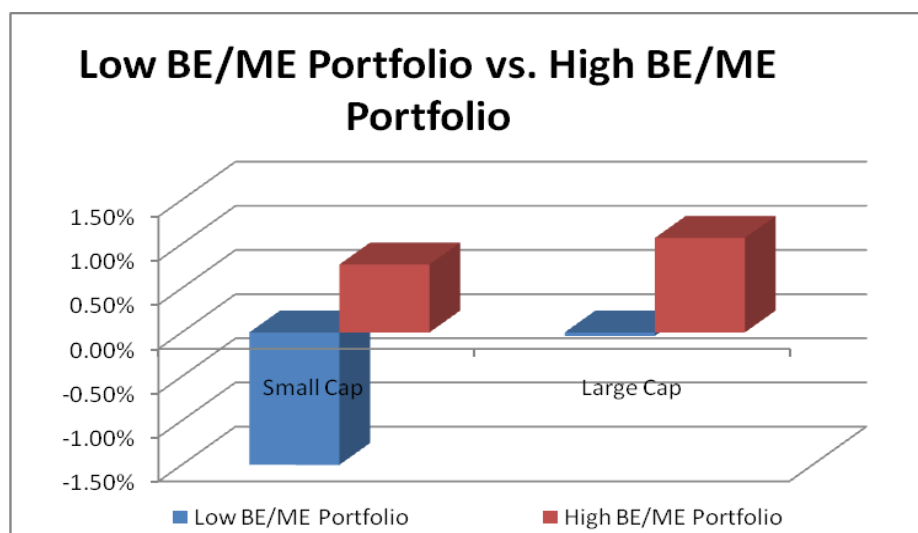


Figure 2



As seen in Table I, the mimicking portfolio for Size, SMB, has a negative average return of -2.57% over the sample period. Inspection of Figure 1 reveals that big cap companies generally outperform small cap stocks with reference to returns. As a result of this observation, Table I in association with Figure 1 shows **that higher cap stocks produce higher than average returns than lower cap stocks in the UK market, representing a big firm effect**. This result challenges the Fama and French (1993, 1996) small firm effect findings for the US Market but is consistent with findings of Malin and Veeraraghavan (2004) for the UK market.

The mimicking portfolio for value, the HML, has a positive average return of 3.40% and a standard deviation of 4.80%. Figure 2 shows that stocks with higher BE/ME outperforms stocks with lower BE/ME in both the large cap and small cap portfolios. **This performance suggests that there exists a value premium effect in the UK market over the sample period**. This result is consistent with the findings of Fama and French (1993, 1996) and Dimson, Nagel and Quigley (2003) of the US and UK markets respectively.

The OLS regressions of the six (6) value weighted portfolios are shown in Table II. Tests were conducted to examine whether the risk factors of β explains the cross-section of mean returns on stocks by focusing on the intercept estimates of the multivariate regression system. **If the**

CAPM describes expected returns and a correct market proxy is selected, the regression intercept for all assets should equal zero (0). Table II, shows that four (4) of the six (6) intercepts are significantly different than zero (0) at the 5% level. These results imply that the portfolios of S/L, S/H B/M and B/H are not fully explained by the factors contained in the full period CAPM. The full period CAPM is therefore unable to fully capture the pattern of portfolio returns in the UK. The R Square (R^2) statistics range between 87% and 94% for the six (6) portfolios.

Table II
CAPM Regressions to Explain Monthly Returns for May 2001 to June 2007

The CAPM regression is

$$R_{it} - R_{ft} = \alpha_{it} + \beta_i M (R_{Mt} - R_{ft})$$

where R_{it} is the return on one of the six size- B/M portfolios in excess of the 90 day Treasury bill rate, R_{ft} is the bill rate, and R_{Mt} is the value weight market (LSE) return. The portfolios comprise of LSE stocks into two size groups, S (small, firms with the June market cap below the LSE median) and B (big, market cap above the LSE median), and three book-to-market equity (B/M) groups, L (low, firms in the bottom 30% of LSE B/M), M (Medium, middle 40% of LSE B/M), and H (high, firms in the top 30% of LSE B/M).

Multifactor Regression for Portfolios Formed on Size and Book-to-Market Equity Ratios							
$R_{it} - R_{ft} = \alpha_{it} + \beta_i M (R_{Mt} - R_{ft})$							
May 2001 - June 2007							
SIZE PORTFOLIOS		BOOK TO MARKET EQUITY PORTFOLIOS					
		Low	Medium	High	Low	Medium	High
		α coefficient			P Value		
Small		-0.016	0.005	0.005	0.000	0.167	0.000
Big		-0.001	0.005	0.009	0.420	0.000	0.000
		β_i coefficient			P Value		
Small		1.213	0.975	0.802	0.000	0.000	0.000
Big		1.133	0.975	0.956	0.000	0.000	0.000
		R^2					
Small		0.871	0.907	0.918			
Big		0.930	0.944	0.897			

A. Split Sample CAPM (CAPMS1 & CAPMS2)

Table III reports the regression results for the CAPMS1 while Table IV reports the regression results for the CAPMS2.

CAPMS1 regression results show that four (4) of the six (6) intercepts are significantly different than zero (0) at the 5% level. Interestingly, the four portfolios rejected are the same as those unexplained by the Full period CAPM. The R Squared for CAPMS1 ranges between 89% - 96%.

CAPMS2 shows deteriorating evidence for the CAPM's ability to fully explain the market returns of the UK market by having five (5) out of the six (6) intercepts that are significantly different than zero (0) at the 5% level. The R^2 for CAPMS2 ranges between 74% - 88%.

Table III
CAPMS1 Regressions to Explain Monthly Returns for May 2001 to May 2004

At the end of each May from 2001 to 2004, six value-weight portfolios are formed, *S/L*, *S/M*, *S/H*, *B/L*, *B/M*, and *B/H*. The portfolios comprise of LSE stocks into two size groups, *S* (small, firms with the June market cap below the LSE median) and *B* (big, market cap above the LSE median), and three book-to-market equity (*B/M*) groups, *L* (low, firms in the bottom 30% of LSE *B/M*), *M* (Medium, middle 40% of LSE *B/M*), and *H* (high, firms in the top 30% of LSE *B/M*). Table 3.3 presents the results of the model for the period May 2001 – May 2004.

Multifactor Regression for Portfolios Formed on Size and Book-to-Market Equity Ratios							
$R_{it} - R_{ft} = \alpha_{it} + \beta_i M (R_{Mt} - R_{ft})$							
May 2001 - May 2004							
SIZE PORTFOLIOS		BOOK TO MARKET EQUITY PORTFOLIOS					
		Low	Medium	High			
		α coefficient			P Value		
Small		-0.018	-0.002	0.009	0.005	0.491	0.001
Big		-0.006	0.005	0.008	0.050	0.014	0.012
		β_i coefficient			P Value		
Small		1.219	0.952	0.817	0.000	0.000	0.000
Big		1.135	0.961	0.951	0.000	0.000	0.000
		R^2					
Small		0.891	0.918	0.937			
Big		0.943	0.961	0.914			

Table IV
CAPMS2 Regressions to Explain Monthly Returns for June 2004
to June 2007

At the end of each June from 2004 to 2007, six value-weight portfolios are formed, *S/L*, *S/M*, *S/H*, *B/L*, *B/M*, and *B/H*. The portfolios comprise of LSE stocks into two size groups, *S* (small, firms with the June market cap below the LSE median) and *B* (big, market cap above the LSE median), and three book-to-market equity (*B/M*) groups, *L* (low, firms in the bottom 30% of LSE *B/M*), *M* (Medium, middle 40% of LSE *B/M*), and *H* (high, firms in the top 30% of LSE *B/M*). Table IV presents the results of the model for the period June 2004 - June 2007.

Multifactor Regression for Portfolios Formed on Size and Book-to-Market Equity Ratios							
$R_{it} - R_{ft} = \alpha_{it} + \beta_i M (R_{Mt} - R_{ft})$							
June 2004 - June 2007							
SIZE PORTFOLIOS		BOOK TO MARKET EQUITY PORTFOLIOS					
		Low	Medium	High			
		α coefficient			P Value		
Small		-0.013	-0.004	0.003	0.002	0.062	0.031
Big		0.004	0.005	0.010	0.027	0.005	0.000
		β_i coefficient			P Value		
Small		1.127	1.120	0.770	0.000	0.000	0.000
Big		1.023	1.053	0.962	0.000	0.000	0.000
		R^2					
Small		0.741	0.875	0.835			
Big		0.886	0.866	0.797			

B. Full Period versus Split Sample CAPMS: Does Beta Vary?

Although not the major focus of this study, the variation of beta can also assist in the determination of whether the full period CAPM is an appropriate asset pricing model in explaining UK stock returns.

For each of the six portfolios a percentage change review was conducted with the CAPMS1 period being used as the base period. The S/M portfolio produced the largest variation in β with a -17.61% change between split sample periods. In fact, five (5) of the six (6) portfolios have percentage changes (whether positive or negative) over 5% mark. The most stable β portfolio is the B/H portfolio with the smallest percentage change of (-1.13%).

In addition to the previously identified pricing errors for both the full period and split sample CAPM, further evidence against the full period CAPM as an investment tool is also shown by the lack of uniformity of β between examined split sample periods.

Table III shows that the CAPMS1 model explains more of the variance of the true β than the full period CAPM while the opposite result (Table IV) applies to a comparison between the full period CAPM and the CAPMS2 which shows that former having more explanatory power than the later.

C. THREE FACTOR MODEL (TFM)

Table V shows the regression estimates for the TFM along with its corresponding p values. The results show that the intercept is not statistically different from zero for all of the six (6) portfolios at the 5% level. ***These results suggest the TFM's risk factors are adequately priced leaving no abnormal returns to the portfolio.***

Table V also shows that the market beta (β_i) is close to one and significant at the 5% level for all portfolios. This implies that all the stocks generally move in step with the market.

The β_i s coefficient is positive and significant at the 5% level for the three (3) small portfolios. With regard to the three (3) big portfolios, the β_i s coefficient is negative but significant at the 5% level. These results are consistent with the findings of Fama and French (1993, 1996) who report that small firms load positively on the SMB portfolio while big firms load negatively on the SMB portfolio. ***The size premia¹² however shows a growth effect where large ME firms outperform small ME firms given the negative return attached to the SMB factor.***

High BE/ME stocks (value stocks) have a positive coefficient on the HML portfolio. With respect to Low BE/ME stocks (growth stocks) β_{ih} is positive for the S/L portfolio and negative for the

¹² The size and value premia are taken as the product of the factor returns and the corresponding coefficients for each portfolio

B/L portfolio. The β_{ih} coefficient is significant for all portfolios except the B/M portfolio at the 5% significance level. The parameter estimates for the HML portfolio are generally consistent with the findings of Fama and French (1993, 1996). Fama and French (1993, 1996) report that High BE/ME stocks load positively on the HML portfolio while Low BE/ME firms load negatively on the HML portfolio. *The value premia shows that on average, high BE/ME stocks outperform low BE/ME stocks, i.e., a value premium effect is identified for the UK market.*

Table V

Three Factor Model (TFM) Regressions to Explain Monthly Returns for May 2001 to June 2007

At the end of each May from 2001 to 2007, six value-weight portfolios are formed, *S/L*, *S/M*, *S/H*, *B/L*, *B/M*, and *B/H*. The portfolios comprise of LSE stocks into two size groups, *S* (small, firms with the June market cap below the LSE median) and *B* (big, market cap above the LSE median), and three book-to-market equity (*B/M*) groups, *L* (low, firms in the bottom 30% of LSE *B/M*), *M* (Medium, middle 40% of LSE *B/M*), and *H* (high, firms in the top 30% of LSE *B/M*). Book equity is Fame Database's Book Value per Share for the specific period multiplied by the Shares Outstanding for the specific period. In the *B/M* sorts in June of year *t*, book equity is for the fiscal year ending in the preceding calendar year, *t* - 1, and market equity is market cap at the end of December of that calendar year. Only firms with positive book equity are used. The size premium, *SMB* (small minus big), is the simple average of the returns on the three small stock portfolios minus the average of the returns on the three big stock portfolios. The value premium, *HML* (high minus low), is the simple average of the returns on the two high portfolios minus the average of the returns on the two low portfolios. $RM_t - R_{ft}$ is the difference between the value-weight market return (LSE) and the Bank of England three (3) month Treasury Bill Rate.

Book-to-Market Equity Ratios							
$R_{it} - R_{ft} = \alpha_{it} + \beta_{im}(R_{Mt} - R_{ft}) + \beta_{is}SMB_t + \beta_{ih}HML_t + \epsilon_{it}$							
May 2001 - June 2007							
SIZE PORTFOLIOS		BOOK TO MARKET EQUITY PORTFOLIOS					
		Low	Medium	High			
		α coefficient			P Value		
Small		0.000	0.001	0.000	0.919	0.931	0.130
	Big	0.000	0.002	-0.002	0.200	0.530	0.964
Small		β _{im} coefficient			P Value		
	Big	1.017	1.036	0.943	0.000	0.000	0.000
Small		β _{is} coefficient			P Value		
	Big	0.974	0.977	1.047	0.000	0.000	0.000
Small		β _{ih} coefficient			P Value		
	Big	0.179	0.199	0.112	0.000	0.000	0.001
Small							
	Big	-0.210	-0.157	-0.144	0.000	0.000	0.000
Small		β _{ih} coefficient			P Value		
	Big	0.355	0.080	0.226	0.000	0.013	0.000
Small							
	Big	-0.246	0.024	0.173	0.000	0.260	0.000
Small		<i>R</i> ²					
	Big	0.963	0.958	0.976			
Small							
	Big	0.989	0.981	0.955			

The TFM has R^2 values ranging from 96% to 99%. A comparison of R^2 for each of the three models used in this study indicates that the TFM has greater explanatory power than both the full period and split sample CAPM models. It can be therefore concluded that the TFM explains the variance in the return of UK stocks better than the full period and conditional CAPM models.

D. Value Premium and the CAPM in the United Kingdom

It was shown in the previous section that the TFM is adequately priced and explains a value premium effect for the UK market.

This section tests whether the VCAPM or its split sample versions (i.e. VCAPMS1 and VCAPMS2) can explain a value premium effect in the UK market and if so, whether these tests provide a better explanation versus that of the TFM. To test the VCAPM's ability to explain value premiums in the UK market, we examine the following relationship:

$$HML_t = \alpha_{it} + R_f + \beta_i[E(R_m) - R_f], \quad [2]$$

The VCAPM's ability to explain a value premium effect will be determined by the value of the intercept (α_{it}) in equation [2]. For the VCAPM to explain a value premium effect the intercept of equation [2] should be equal to zero, that is, there exists no pricing error in the model's specification. (Fama and French 2006)

The regressions of *HML* returns on the excess market return in Table VI test whether the VCAPM can explain value premiums in the UK market. The results from Table VI show that the full period VCAPM as well as both split sample VCAPMS have intercepts significant at the 5% level. ***These results easily reject the VCAPM's and split sample VCAPM's ability to explain value premiums in the UK market.***

Table VI
VCAPM, VCAPMS1 & VCAPMS2 Regressions to Explain Monthly Returns for
May 2001 to June 2007

The VCAPM regression is

$$HML_t = \alpha + \beta_i M(RM_t - R_{ft})$$

where the value premium, *HML* (high minus low), is the simple average of the returns on the two high portfolios minus the average of the returns on the two low portfolios, *R_{ft}* is the 3 month Treasury bill rate, and *RM_t* is the value weight market (LSE) return.

	α coefficient	β_i coefficient	p Value (α)	p Value (β_i)	R^2
VCAPM	0.03	-0.58	0.00	0.00	34.00%
VCAPMS1	0.04	-0.58	0.00	0.00	37.60%
VCAPMS2	0.02	-0.42	0.00	0.02	13.70%

IV. Conclusions

This study had two main objectives, firstly to provide an out of sample test for the TFM in the UK market over the period 2001 – 2007 and secondly to empirically examine whether the market β 's of the (1) full period CAPM and (2) whether a split sample CAPM can explain observed value premium effects for the UK market.

Such results contribute to the burgeoning literature and debate on Asset Pricing Models and their “real world” applicability and effectiveness in explaining stock market returns.

OLS regression results indicated that the TFM outperformed both the full period CAPM and Split Sample CAPMs in explaining UK stock market returns. Inspection of the TFM output revealed no pricing errors in asset return explanation. The study identified a Big firm and Value premium effect for the UK market. This result is significant for investors and portfolio managers alike. It suggests that investors who hold stocks in firms with large Market Equity generate superior returns. This result challenges the findings of Fama and French (1993, 1996) that identify small firm effect findings for the US Market but is consistent with findings of Malin and Veeraraghavan (2004) for the UK market. This study also shows that investors who invest in value stocks will generate higher returns than those who hold growth stocks. This result is

consistent with the findings of Fama and French (1993, 1996) and Dimson, Nagel and Quigley (2003) of the US and UK markets respectively.

The CAPM and its split sample versions do not describe Value Premium effects in the UK market. Intercepts of the regressions estimates are shown to contain pricing errors. The low R^2 estimates (average of 28% for CAPM and Split sample CAPMs) signal that there exists further explanation of the HML (Value) variable which is not captured by the three CAPM models.

Fama and French (1992) propose that the performance of managed portfolios can be evaluated by comparing their average returns with the returns of benchmark portfolios with similar firm size and book-to-market equity characteristics. Evidence provided in this study provides support for the TFM and its superior ability over the CAPM to explain returns and value premiums. These findings have implications for portfolio performance and investments strategies adopted by portfolio managers.

This study also shows the variation of β over time through the use of a split sample CAPM. This result has implications for investors and portfolio managers who maintain the use of the traditional full period CAPM. It affords the opportunity for such persons and institutions to recognize and take into consideration the time varying component of β as it relates to systematic risk and return.

There are, however, areas of research left unanswered by this study. For instance, this study did not examine the implications of industry classification on the TFM and CAPM or whether additional pervasive factors explain stock returns. This study also did not examine more complicated versions of the CAPM such as the Inter-temporal CAPM and its ability to explain returns in the UK. Future research is needed to determine the empirical justification of these and other issues not discussed in this study.

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